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Audit in Clinical Surgery

An autopsy study

W.B. Barendregt

AUDIT IN CLINICAL SURGERY

Bij de voorplaat: AUTOPSIE TER VASTSTELLING VAN DE DOODSOORZAAK.

**Uit: Manuscript: "LA GRANDE CHIRURGIE" VAN GUY DE CHAULIAC (1298-1368).
BIBLIOTHÈQUE DE L'UNIVERSITÉ, MONTPELLIER.**

Overgenomen met toestemming van de redactie van Medisch Contact.

AUDIT IN CLINICAL SURGERY

AN AUTOPSY STUDY

EEN WETENSCHAPPELIJKE PROEVE OP HET GEBIED VAN DE
MEDISCHE WETENSCHAPPEN, IN HET BIJZONDER DE GENEESKUNDE.

PROEFSCHRIFT

TER VERKRIJGING VAN DE GRAAD VAN DOCTOR
AAN DE KATHOLIEKE UNIVERSITEIT NIJMEGEN,
VOLGENS BESLUIT VAN HET COLLEGE VAN DECANEN

IN HET OPENBAAR TE VERDEDIGEN OP

DINSDAG 6 OKTOBER 1992,

DES NAMIDDAGS TE 3.30 UUR PRECIËS

DOOR

WOUTER BASTIAAN BARENDREGT

geboren op 20 mei 1957 te Amsterdam

Promotor : Prof. Dr. H.H.M de Boer

Co-promotor: Dr. K. Kubat

I thought, however, that after seven days adrift I would become accustomed to the sea, to my anxious way of life, without having to spur my imagination in order to survive. After all, I had endured a week of harsh winds and waves. Why wouldn't it be possible to live on the raft indefinitely?

From: The story of a shipwrecked sailor, Gabriel Garcia Marquez

*Financial support for the publication of this thesis was received from:
Glaxo Gastro-enterology, Nieuwegein and West Instrumenten bv., Bilthoven*

Nederlandse titel: KWALITEITSCONTROLE IN DE HEELKUNDIGE KLINIEK.
EEN OBDUCTIE STUDIE

CIP-DATA KONINKLIJKE BIBLIOTHEEK, DEN HAAG

Barendregt, Wouter Bastiaan

Audit in clinical surgery: an autopsy study /

Wouter Bastiaan Barendregt. - [S l. : s.n.]. - 111.

Thesis Nijmegen. - With ref. - With summary in Dutch.

ISBN: 90-9005308-5

Subject headings: autopsy / surgery.

Drukkenj: Benda, Nijmegen

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CHAPTER I

GENERAL INTRODUCTION

I.1 The autopsy

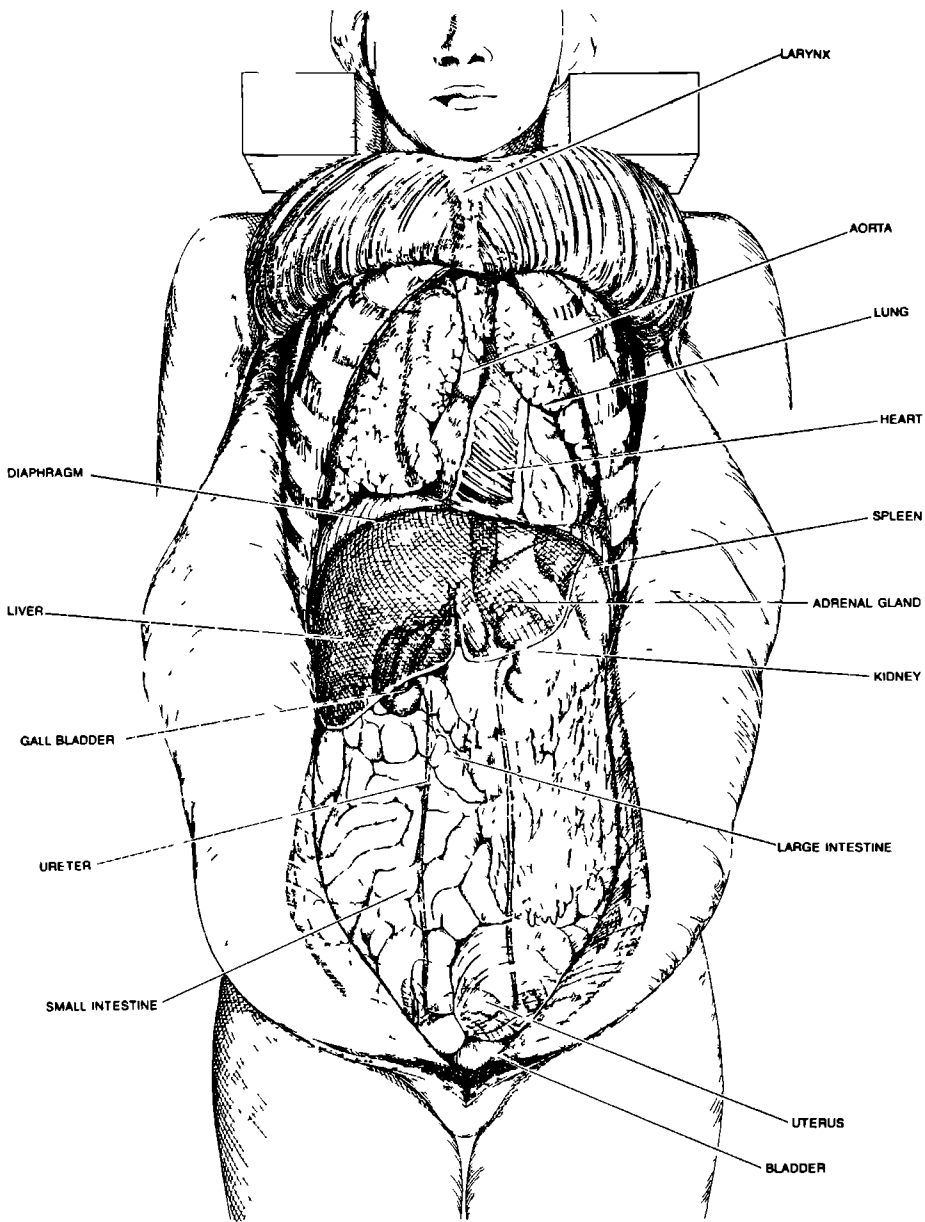
I.1.1 Historical review

Several methods to investigate diseases of the human body are available to medical science. One very old means to obtain information on life and death, as well as information on the processes that maintain life or lead to death, is the postmortem examination of that human body, also called autopsy. The word autopsy is derived from the Greek, meaning 'seeing oneself'. The old Babylonians probably performed postmortem examinations upon human bodies, but it is assumed that Hippocrates was the first to view it as a means to obtain information on the causes of death. He considered it however to be an unpleasant task. In the centuries which followed only occasional reports on postmortem examinations are to be found. The autopsy remained to be used to assess the causes of death, which is also shown by the front cover of this thesis, derived from 'La grande chirurgie' by Guy de Chauliac (1298-1368). In the 16th century the first report on a series of autopsies was published by Benivieni, to be found in his book 'De abditis nonnullis ac mirandis morborum et sanationem causis'.^{1,2,3} In 1761 Morgagni's report on a series of autopsies appeared: 'De sedibus et causis morborum per anatomen indagatis'.

The names of many pioneers in the field of medicine are associated with the autopsy: Harvey, Vesalius, Bartholin, Malpighi, Virchow, Rokitansky and others. Corvisart, Napoleon's "physician-in-ordinary", must have proclaimed in the autopsy room that "... immense was the delight of the doctor and his pupils if the autopsy confirmed the diagnosis. Still more instructive, however, were instances in which discrepancies arose".⁴ Sir William Osler spent considerable time performing autopsies, as did many of his contemporary colleagues in the early 20th century. It is to be noted that most of these pioneers were in the first place clinicians.

I.1.2 The procedure

The postmortem examination or autopsy starts with examination of the exterior of the body. Orifices, wounds, scars etc. are noted. Thereafter dissection begins with a Y-shaped incision from just below the shoulders, joining in the midline at the tip of the sternum and continued down to the pubic bone. Through this incision the internal organs of the thoracic and abdominal cavity can all be examined in their various relations to each other and can be removed for further examination (see figure I.1). One method for this macroscopic inspection of the different organs, described by Virchow, is to remove them from the body one by one; the other method, more common than the first, is to remove several organs 'en-bloc', so that connections between organs or even between organ systems can be better studied.⁵ This method was described by von Zenker (derived from his contemporary Rokitansky).^{5,6} The skull is opened in some autopsies, so that the brain and its connection with the spinal cord can be studied. Usually, special consent is needed to perform postmortem examination of the skull.



EVICERATION OF ORGANS is done according to one of two different methods. Here the method is to remove the organs en masse and examine and dissect them as organ systems before dissecting the organs individually, the method was developed in the 19th cen-

tury by the German physician Friedrich Albert von Zenker. In the other method, devised by Rudolf Virchow, the organs are removed from the body one by one and dissected separately. After the autopsy the organs are returned to the body and the incisions are sewn up.

Figure 1.1: The autopsy procedure.
 From: 'Autopsy', by Stephen A. Geller. Copyright June 1992 by Scientific American, Inc. All rights reserved.

After removal from the human body, the individual organs are weighed or measured and incised for complete macroscopic inspection. Observations are often recorded using standard forms. Slices of tissue are then taken for further light-microscopic examination, if necessary after special staining techniques. In some cases, tissues are examined by electron-microscopy. Material is removed for microbacterial cultures and less frequently for chemical analysis.

It is considered good medical practice to have the clinicians concerned attending the autopsy. Where applicable, direct information can be given benefitting both pathologist and clinician.

Usually the postmortem examination is performed by a resident in pathology, this procedure being the case in most teaching hospitals. In this, the resident is assisted by a senior pathologist, as much in the macroscopic as in the microscopic assessment of the organs and tissues. In many cases the pathologist is able to give a reasonable recount of the diseases concerned and of the cause of death after performing the macroscopic postmortem examination.⁷ The duration of the macroscopic examination is approximately two hours, depending on whether the autopsy is total or limited, or whether it is performed by an experienced pathologist or a resident. The final report may not be available for a number of weeks or occasionally months, depending on the additional examinations to be performed.⁶ Usually, this report is concluded by an epicrisis or a short summary.

In some instances, only restricted autopsies may be performed due to limited permission. Such an autopsy could e.g. be carried out via a surgical wound. In exceptional cases the post-mortem examination could be reduced to a sampling of tissues e.g. by a needle technique.⁵

In recent years the processing and storage of data has largely been computerized. For future studies this will facilitate data collection.

1.1.3 The role of the autopsy in hospital practice

The autopsy has been an integral part of medical practice for more than one hundred years, although its purposes have probably changed over the years. The autopsy used to be performed to identify the basis of disease and the cause of death. Very often this is still the main purpose of it. Especially in cases of unexpected or sudden death, or in cases of unattended death, the autopsy is the only means of understanding the terminal events.⁶

It is assumed nowadays, that most diseases are diagnosed correctly before death, especially in hospitalized patients. The autopsy therefore serves as a "final consultation" or a means of quality control. It plays an important role in determining the accuracy of diagnosis and in determining the complications and failures of therapies. Both medical and surgical treatment failures or side effects, as well as efficacy may be assessed by the autopsy. At times it may add to the evaluation of new diagnostic procedures or new surgical techniques; Ludwig also stated that all autopsies in postoperative cases can present difficulties in interpretation as a result of possible findings indicating an unnatural cause of death.⁵

The autopsy still plays an important role in the education of medical students, but also in the continuing education of post-graduates in medical science. In the case of relatively new diseases certain relationships may be found. Some of the aspects of, for instance, Legionnaire's disease and the Toxic Shock Syndrome became clear only after postmortem studies. Wilkes et al. found that in autopsies of patients who died with the 'Acquired Immune Deficiency Syndrome', only 40% of lymphomas were diagnosed before death, as well as many missed viral and bacterial infections. These observations could lead to new diagnostic and treatment strategies.⁸ Much has been learned about the behaviour and epidemiology of prostatic carcinoma and of thyroid carcinoma, these cancers being frequently found as unexpected or occult lesions in people who died as a result of other causes. Patterns of metastases of other malignancies were also investigated by autopsy studies.^{9,10}

Clearly, the autopsy has played a very important role in the evaluation of cases of stillbirth, neonatal and maternal death.^{11,12,13,14} Postmortem examination has been extremely valuable to pathologists, clinicians and lay people in cases of sudden death in children, adolescents and sportsmen.^{15,16,17,18} The value of the autopsy in peri-operative death was recently stressed by Shanks et al.¹⁹ The autopsy probably has a role to play in investigations of congenital diseases and of environmental diseases.

The autopsy plays a major role in forensic medicine and the assessment of criminal cases, but in the practice of hospital medicine, at least in the Netherlands and in the situation in the University Hospital Nijmegen, it does not play a role of importance and certainly not from a statistical point of view.

1.1.4 Present perceptions of the autopsy

Many medical practitioners believe in the benefits of the autopsy but lack facilities for a postmortem examination, for example in a patient who dies outside the hospital. On the other hand, there are numbers of clinicians who are convinced that the postmortem examination is no longer necessary. Great confidence in diagnostic methods has probably led to such a belief. A number of physicians and surgeons may regard death as a failure to be quickly forgotten, and some may fear that autopsy findings will increase malpractice risks, although this last factor does not play an important role in the Dutch situation. For many clinicians, attending the autopsy session is a troublesome waste of precious time, time that is lost for the 'more important' clinical work. Finally, the process of obtaining permission from the relatives to perform the postmortem examination, is usually a difficult and awkward task.

The lay public's exposure to information on the purposes and values of the autopsy is very sparse. Information is rarely given in the form of newspaper articles or television programmes, as is so often the case in other fields of medicine. Most lay people are first confronted with the autopsy, when they have to decide upon giving permission in the case of the death of a close relative or partner. Many people may not even be clear about differences between autopsy, donating organs for transplantation purposes and donating one's body to a medical school or to science. Quite often it is heard from the relatives that the deceased has suffered enough, and therefore permission is not given. The belief that nowadays' diagnostic procedures and machines are infallible, probably plays as much a role among lay people as it does among medical professionals. Religious and cultural objections may be raised in some cases and finally, the belief that the autopsy is lengthy and delays the final arrangements, interferes with the proper appreciation of the postmortem examination. Improper communication of the results to the relatives only adds to lay person's perceptions of the autopsy.²⁰

1.2 Aim of the study

Medicine and also the field of general surgery have seen many great changes over the past decades. Still many innovative diagnostic possibilities have been introduced in the past ten to fifteen years and more are to be expected in the near future. With the scope of our diagnostic achievements, treatment evolves at the same rate. Due to these factors new diseases have been discovered and induced. These developments do not preclude any errors in the medical or surgical practice, indeed they may even be provoked by them. The general public is increasingly informed about any errors, as it is informed about innovations in diagnostic and therapeutic procedures. Therefore there is a continuing need for quality assessment in medicine. One ancient means of

quality assessment is the autopsy. The question is: is the autopsy still a valuable form of quality assessment?

A number of studies have appeared in the literature stating that diagnostic accuracy is not as high as would be expected from the opinions of medical practitioners or the opinions of the general public. Indeed, diagnostic accuracy may not be any higher than twenty or fifty years ago, despite innovations in medicine, at least in some aspects.

Quality assessment in the field of general surgery, as performed by postmortem examinations in individual patients, has long been practised. Very often, findings related to the surgical treatment or related to concomitant diseases, seem to be important. Occasionally unexpected findings occurred. Some of these postmortem findings were thought to have influenced the therapeutic regimen had they been known before death.

However, the results of an analysis of these postmortem findings in surgical patients as a separate group have not previously been described. It therefore seemed necessary to try to find out whether certain patients could be at risk for any missed diagnoses, and if so, which diagnoses were missed in the population of surgical patients. The question of which errors in therapy, and in which patients is to be answered.

To summarize: the aim of the study is to evaluate the matter of incorrect diagnosis and treatment in a group of surgical patients, as assessed by the autopsy. The value of the postmortem examination as a means of quality assessment in surgical practice is to be clarified.

1.3 Definitions and limitations

It is important to define a number of terms as they are used in this study. The 'diagnosis' or 'diagnoses' were always described in the abstracts made of the patients' records, that is, they were not coded according to the ICD, the 'International Classification of Diseases', as laid down by the 'World Health Organisation'.²¹ This was done to prevent the possibility of minor and unimportant differences being called a 'misdiagnosis'. It did not even seem practical to use the ICD-numbers for major differences, as these were easily recognized and handled by interpretations or statistical analysis without an ICD-number. At the same time, coding according to the ICD is a difficult task, not easily done by any person who is not trained in that field.

'Primary diagnosis': the main or most important diagnosis of a disease, for which the patient is surgically treated and this usually being the diagnosis made at or shortly after admission to hospital.

'Complications of the primary disease': complications that arise due to the most important disorder; these usually develop during or just prior to hospital admission.

'Secondary diagnosis': a disease which is not related to the primary disease, but which does have clinical importance (also called contributory disease). This secondary disease is not always present.

'Cause of death' or 'mechanism of death': the disease process or event directly leading to death. It should be clear that the WHO-definition 'The disease or injury which initiated the train of morbid events leading directly to death' is expressed in this study by 'primary diagnosis'. An example may clarify this: a patient with acute necrotizing pancreatitis as the primary diagnosis died due to severe intra-abdominal haemorrhage. This terminal haemorrhage would be called the direct cause of death or mechanism of death.

'Iatrogenic complications': complications caused by any medical or surgical interference. These complications are sometimes unavoidable and are not necessarily a shortcoming.

Subgroups of disorders were recognized in the patients admitted to the general surgical units. These subgroups were defined on the basis of the clinical diagnosis. Occasionally a patient could have been classified in two different disease groups, such being the case when the clinical diagnosis was refuted by the autopsy and the autopsy diagnosis fell into a different subgroup. For purposes of statistical analysis however, only the clinical diagnosis was taken for classification. Some of the interesting cases will be described as case reports in a separate chapter (IX).

The study was performed by the author, who selected from autopsy records patients from the general surgical units, or who were submitted to surgical intervention. The clinical records of these cases were then traced and were compared for diagnoses, clinical course, diagnostic procedures and results, treatment (medical and surgical) and terminal events. Naturally, several individual denominators such as age, sex etc. were also noted.

After comparing the above mentioned factors, the results of the analysis were discussed with a senior surgeon (Prof. Dr. H.H.M. de Boer) and a senior pathologist (Dr. K. Kubat). If any disagreement concerning the results of the analysis existed between the author and one of the consultants, the case was again discussed until final agreement on the results was reached, from both the clinical and pathological point of view. It can be argued, however, that interpretations occurred in place of collection of clear and numerical data.

There are of course several other limitations to the study, which must be kept in mind. One practical limitation is that patients under the age of 14 years are not included in this study, due to the fact that their admission and treatment took place in the department of paediatric surgery. In the same way, patients admitted to and treated in the departments of cardiac surgery, orthopaedic surgery (trauma patients admitted to the department of general surgery are included) and urology are excluded from this study. These facts must be stated to clarify differences with other countries. Also excluded from this study are patients who were operated upon for pulmonary diseases such as bronchial carcinoma. These patients were treated in a specialized hospital for thoracic diseases, situated a short distance from the University Hospital. The study was performed in a general surgical department and although it may show similarities to previous studies, it's conclusions should not be directly applied to medical departments. Similarly, the results do not give any information on the prevalence or incidence of certain diseases in the population outside the hospital and in a general surgical population.

For instance, the sensitivity of a certain diagnostic process can not be clearly discerned from the present study alone: it was only possible for patients who died as a result of their disease to have undergone a postmortem examination, not the ones who survived. It follows that this sensitivity is to a large extent dependent upon the curability of a disease.

A disease that has a 100% cure rate if detected and a 100% mortality if undetected, may give a sensitivity of the diagnostic process of 0%, if this rate is assessed by the number of correct diagnoses at autopsy. If for instance 90% of the cases that were admitted to hospital were diagnosed correctly, they would also be cured and therefore would not come for autopsy. The sensitivity would then be, according to the clinical figures, 90%. Of course, the diseases dealt with in the present study, do not have a 100% or 0% cure rate, depending on accuracy of diagnosis alone. At the same time the results of this study are influenced by the severity of certain diseases, and, as will be seen later, only about half of the patients who died came to autopsy.

These limitations being accepted, the study still gives insight into the correctness of diagnosis and treatment in a group of surgical patients, who suffered from serious illnesses. It is intended to highlight the value of the autopsy as a means of quality control in a surgical department and may

pinpoint 'problem cases' and 'problem diagnoses'. Certain relationships will be defined and an attempt will be made to propose solutions aimed at failure prevention.

The study results will be described after a review of the literature. Individual chapters are used to present the various patient groups.

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LITERATURE, A REVIEW

II.1 Historical review

The first publication in the English literature about diagnostic pitfalls discovered by postmortem examination, appeared in the Journal of the American Medical Association by Cabot in 1912.¹ He studied 3000 cases and enumerated 'classic' time honoured mistakes in diagnosis as well as less familiar ones. He stressed the point that with certain diagnoses, the failure ratios were high. Stating that the diagnostic process was more fallible than the men behind it, he gave percentages of diagnostic success for several diseases: cancer of the colon 74%, hepatic cirrhosis 39% and bronchopneumonia 33%. Cabot also stated that in cases of acute illnesses a greater number of diagnostic failures were seen and he wanted to stimulate greater precision by clinicians. In 1919 Karsner suggested that only those diseases that might reasonably be expected to present definite signs and symptoms in life be included as error in diagnosis.² He found in the study of 600 autopsy cases 8% with very obvious diagnostic errors. Both these very early publications mention the difficulty in diagnosis of certain cancers, liver cirrhosis, liver abscesses and tuberculosis. The autopsy percentages of 60-70% mentioned in Karsner's publication apply to the larger hospitals and give a mean autopsy percentage of less than 40 for small hospitals. Karsner also took a positive point of view in stating that the inaccuracy of diagnosis is not so much a sign of failure of the medical profession, but more an indication of the need for improvement. A further publication from this era was by Wells, who discussed the relationship between the clinical diagnosis of cancer and necropsy diagnosis.³ He mentioned that 20 - 25% of the cancers in other studies were only found at autopsy, whereas in his study of 3712 autopsy cases he found for cancer diagnosis a diagnostic error of 36.5%. Of course, the more accessible cancers were more often correctly diagnosed and the most easily missed were primary lung carcinoma, pancreatic carcinoma and primary liver carcinoma. In his publication he refers to probably the oldest scientific article about diagnostic failures discovered by postmortem examination: "Eine Krebsstatistik vom Pathologisch-anatomischen Standpunkt" by Reichelmann in 1902. He described 7790 autopsy cases.⁴

From 1925 until 1960 few publications on this subject have appeared in the medical literature. Munck described a study of 1000 autopsy cases in 1952, stating major missed diagnosis with clinical relevance in 12% of the cases.⁵ Gruver and Freis found a misdiagnosis rate of 6%, approximately a quarter of these in the patients hospitalized less than 24 hours.⁶ Berkowitz mentioned the difficulties in correctly diagnosing major gastro-intestinal haemorrhage and Holler and De Morgan also found a rate of 8% of major missed diagnoses.^{7,8} Prutting mentioned the lack of correlation between clinical and autopsy diagnosis in cases of pulmonary embolism (less than 50% correct), and in cases of major gastro-intestinal haemorrhage he found 33% incorrect diagnoses.⁹ Again bronchiogenic carcinoma and liver abscess had been difficult to diagnose, but also acute pancreatitis. Prutting concludes his article in 1967 with the statement that a point in medical development had been reached at which elaborate diagnostic tools would remove guesswork from diagnostics and narrow the gap between antemortem and postmortem diagnosis.

Goldman et al. published an article in 1983 about the value of the autopsy in three medical eras: 1960, 1970 and 1980. In all 3 eras approximately 10% of the autopsies revealed that a major diagnosis, if known before death, might have led to a change in therapy and prolonged survival. Another 12% showed a clinically missed major diagnosis for which treatment would not have been changed.¹⁰ From 1960 till 1980 the number of missed major diagnoses did not change, but the types of diagnoses did. There was for instance a significant increase in the number of systemic infections (in immune compromised patients). Although pulmonary embolism occurred less

frequently as an autopsy diagnosis, it remained the most common missed major diagnosis. Cancer diagnoses proved to be more often correct in 1980 than in 1960. From 1960 until 1980 there had been no significant change in the use of X-ray procedures, endoscopies and biopsies and surgical explorations, but in 1980 the number of nuclear-medicine, ultrasound and computerized tomographic procedures increased enormously. Goldman et al. state that although the newer noninvasive tests were probably very accurate in diagnosing conditions in patients who did not die, their findings suggest that "advances in medicine have left a residuum of obscure diagnoses, thus preserving the value of the autopsy".¹⁰

Finally, in a publication in 1984, Goldman summarizes the developments in diagnostic accuracy from 1912 until 1980.¹¹ Even over this large period of time the percent yield of the autopsy for clinically important missed diagnoses has changed very little. Of course, concurrent decline in infant mortality rates and increase in life expectancy show that despite these figures, medical progress has taken place. Diseases that were missed at the beginning of this century, were to be considered obvious in the 1980's.

II.2 Vital statistics and death certificates

In his publication in 1923, Wells was the first to question the value of existing cancer statistics.³ He assumed that diagnostic errors made throughout the country must be larger than the ones made in 'modern' hospitals. Several other authors have since questioned the reliability of not only cancer statistics, but also of mortality statistics in general.^{12,13} It has even been suggested that, due to the fact that only a small number of the people who die yearly in the U.S. are autopsied, at least a million death certificates are erroneous each year.

Death certificates are supposed to be the basis on which vital statistics or mortality statistics are built. Death certificates are usually completed by the attending medical officer immediately after the act of certifying death of the patient. This implies that in most cases no autopsy information is entered in the death certificate. Rarely does the pathologist get a chance to add the postmortem findings to the death certificate, except perhaps in medico-legal cases. Even a change in the primary diagnosis as found by the autopsy probably never leads to amendment of the death certificate. These factors may lead one to assume that mortality statistics are completely unreliable, although they are one of the oldest medical statistics existing.

In a special article in the *New England Journal of Medicine* in 1985, Kircher et al. claim that the autopsy remains an important method for ensuring the quality of mortality statistics.¹⁴ They analyzed 272 randomly selected autopsy reports and corresponding death certificates. In 29 percent of the deaths, a major disagreement on the underlying cause of death led to reclassification of the death in a different International Classification of Diseases major disease category. It has to be stressed that these were deaths in the general population, among hospitalized and non-hospitalized persons. Here again, medical information from autopsy reports was rarely used to supplement or revise the causes of death on death certificates. Although the proportion of decedents taken to autopsy is relatively small, he suggests that the postmortem examination is a potential source for assessing and improving the quality of the data derived from vital records, especially where they are used for planning of health services and epidemiologic research. It is also suggested by Kircher that the cause of death (on the death certificate) assigned by a physician on the basis of autopsy findings in combination with pertinent clinical data could be considered the best estimation of the true cause of death. In the same issue of this journal Carter mentions the low autopsy rates and

the bias that occurs in taking a hospital population or even an autopsy population for reference in connection with accuracy of death certificates.¹⁵ However, one of the proposals he makes to improve the accuracy of death certificate diagnoses is the postponement of completing the certificate, if an autopsy is to be performed, until the autopsy results are known. One of the other proposals to improve the reliability of mortality statistics was the introduction of a computerized national autopsy data bank. The goal would be to develop a system of pathological, demographic, biomedical and epidemiological information that could supplement mortality statistics.^{16,17}

The reliability of mortality statistics depends on several factors. One of these factors in the Netherlands is the classification of the cause of death according to the International Classification of Diseases by the officer of the (Dutch) Central Statistics Office. Assuming that this is a reliable process, another factor involved is the reliability of the information given by medical practitioners. Differences in classification by the statistical officer and the medical practitioner will certainly occur.¹⁸ In an article that appeared in the 'Nederlands Tijdschrift voor Geneeskunde', the author mentions some difficulties that may be encountered in completing the certificate of the cause of death. It can not be expected that medical specialists in the hospital do any better than general practitioners outside the hospital. Despite suggestions to change the certificate and also to allow for possible additional information given by postmortem examination, the present certificate has been in use for a long period of time.^{19,20}

In defence of the mortality statistics, a further article appeared in the Dutch literature in 1985. Bonte et al. mention the wide range in reported diagnostic inaccuracies: from as low as 6% to as high as 68%.²¹ According to these authors this only shows the wide variety in methods, criteria and background of studies. Although the authors agree with a healthy scepticism, this should not blind us to the potential value of the vast stores of mortality data that have accumulated over the years.²² Statistics should be used to observe trends in time and place and to initiate epidemiological study. Mortality statistics are only a part of health statistics and can assist in evaluation of health care systems, but hardly ever give precise figures about diseases, being the result of incidence and lethality. It has also been suggested that the end-result of 'true' mortality statistics would not differ that much from the existing figures, after correction by the postmortem results, as many of the changes within the major disease categories (ICD) or even changes between major disease categories would cancel each other out.

In this thesis the question of reliability of mortality statistics is left open.

II.3 Declining autopsy rates

In recent years a decline in autopsy rates for hospitalized patients and for the general population has been observed. This has led many pathologists and also quite a number of clinicians to express their concern in medical journals and to make a plea for a renewed interest in postmortem examinations. The autopsy rate (the number of autopsies performed, divided by the number of deaths in the same population as expressed in a percentage) has dropped steadily since approximately 1950-1960. Friederici mentions a hospital autopsy percentage of 11% in 1919 in the Chicago area hospitals, increasing to 51% in 1965. Thereafter the percentage decreased again to 16% in 1987.²³ However, in the large teaching hospitals the recent autopsy percentage was reported to be 32%. The mean hospital autopsy rate for the United States was approximately 50% in 1945; by 1964 this rate for all U.S. hospitals had dropped to 41%, by 1975 to 22% and by 1980 to 15%.^{24,25} Also in Western Europe a gradual decrease in autopsy rates has taken place, the

present rate for some major hospitals being not higher than 20%.¹⁷ It has already been mentioned that generally in the larger teaching hospitals the autopsy percentages tend to be higher than in small community hospitals. Apparently the autopsy still provides means for instruction. Some non-teaching hospitals probably have autopsy rates below 10%.²⁶ In paediatric units the autopsy percentages reach approximately 70%, this figure probably being true in most Western countries.¹⁷ In analyzing age trends in autopsy rates, Ahronheim and others found a striking decline with advancing age, the peak (autopsy rate 82.5% for the general population) occurring in the third decade of life, the nadir (2.4%) by age 90 years.²⁷ In 1977 Cameron et al. made this same observation for hospital autopsy rates.²⁸

The graph for age-related autopsy rates had the same profile for both sexes, although in all decades of life men were more likely to undergo autopsy than were women. This sex difference in autopsy rate was statistically significant for all age groups.²⁷ A clear explanation for this sex difference is not known.

There seems to be no clear relationship between cause of death and autopsy percentage: for many common diseases the autopsy rates were not significantly different from each other.^{25,27} An exception is probably an external cause of death, such as homicide, suicide or motor vehicle accident; in the Netherlands these causes of death can become cases for the coroner with possible autopsy being mandated by law. This plays a more important role in the U.S. than in Western Europe.

These cases will not be further discussed in our study. It may be important to realize that in several Scandinavian studies autopsy rates of approximately 90% are reached. In Britton's study a hospital autopsy percentage of 96 is mentioned.²⁹ These figures are most likely due to the fact that in Scandinavian countries an autopsy can be performed in every death, unless the relatives object.

What are the reasons for the declining autopsy percentages? Several factors probably play an important role. Some call the loss of interest in the autopsy a widespread phenomenon, in the sense that pathologists as well as clinicians have become indifferent or even hostile to it. Due to the fact that it is the clinician who decides on whether or not an autopsy be requested, it is still he who probably receives the first blame.

In general, clinicians believe that postmortem examination hardly ever provides information that was not already available during life. There is clearly a great confidence or even an over-reliance in most clinical diagnostic methods. Most certainly, many clinicians have been lulled into a sense of confidence in their diagnostic acumen by what they view as discriminating laboratory tests and radiographic techniques. Clinicians are more excited by the potential of nuclear magnetic resonance than by facts revealed by postmortem. Secondly, the clinician may fear embarrassment by mistakes that will be revealed, and that malpractice suits may follow.

Additional factors from the clinicians point of view could be: desire not to upset a recently bereaved family, lack of time to go through the task of requesting an autopsy or lack of time to attend to the postmortem examination.^{24,26,30}

According to most authors, the pathologists are not free from any blame either. Their reasons for the loss of interest in the postmortem examination are several. One aspect is the thanklessness of the task of performing the postmortem if there is no interest shown by the clinicians. A second reason is the time consuming tasks of the other aspects of pathology today: histologic and histochemical assessment of surgical specimens, immune-histochemistry and cytology, organ-specialized pathology and even electron-microscopy. At the beginning of the 20th century the most important task of the pathologist was only to perform postmortem examinations!³¹

Autopsies are nowadays often seen as an inferior duty of the pathologist and in many institutions they are performed by the most junior pathologist in training, the specimens being prepared lastly by the technicians and the reports kept in the secretaries' office.²⁴ A final problem is the reimbursement for performed autopsies: no proper professional fee is available for autopsies performed.^{24,26,30,32}

One important aspect of the declining autopsy rates in the U.S. was the decision of the Joint Commission on Accreditation of U.S. hospitals to end its requirement of a minimum autopsy rate for accreditation.^{25,30} The minimum rate had been 20% until the 1960's, but was eliminated in 1971. This decision has obviously not led to the declining autopsy percentages, but was more a consequence of it. All the same, it may still exert a negative influence on the general attitude towards the postmortem examination.

How many postmortem examinations should ideally be performed? This question can not be easily answered after studying available literature. Madden in 1965 mentioned that the 'ideal is certainly an autopsy on every death, but practical considerations generally prevent achievement of this ideal'.³³ Most authors, however, agree on the fact that the present autopsy rates are too low for proper quality assessment of medical care and for instruction purposes.^{17,25-29} Geller also suggested in 1983 that the ideal autopsy rate for a tertiary-care teaching hospital would be 100%.

Several suggestions to prevent a further decline in autopsy rates are found in the literature. Information obtained at autopsy should be clearly and appropriately made available to the clinicians and also to the relatives of the deceased. Awareness of the potential of the autopsy is mentioned by different authors, stressing the change in the nature of the contributions provided by the autopsies. A plea for adequate monetary support for the performance of the autopsy is made in several articles and 'letters to editors' and a renewed interest by the Accreditation Commission is hoped for.

Another practical suggestion is the plea for abandoning the view that a complete autopsy should be performed in all cases sent for postmortem examination (see II.6). Finally, it is suggested that the method by which permission is obtained for an autopsy, should be amended. The Scandinavian experience shows that higher rates can probably be achieved by the reverse procedure: only in cases of clear objections by the close relatives or a written declaration by the patient, should the autopsy be declined.³⁴

II.4 The Dutch situation

Declining autopsy rates have also been mentioned in the Dutch literature. The postmortem examination as a means of quality control and evaluation of accuracy of diagnosis has also been advocated in the Netherlands.

A most interesting article appeared in 1963 by Kuijjer et al., giving the results of their analysis of the causes of death in a group of surgical patients.³⁵ The autopsy percentage in this study was 60%. The authors state that in approximately 20% of deaths, an error had been made.

Multiple traumatized patients, patients with ulcer disease, with bile duct disease and patients with ileus had been especially at risk. The results of this study led the authors to an increased understanding of their potential failures. In contrast to the earlier statements by Cabot and Karsner, Kuijjer feels that the diagnosis and treatment failures were due more to human errors than to other reasons.^{1,2} The autopsy percentage mentioned by van Rijssel was less than 50% for three university

pathology services in the mid-1980's.³⁶ As previously stated, the autopsy percentage for paediatric units was approximately 70%. The autopsy rate in the provincial hospitals in one Dutch area had declined to 15% in 1983. Inaccuracy of diagnosis was found to occur in 42% of autopsies in Steffelaar's study, and in 68% of autopsies in the study of de Vries et al. unexpected findings were revealed.^{37,38} Clearly, not all these inaccuracies in diagnosis had been of major clinical importance.

In a recent article in the *American Journal of Medicine* a Dutch author refers to a study in one of the university hospitals in the Netherlands, in which the fact that unsatisfactory autopsies are performed, is mentioned. In this study, the frequency of inconclusive autopsies in internal medicine was found to increase with decreasing clinical certainty.^{39,40}

Other recent publications in the Dutch literature again mention the difference between clinical diagnosis and autopsy diagnosis, especially regarding acute myocardial infarction, overreported in the national statistics compared to the autopsy figures, and bronchopneumonia, which is underreported in the national statistics.⁴¹ A plea is made for an increase in the number of autopsies and easier access to autopsy services in old age nursing homes to improve the quality of medical care for geriatric patients.⁴² In a recent publication the pleas are repeated for institutions for mentally retarded.⁴³ The changing aspects of the services rendered by the pathologist occur in the Netherlands as well as in other Western countries.^{31,36} There is however a definite need for training in autopsy pathology for the pathology resident. Residents in training for other specializations have to attend autopsy sessions and ample facilities are mandatory for a hospital before residencies are accredited. According to the 'Association of Surgeons of the Netherlands' the autopsy rate for a teaching institution in general surgery should be at least 50%. In 1985, Klazinga stressed the importance of the autopsy and clinico-pathological conferences to discuss necropsy results as a means of quality control in all hospitals. The publication was supported by the 'Centraal Begeleidingsorgaan voor de intercollegiale toetsing'.⁴⁴ In 1990 a number of articles appeared in the 'Nederlands Tijdschrift voor Geneeskunde' regarding the need for autopsies in general and for the Acquired Immune Deficiency Syndrome in particular.^{45,46,47}

II.5 Accuracy of diagnosis, present state

The present state of accuracy of diagnosis as assessed by the postmortem examination is published by several authors. Landefeld et al., in 233 consecutive autopsies, found an 11% level of major unexpected findings at autopsy, whose premortem diagnosis would probably have improved survival and a 12% level whereby premortem diagnosis would probably not have altered survival.⁴⁸ The study was performed in a university hospital and figures were compared with those from a community hospital. In 1980 Cameron and McGoogan reported a 39% error rate in major cause of death and Britton in 1974 reported a 7% rate for major errors, a 7% intermediate error rate and a 16% minor error rate.^{49,29} In the study by Britton the accuracy rate of completely correct diagnoses was 57%, the study being performed in a medical ward with an autopsy rate of 96%. Of the 39% major errors in Cameron's study approximately half were thought to have been clinically relevant. Scottolini and Weinstein found that 13% of major clinical diagnoses were not confirmed at autopsy, whereas in 24% of cases the cause of death was not included in the clinical diagnoses.⁵⁰ In a recent study from Battle et al. data were collected from 32 U.S. hospitals: 34% of cases showed discrepancies in primary diagnosis with just less than a third of these, 10% of the total number, showing discrepancies that probably had an adverse impact on survival.⁵¹ These differences already indicate that methods of classification of errors and methods of investigation are probably important in influencing the outcome of the different studies.

Differences in classification of diseases as 'major' or 'minor' or classification as 'primary' or 'contributing' illnesses have relevance in this aspect. Is the 'cause of death' the underlying disease or the mechanism of death? In one case the underlying disease can be diagnosed correctly, but at the same time the mode of death can be missed. Some authors use, as has been mentioned before, the ICD-classification of diseases and thereby errors can be classified as a shift from one major category to another or as a shift within a disease category, for instance from one subgroup to another.

Goldman has attempted to standardize the accuracy of diagnoses according to 5 classes after defining that major diagnoses included all principal underlying diseases and primary causes of death. He included as minor diagnoses all antecedent conditions, related diagnoses, contributing causes and other important conditions. These 5 classes were:

CLASS I:

a missed major diagnosis for which detection before death would in all probability have led to a change in management that might have resulted in cure or prolonged survival.

CLASS II:

missed major diagnoses for which earlier detection would not have led to a change in management, because effective therapy had not been available or the patient had received adequate therapy despite the missed diagnosis or the patient had refused further therapy.

CLASS III:

missed minor diagnoses related to the terminal disease process.

CLASS IV:

missed minor diagnoses, unrelated to the primary disease, but with a possible influence on the prognosis.

CLASS V:

correct diagnoses.¹⁰

Although other authors have used the same classification of concordance between clinical and autopsy diagnosis, or even with some modification, it has not become widely used.^{48,51,52} In most studies the relevance of discrepancies is stated clearly as being of clinical importance, of epidemiological importance or being only of academic interest. Our present study does not make use of the aforementioned classification, although similarities can definitely be found. The clinical importance of the discrepancies within the different categories of diagnoses will be stated clearly.

A number of factors is said to influence accuracy of clinical diagnosis. Age is one such factor; most authors found that a greater number of inaccuracies occurred with advanced age, probably due to the multiple and simultaneous pathology in elderly people.^{29,49,51,52,53} Landefeld could not confirm these age related discrepancies after multivariate analysis.⁴⁸ Battle et al. found that the apparently significant influence of age at death was almost entirely due to a marked difference in the rate of major discrepancies in persons dying before or after the age of 30 years.⁵¹ This author is also one of the few, who found that females displayed significantly more discrepancies than males. A suitable explanation for this fact was not given. Type and size of the hospital also influences accuracy of diagnosis: larger hospitals, especially when they are teaching or university hospitals, tend to have fewer discrepancies.^{51,52} The accuracy rate could be improved by a higher

autopsy percentage in hospital deaths.^{29,50,51} This could be a reflection of both a smaller number of difficult cases in the total group of autopsy cases and an increased interest by clinicians to state the final diagnoses as clearly as possible, or possibly an increased rate of accuracy of the clinical diagnostic process in hospitals with a large number of autopsy cases. Of course, teaching institutions have the highest autopsy percentages, so a few of these factors may be interrelated. Discussing the correct and logical sequence of the various disease processes and causes of death could lead to avoidance of formal errors in assessing accuracy of clinical diagnoses.^{50,53} According to Battle et al. there is little difference between whether the person who is responsible for classification of the proportion of discrepancies is the pathologist functioning independently, jointly with the patient's physician or as part of a hospital committee.⁵¹ Although it could be suspected that the pathologist would be more critical than the responsible clinician, this was not confirmed by that study. Cameron however, assumed that most pathologists are reluctant to judge the clinical significance of diagnostic discrepancies, and are wary of passing judgement on clinical investigations and management.⁴⁹ Possibly the studies performed by pathologists and clinicians working together are the most reliable ones.

Another factor could be duration of hospital stay before death. Some authors found indications of decreased accuracy rates in patients hospitalized for less than 24 hours.^{48,51} These findings were not statistically significant however. It could be argued that a hospital stay of less than 24 hours duration might not give clinicians enough time to make a complete or proper diagnosis, although it can be argued as well, that during a prolonged stay in hospital, especially under circumstances of intensive care, more complicated patterns of pathology occur.

Certainty or uncertainty of the clinical diagnoses, such being stated by the attending clinician, has its effect on the number of discrepancies found at postmortem. Britton reported that when the diagnosis was stated by the clinician to be fairly certain, it was revealed to be inadequate in 25% of cases, but in 45% when the diagnosis had only been considered as probable.²⁹ Other authors found the same relationship between the clinician's confidence in his major diagnosis and the rate of accuracy as found by postmortem examination.^{48,49,54} Nevertheless, even when the diagnoses were certified as fairly certain and the yield of the autopsy had been considered to be lowest, the major diagnosis had been wrong in 25% of cases in Cameron's study, in 17% in Landefeld's study and in 19% in Hartveit's study. These findings suggest that selection of cases for autopsy by the attending clinician will still give rise to a large proportion of discrepant findings.

A large number of different diagnoses have been mentioned to occur as missed in the clinical situation. As has been previously stated, the types of diagnoses that were missed have altered over the decades and the proportions have changed in the total autopsy material. Some very interesting cases may only be of academical interest, but clinicians will definitely learn from some of their cases, may it still be without any regular pattern of discrepancy. On the other hand there is a group of diseases that is frequently diagnosed inadequately or missed completely. Major fungal infections in immuno-compromised patients is such a group of diseases that was reported to be underdiagnosed.⁴⁸ Pulmonary embolism remains a very difficult clinical diagnosis with a large proportion of both under and overdiagnosis.^{48,51,55,56} Acute myocardial infarction is similarly misdiagnosed in many cases, and probably pulmonary embolism and myocardial infarction are both commonly used as convenient labels when the cause of an unexpected death is unknown.^{51,55,56,57} Battle found that inaccurate diagnoses of bronchopneumonia had a large impact on discrepancy rates and Cameron found many cases of under and overdiagnosis for cerebrovascular diseases, it being most commonly a problem of differential diagnosis in distinguishing it from cardiovascular disease. Britton stated that neoplasm had been underdiagnosed in her study (1974), as well as a large number of undiagnosed cases of digestive diseases such as liver cirrhosis and peptic ulcer.

In this study a number of cases of acute abdomen had not been diagnosed correctly, which may indicate a low level of suspicion for surgical cases in a medical ward. Whether inaccurate diagnoses on surgical wards tend to be of a different kind than the ones mentioned before, remains unclear: only a few studies about discrepancies in a surgical department have been published so far, without any attempt to report more than a few examples of missed diagnoses in surgical cases.^{35,58} In these studies approximately 80% of clinical diagnoses had been completely or almost completely correct. Several other studies could not show any difference in discrepancy rates between surgical and medical departments.^{49,56,59}

II.6 Questions that remain to be answered

A number of questions are not completely dealt with in the available literature. One of the most prominent ones is the problem of selection of cases sent for postmortem examination, which may potentially affect the rates of accuracy of diagnosis and the percentages of cases, who were correctly treated. As has been described in II.5, an increase in the number of autopsied cases, at least when this increase is achieved by artificially raising the number of requests, probably leads to higher accuracy rates.^{59,60} Even then, there is still a considerable proportion of missed diagnoses. Bias due to selection of cases for autopsy is probably lowest in the studies with higher autopsy percentages, such as the ones from Scandinavian countries.^{29,51} It is usually assumed that the more difficult cases will be sent for postmortem examination more frequently than the 'easy' cases, or the cases of terminally ill patients in whom further treatment had been withheld.

Selection of cases can also occur as a result of patterns of referral to larger hospitals and teaching centres.⁵¹ These centres may be dealing with more complicated disease groups or more complicated individual cases. Due to the teaching aspect of their medical and surgical services, an increased number of cases will probably be sent for autopsy.

It would be interesting to compare the patterns of diagnosis and management between the populations of the autopsied cases and the non-autopsied cases. Landefeld found that patients in the autopsy group were younger, more often male, and less likely to have died in an intensive care unit or to have had a "do not resuscitate" order written, than the patients in the non-autopsy group.⁴⁸ The autopsy cases and the non-autopsy cases had been similar with respect to most major clinical diagnoses. In this particular study, the expected yield of the autopsy had been estimated to be equal for both autopsy cases and non-autopsy cases, but several reasons prevented a postmortem examination being performed: in 80% of the non-autopsied cases the family had refused permission. In only 4% of the non-autopsied cases had the postmortem examination not been requested. Cameron reported that an increased length of stay in hospital is associated with a fall in the number of autopsy requests and a rise in the number of refusals.⁴⁹ This could add to the non-selection of difficult cases for autopsy.

A number of questions concerning the autopsy itself still have to be answered. There is the question of the completeness of the postmortem examination: does a complete autopsy have to be performed in all cases, or may it suffice to perform limited autopsies in a number of cases? Only very few studies mention the extent of the autopsies that they refer to. In a Danish study with an autopsy percentage of 85%, opening of the skull was performed in 51% of cases, and in the recent American study by Landefeld et al. the autopsy had been complete (complete body and brain) in 76% of cases.^{53,48} It is assumed that in most studies the rates must be approximately the same. Apparently, and also according to Roberts, there is no need for a complete autopsy in all cases to get a proper clarification of the pathological processes, although this seems to be a contradiction

to the values that are ascribed to the postmortem examination.²⁴ Roberts also stated that the macroscopic postmortem examination is sufficient in most cases, whilst histological descriptions are usually supplementary.

Wellmann (1969) described the needle autopsy in cases of very restricted permission for postmortem examination: in 77% of cases meaningful pathological alterations were found.⁶¹ This method is rarely practised, although some time ago it was introduced again for cases of severe risk of infection.^{62,63} Reid also commented that unselected postmortem histology is certainly not cost effective for purpose of diagnosis.⁶⁴

It must be realized that in a small number of cases the pathologist will not be able to give a full account of the disease processes in life or the ones leading to death. A few authors have reported on the problem of autopsies with inconclusive or indeterminate autopsy results.^{40,65,66} The frequencies range from 7%-10% in these studies.

Usually the autopsy is the golden standard and the clinical findings have to be compared with this golden standard.⁵¹ At times the pathologist will be guided by the clinical notes to explain his findings. It may occur that the clinical processes are not accompanied by a morphological substrate: heart rhythm disturbances or metabolic derangements such as acidosis, hypo- and hyperkalaemia or hypoglycaemia. It must be assumed that in most studies no attempt was made to find completely similar descriptions of diagnoses in both the clinical notes and the autopsy report. A clinician usually does not give a morphological diagnosis but a clinically relevant diagnosis (for instance a pulmonary infiltrate may be morphologically diagnosed as a pneumonia). These facts again clarify the need for mutual consultation as has been stressed by many authors.⁶⁰ Some authors refer to objections by clinicians, that the autopsy is only showing the end result of the process of death and therefore not able to show the dynamic processes that occurred during life and disease. Most clinicians will however agree that the postmortem examination is more than "the inspection of a piece of dead meat".⁶⁰

The extent of the macroscopical postmortem examination is also determined by the number of excisions taken from each of the different organs. The minuteness with which the microscopy or any further examinations on the material are performed, add to the completeness of the autopsy. Probably these are usually done in a standardized way, although these points are not described in the available literature.

Finally, at the end of this chapter, it should be concluded that discrepancies between clinical diagnosis and pathological findings at autopsy occurred in the past and still occur at present. Many authors have reported discrepancy rates ranging from 5% to approximately 25%, or even higher rates, depending on methods of selection of cases and on methods of investigation.⁵²

Apparently, a certain percentage of missed major discrepant diagnoses, even with adverse impact on survival, must be deemed acceptable. Anderson suggested in 1984 that this rate should not be higher than 10%. In centres with high autopsy rates this allowable percentage of missed major diagnoses can be closer to 5%, according to results of other studies referred to previously. Anderson et al. also strived for an understanding of 'necessary fallibility', and for an autopsy based quality assessment.^{67,68} A 65% autopsy rate was suggested to be necessary for this quality assessment. Any improvement should be strived for, which implies that in at least those cases of missed major discrepancy with a potential or real impact on survival, the errors must be reviewed by the departments involved. Audit committees have to attend to these problem cases on a regular basis, which could occur monthly.^{69,70} Autopsy data should be collected systematically, updated autopsy protocols should be promoted and a national autopsy data bank instituted.^{71,72} There should

be a greater professional, managerial and public awareness of the importance of the autopsy as the 'ultimate audit' of clinical outcome.⁷² Steps in this direction were recently taken by the American Joint Commission for the Accreditation of Health Organizations.^{68,73} Added to this, proper completion of the death certificate may further improve mortality statistics.⁷⁴ The values of the autopsy in a surgical department will be assessed in the following chapters.

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AUTOPSY ANALYSIS IN SURGICAL PATIENTS A BASIS FOR CLINICAL AUDIT

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British Journal of Surgery, *in press*

III.1 Introduction

Audit and quality control of clinical management are becoming more and more important in today's clinical practice. Autopsy as a contributor to surgical audit is suggested by some authors.^{1,2,3} In 1989 Anderson discussed the sensitivity and specificity of clinical diagnostics for a group of diseases of mainly medical origin.⁴ Autopsy data over a period of five decades were compared and the issue of 'necessary fallibility' was introduced. Other studies describe discrepancies between clinical diagnoses and autopsy findings. It is postulated that there must be an irreducible error rate inherent in the diagnostic process, at least among persons dying in hospital.^{5,6,7} According to a number of large studies the error rates detected by autopsy can be as high as 20%-30% for hospitalized patients.^{8,9} In this era of declining autopsy rates, instances of missed clinical diagnosis which had an adverse impact on the course of the disease, may be quickly forgotten. This study assesses the value of the autopsy as a means of quality control in surgical patients. It deals with the sensitivity and specificity of clinical diagnostics assessed with autopsy. The autopsy as a basis for regular audit will be assessed. An attempt will be made to show which diseases or factors influence accuracy rates in surgical patients.

III.2 Patients and methods

During the period 1977-1987 an autopsy was requested for every patient who died in the Department of General and Vascular Surgery at the Nijmegen University Hospital. During this period the department had 3000-3500 admissions and 2500-3000 operations yearly. Necessary consent from relatives was obtained in 312 cases. The autopsy rate in this period was 51% (range 36%-62%). Instances in which relatives refused consent were not included in this series of 312 patients. In all cases the clinical notes were compared with postmortem findings. Cases in which discrepancies between clinical and postmortem findings occurred, were discussed with a senior surgeon and pathologist. Differences between descriptive clinical terms and morphological autopsy diagnoses were only noted in cases of clear discrepancies. Trivial inaccuracies were not scored. The accuracy of the primary surgical diagnoses, the diagnoses of complications and relevant contributory diagnoses were assessed. False negatives and false positives were counted and sensitivity and specificity were calculated for a number of diagnoses. Treatment and diagnostic procedures were evaluated and compared with postmortem findings. A number of factors were statistically analyzed to detect a significant influence on accuracy of diagnosis or treatment. Statistical analysis was performed by the unit of Mathematical Statistical Advice of the University of Nijmegen. The Chi-square test for unpaired data was used.

III.3 Results

The group of 312 patients consisted of 198 men and 114 women, the mean age being 60.0 years (range 14-93 years). The patients were divided into five subgroups according to the primary clinical diagnosis:

- | | |
|---|-------------|
| 1. Malignant tumour: | 77 patients |
| 2. Trauma: | 56 patients |
| 3. Vascular surgical disease: | 68 patients |
| 4. Benign surgical digestive tract disease: | 77 patients |
| 5. Miscellaneous disorders: | 34 patients |

In 77 patients the prognosis on admission was expected to be fairly good, in 140 patients poor and in 95 patients the prognosis was unclear. In 33 patients with a poor prognosis on admission treatment was withheld in the terminal phase of the disease, without any failure in management according to postmortem analysis. Twelve patients died during surgery. One hundred and sixty patients died on the surgical intensive care unit and another 38 patients had been admitted to the intensive care unit during their hospital stay. Twenty six patients died within 24 hours of admission. One hundred and eighty two patients were emergency admissions and 130 were elective.

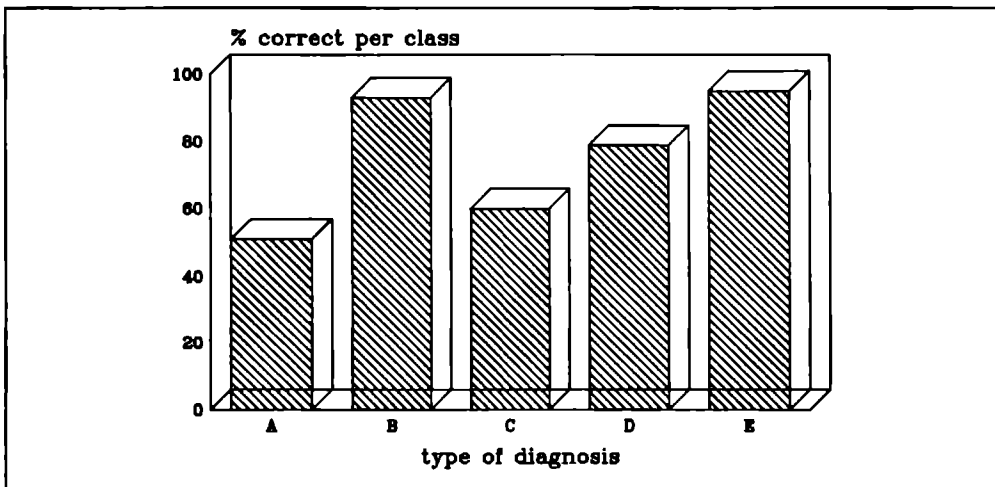


Figure III.1: Accuracy of clinical diagnosis. A=all diagnoses; B=primary diagnoses; C=diagnoses of complications; D=mechanism of death; E=contributory diagnoses.

Clinical diagnoses:

According to the autopsy analysis all clinical diagnoses were correct in 159 patients (51%) (see figure III.1). In 49% of the patients one or more errors in diagnosis occurred. Despite correct diagnoses treatment had been incorrect in 12 of the 159 cases. The primary clinical diagnosis was correct in 290 patients (93%) and diagnoses of the complications of the primary disorder or its treatment had been correct in 188 (60%) (figure III.1). In 124 patients an error occurred in diagnosis of complications; the error had been relevant to the course of the disease or the treatment in 34 patients.

The direct mechanism of death was properly diagnosed in 247 patients (79%). Sudden unexpected death occurred in 44 patients but was accurately diagnosed in only 22 cases. Death due to brain damage occurred in 18 patients which was due to direct trauma in 15. Brain damage as the direct mode of death was missed clinically in 2 patients (sensitivity 89%).

Relevant contributory diagnoses, not related to the primary disorder or its complications, were diagnosed correctly in 296 patients (95%).

Diagnostic procedures:

According to postmortem assessment, diagnostic procedures were correct in 282 patients (90%). In 270 of these patients the results were helpful, in 12 cases the results were misleading. In 30 patients (10%) diagnostic procedures had been inadequate: in 15 patients with abdominal sepsis diagnostic errors occurred. These included 9 cases of failure to perform an ultrasound examination in cases of localized pus collections and 6 cases of failure to perform an explorative (re-)laparotomy for free bowel perforations (without localized pus collections). In 15 patients without abdominal sepsis diagnostic errors occurred: 3 cases with pulmonary embolism without scintigraphic examinations; 3 cases with chest disorders without chest X-rays; 3 cases with cardio-vascular disorders, which could have been diagnosed by ultrasound examination; 2 cases with severe haemorrhage in whom time was lost trying to perform angiography; 3 cases with insufficient laboratory investigations and 1 case with insufficient physical examination.

Table 1: Treatment errors in 312 surgical patients.

TYPE OF ERROR	NUMBER OF PATIENTS
Failure to treat abdominal sepsis by (re-)laparotomy	17
Failure to treat abdominal bleeding by (re-)laparotomy	9
Failure to perform other surgical operations	9
Non-surgical errors	16

Treatment errors:

Comparison of clinical notes with autopsy findings showed that treatment had been incorrect in 51 patients (16%), of whom 12 had all diagnoses correct. The error in treatment had clearly had an adverse effect on the course of the disease in 35 patients (11%). The effect had been likely to be adverse in 16 cases (5%). The treatment errors which occurred most frequently are shown in table I.

Complications:

Abdominal sepsis occurred in 94 patients and was most often found in the group of patients with benign gastro-intestinal disease. In eleven patients the diagnosis was completely missed (inadequate diagnostic procedures in 15 cases) in the clinical phase: sensitivity 88%. Correctly performed diagnostic procedures but with misleading results occurred in 4 cases with abdominal sepsis: 1 false negative ultrasound examination; 1 false negative laparotomy (duodenal perforation); 1 false negative plain X-ray and 1 false negative biopsy of pancreatic cancer. One false positive case occurred: specificity 99%. Multiple Organ Failure was associated with abdominal sepsis in 38 patients.

A leaking intestinal- or gastric anastomosis was found as a complication in 29 patients and 3 were missed clinically: sensitivity 90%. Specificity was 100%.

Bronchopneumonia was found at autopsy in 142 patients. The diagnosis was missed clinically in 37 patients and 6 false positive diagnoses occurred: sensitivity 74% and specificity 96%. Bronchopneumonia was a common disorder in all subgroups and missed equally in all subgroups, frequently as a late complication in severe illness. Multiple Organ Failure was found to be associated with bronchopneumonia in 43 patients of which 24 had added abdominal sepsis.

Pulmonary embolism was found at autopsy in 21 patients and had been missed clinically in 15: sensitivity 29%. False positive diagnoses were seen 11 times: specificity 96%. Pulmonary embolism was most frequently found in the group of patients with malignant disorders, but frequently missed in all subgroups.

Myocardial infarction was present in 36 patients at autopsy. Ten cases were missed clinically, 13 false positive diagnoses occurred: sensitivity 72% and specificity 95%. Myocardial infarction was found most often in the group of patients with surgical vascular disorders.

Haemorrhage as the direct mechanism of death occurred in 52 patients and was detected clinically in 39. Two false positive diagnoses occurred: sensitivity 75% and specificity 99%. Terminal haemorrhage occurred most frequently in the group with vascular disorders.

No significant differences in diagnostic sensitivity or specificity for above complications could be found for the five subgroups of patients.

Statistics:

Statistical analysis using the Chi-square test was performed to identify relevant factors which could have had an influence on accuracy of diagnosis or treatment. Significantly associated with incorrect clinical diagnosis were the occurrence of sudden death ($p < 0.001$) (figure III.2) and failed diagnostic procedures ($p < 0.001$) (figure III.3). Significantly associated with incorrect treatment were: the occurrence of sudden death ($p < 0.001$) (figure III.2), failed diagnostic procedures ($p < 0.001$) (figure III.3) and the occurrence of an iatrogenic complication ($p = 0.010$) (figure III.4).

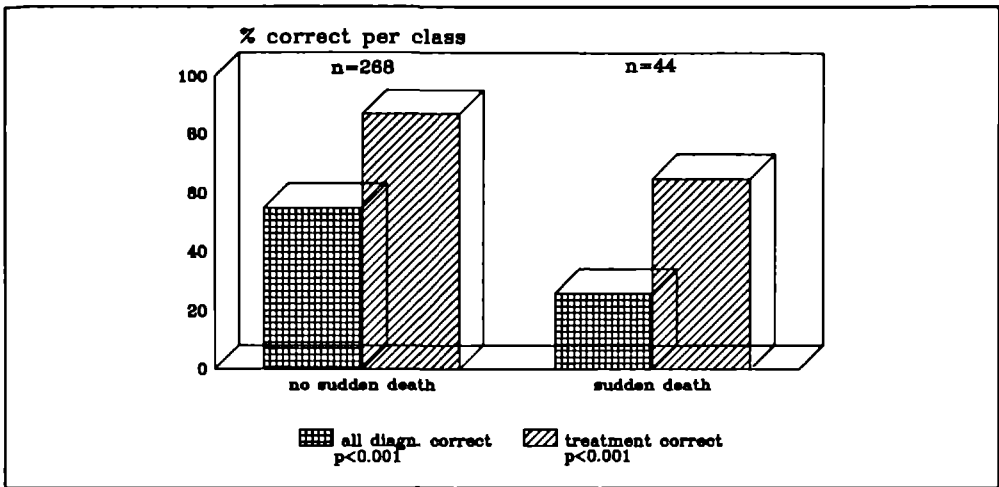


Figure III.2: Influence of sudden death on clinical accuracy.

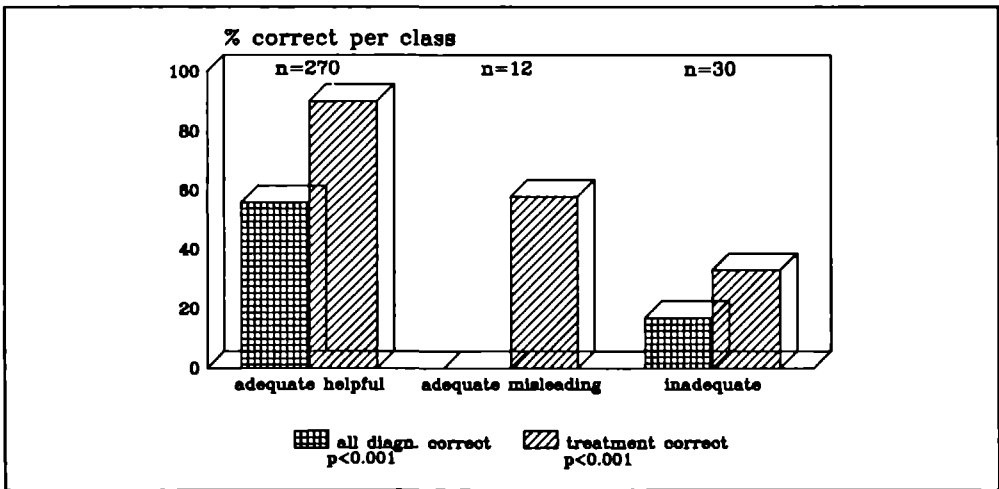


Figure III.3: Influence of diagnostic procedures on clinical accuracy.

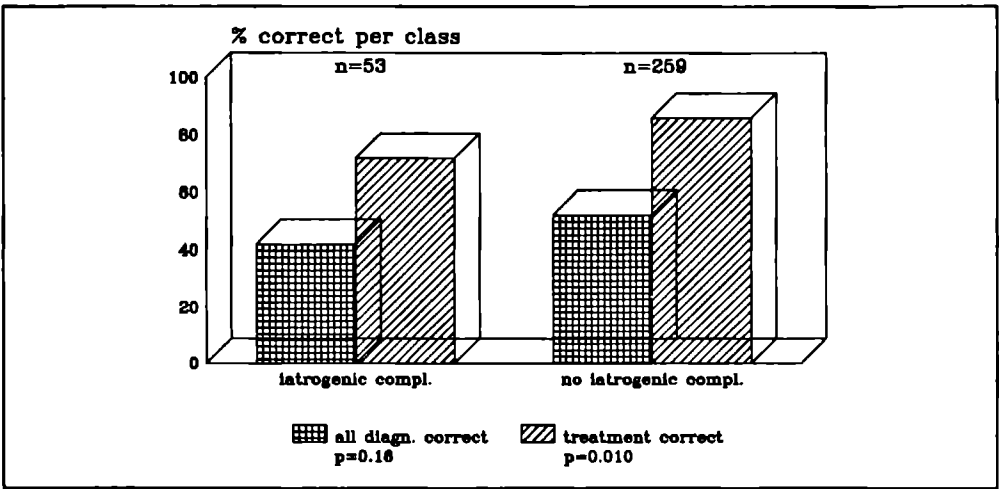


Figure III.4: Influence of iatrogenic complication on clinical accuracy.

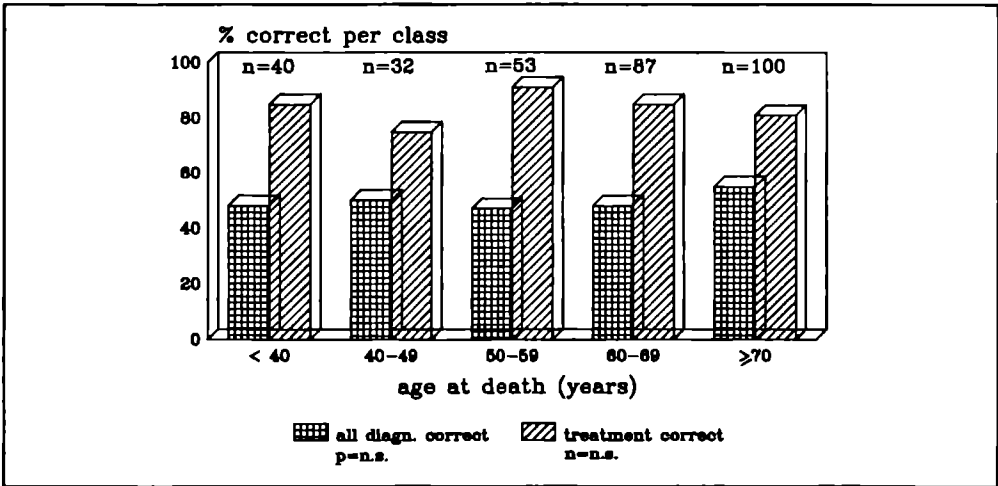


Figure III.5: Influence of age on clinical accuracy.

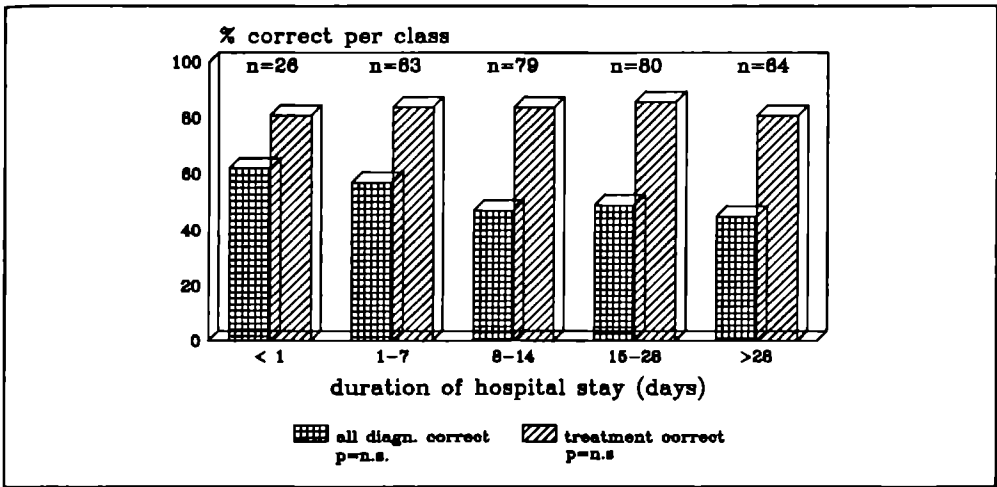


Figure III.6: Influence of duration of hospital stay on clinical accuracy.

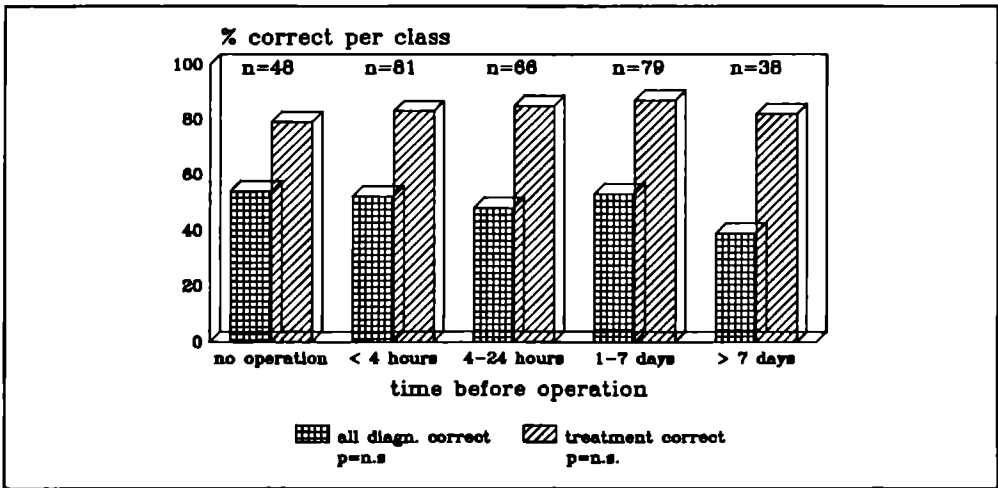


Figure III.7: Influence of time before operation on clinical accuracy.

Death due to cerebral damage or involving abstinence from treatment in the terminal phase of the disease were significantly associated with correct therapy ($p=0.047$ and $p=0.004$ respectively). Statistical analysis did not show any significant influence on accuracy of diagnosis or treatment for age (figure III.5), sex, duration of hospital stay (until death) (figure III.6), time before operation (since admission) (figure III.7) and year of death. Elective admission ($n=182$) or emergency admission ($n=130$) did not influence accuracy of diagnosis or treatment. No correlation was found between incorrect diagnosis or treatment and any specific primary surgical disorder or complication.

Statistical analysis showed that in the 48 patients who did not undergo surgery, diagnostic and therapeutic accuracy were equal to those in patients who underwent surgery. In one case of an old aged patient, autopsy failed to detect the cause of death.

III.4 Discussion

Studies on discrepancies between clinical and postmortem diagnosis often describe error rates of up to 30-40% with decisions affecting survival in up to 10% of patients.^{6,9,10,11} The results presented here show that clinical accuracy in surgical patients is not much higher than in previous studies in non-selected hospital deaths. It is clear however, that primary surgical diagnoses were often correct; the greatest number of errors occurred in the assessment of complications of the primary surgical disorder or treatment. Although septic complications played a very important role in all groups described, severe haemorrhage and myocardial infarction were most often seen in patients with surgical vascular diseases. Pulmonary embolism was as difficult to diagnose in these patients as in other studies.^{6,8,11,12,13} Bell and Zuidema found that 15% of postoperative deaths were caused by pulmonary embolism and a 30-year survey by Bergqvist showed that pulmonary embolism was found at autopsy in 23% of deaths in surgical patients.^{14,15} The incidence and case fatality rate for pulmonary embolism in the hospitalized population have decreased recently and this is demonstrated by the absolute number in the present study.^{15,16} Pulmonary embolism, bronchopneumonia, myocardial infarction and terminal haemorrhage were most frequently missed. Abdominal sepsis is an important disorder in surgical patients and septic conditions are a cause of major morbidity in older patients and in those on intensive care units.^{5,17,18,19} Multiple Organ Failure is frequently associated with sepsis, as was also demonstrated by our figures.²⁰

The most important error of treatment detected was failure to (re-)laparotomize in patients with abdominal sepsis. Patients with latent abdominal sepsis, especially after multiple laparotomies, form a particular problem in clinical surgery. Diagnosis is difficult if there is Multiple Organ Failure. Ultrasound examination is easily performed and only one false negative examination was found in this study. CT-scan is more demanding and at times impossible in mechanically ventilated patients. Laparotomy as a diagnostic procedure appears to be a reliable method with the advantage of extending it into a therapeutic procedure, but morbidity of the laparotomy could be a limiting factor. A number of instances occurred in which localized bleeding may have been treatable. These cases are of particular interest when demonstrated by the autopsy.

This study did not demonstrate significant influences on accuracy of diagnoses and treatment by any factors, except 'sudden unexpected death' and 'failed diagnostic procedures'. The cause of sudden unexpected death is often misdiagnosed and a myocardial infarction is suspected in this situation in hospitalized and non-hospitalized patients.^{12,21} A higher clinical accuracy for elective admissions than for emergency admissions was not found. This could be explained by development of complications during admission, which could be missed subsequently.

Anderson stated that diseases with a low prevalence were most likely to be missed clinically.²² This was not confirmed in the present study of surgical disorders. Larger studies in surgical patients could support the statement. Patients beyond treatment, those dying from brain damage or in whom treatment was withheld in the terminal phase were not affected by errors in management. Some have described accuracy rates influenced by age or by duration of hospital stay.^{7,11,22,23,24,25,26} Most authors indicate that elderly patients have more frequent incorrect diagnoses than younger patients and that prolonged hospital stay may lead to overdiagnosis. Fernandez-Segoviano et al. did not find any relationship between accuracy of diagnosis and length of stay on an intensive care unit.²⁷ The present figures for surgical patients support this observation.

This analysis shows that selection of cases for autopsy is not likely to improve management of surgical patients. The errors described in diagnosis and treatment did not originate from malpractice or negligence. These results, therefore, may be considered as the state of the art in general surgery, until other studies demonstrate higher sensitivity or specificity. The subject of 'necessary fallibility' should be understood by surgeons to aid in understanding the pathophysiology of surgical disorders and their complications. Autopsies should serve as a method of quality control to define the limits of permissible error rates in clinical surgery. Regular surgical audit with continuous registration of autopsy findings in surgical patients deserves a firm place in modern surgical practice and teaching. Autopsy conferences, for instance on a monthly basis, with surgeons and pathologists and if necessary other specialist consultants attending, should be part of surgical training. An additional aid to both pathologists and clinicians would be the installation and use of computer programs to store autopsy data and facilitate analysis.^{1,9,28}

III.5 Conclusion

This autopsy analysis with assessment of sensitivity and specificity of diagnoses and associated treatment in surgical patients shows that accuracy for the primary surgical disorder was good. Many complications were missed clinically, with probable impact on the clinical course in 11% of autopsied patients. A description of the most common complications, abdominal sepsis as the most important one, was given as well as the most common errors in treatment. Sensitivity and specificity were lowest for pulmonary embolism, bronchopneumonia, myocardial infarction and severe (terminal) haemorrhage. As this is apparently the state of the art, necessary fallibility also occurs in surgical patients. According to statistical analysis, sudden unexpected death is the most obvious condition in which a yield from the postmortem examination is expected. Selection of cases for autopsy is not desirable while this will not increase its benefit. This study demonstrates that the autopsy remains important for quality control and as a basis for audit in surgical patients. Declining autopsy rates are not acceptable for clinical surgery.

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AUTOPSY ANALYSIS IN PATIENTS WITH CANCER

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Part of this study was presented at the 'International Symposium on the Role of Autopsy in Epidemiology, Medical Research and Clinical Practice', Trieste, Italy, June 1989 (Organised by the International Agency for Research on Cancer, World Health Organisation).

IV. Introduction

Wells was probably one of the first to express his doubts about the accuracy of cancer diagnosis.¹ According to this author, cancer was probably underreported: 20-25% of cancers being only found at autopsy at the beginning of this century. Recent studies give equal figures for missed cancer diagnoses and even higher rates for incomplete diagnoses.² Few studies on accuracy of diagnosis in surgical patients have appeared in the literature and certainly not on accuracy of diagnosis in surgical cancer patients, as assessed by postmortem examination. This aspect of accuracy of diagnosis, as well as the study on appropriate treatment will be reported.

IV.2 Patients and methods

For patients dying in the General Surgical Department of the Nijmegen University Hospital in the 10-year period, from 1977-1987, consent from the relatives to perform an autopsy was requested by the attending surgeon or surgical resident. In the cases where postmortem examination could be performed, the clinical notes were compared with the autopsy findings. All cases in which discrepancies between clinical diagnoses and pathological notes appeared were discussed with a senior surgeon and with a senior pathologist. In this study, only patients with the clinical or autopsy diagnosis of 'cancer' are reported. Children with cancer requiring surgery were treated in a specialized unit for paediatric surgery and were excluded from this study. During the years in which the study was performed, the number of operations was between 2500 and 3000 per year.

We studied the accuracy of the diagnosis of the primary disease, the diagnosis of the complications of this primary disease and the direct cause of death, as well as the use of diagnostic methods and the given treatment. Relevant contributory diagnoses, not related to the primary disease, were also considered in this study.

Statistical analysis by Chi-square tests was performed by the Unit of Mathematical Statistical Advice of the University of Nijmegen. Sensitivity and specificity of a number of clinical diagnoses were assessed.

IV.3 Results

The mean autopsy percentage for the 10-year period was 51% (range over the years 36%-62%). In 77 cases a diagnosis of cancer was made. The mean age for this group of cancer patients was 62.0 years, with a range of 31-83 years. The group consisted of 46 men and 31 women.

Nine patients were considered to have a good prognosis for their primary disease. Sixteen patients were considered to have an unclear or dubious prognosis on admission, either because of their malignancy or because of their general condition. In the other 52 patients a poor prognosis was suspected from the start. In 23 cases 'do not resuscitate' orders were written in the clinical notes. The autopsy diagnoses of the 77 patients are shown in table I. In 37 patients all clinical diagnoses were correct as compared to the autopsy results (48%) (figure IV.1, flow diagram). In 11 patients the primary diagnosis was wrong (14%). In 30 patients a complication of the primary disease was missed or wrongly stated (39%). In 16 patients the direct cause of death was wrongly stated (21%). In 3 patients a relevant contributory diagnosis was missed (4%).

Table I: Autopsy diagnoses in 77 patients.

DIAGNOSES	NUMBER OF PATIENTS	INITIALLY CURATIVE
Colorectal carcinoma	15	2
Gastric carcinoma	14	7
Oesophageal carcinoma	12	6
Pancreatic or peri-ampullary carcinoma	10	2
Bronchial carcinoma	5	7
Gall bladder or bile duct carcinoma	4	
Urine bladder carcinoma	3	
Endometrial or uterine cervix carcinoma	3	
Skin carcinoma	3	
Small bowel carcinoma	2	
Breast carcinoma	2	
Carcinoma of miscellaneous origin	3	
Pheochromocytoma	1	
Benign ectopic pancreas tissue	1	

In 10 patients (n=77) the treatment had been incorrect as assessed by the autopsy (13%), in 8 instances together with a wrong diagnosis and in 2 instances despite correct diagnoses. In 7 patients the incorrect treatment or the omission of treatment had been harmful to the course of the disease. In 3 additional cases this was doubtful.

In table II the cases with false primary diagnoses are shown: cancer of the pancreas was most frequently involved. The detection rate or the sensitivity of the clinical diagnostic process for pancreatic carcinoma was 60% (4 false negative cases/10 cases found at autopsy). The specificity of the clinical diagnostic process for pancreatic carcinoma was 97% (2 false positive cases).

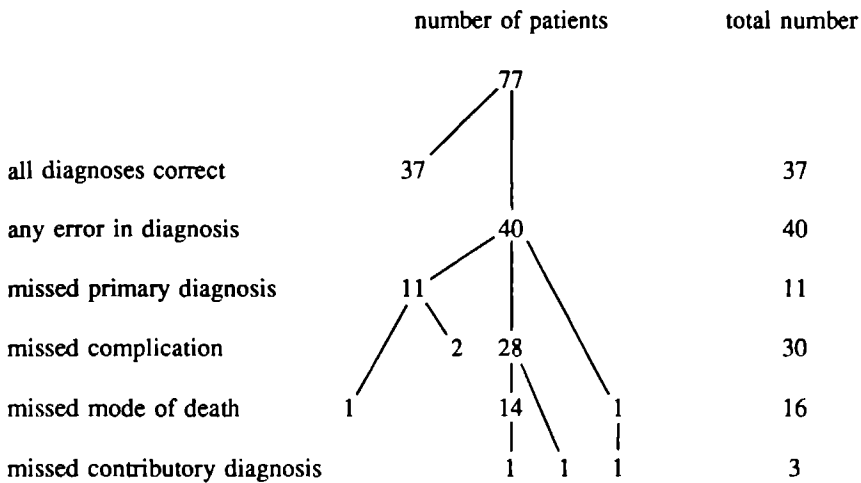


Figure IV.1: Flow diagram: cases with error in different categories of diagnoses.

In the case of bronchial carcinoma the detection rate or sensitivity of the diagnostic process was 40% (3 false negative cases/5 cases found at autopsy). The specificity was 100%. The failure to detect bronchial carcinoma as the primary tumour in these 3 cases did not have any relevance to the treatment.

For the other solid tumours in this study, sensitivity and specificity of the clinical diagnostic process were approximately 100%, as only sporadic cases with a false negative or false positive primary diagnosis were found: 1 case of renal carcinoma was clinically (not histologically or at laparotomy) diagnosed as a cervix carcinoma and 1 case of endometrial carcinoma was clinically (after colonoscopic biopsy and at laparotomy) diagnosed as rectal carcinoma (table II).

As far as the primary diagnoses are concerned, the diagnosis of malignant disease had to be refuted only once in this group of 77 patients.

Table II: Cases with wrong primary diagnoses.

CLINICAL DIAGNOSIS	AUTOPSY FINDING	AGE	PROGNOSIS	TREATMENT
Malignant lymphoma	pancreatic carc.	42	poor	correct
Chron. pancreatitis susp. of carc.	pancreatic carc.	42	unclear	correct
Acute pancreatitis	pancreatic carc.	39	poor	correct
Pancreatic carc.	bronchial carc.	57	poor	correct
Cervix carc.	renal carc.	83	poor	correct
Rectal carc.	endometrial carc.	66	poor	correct
Gastric carc.	bronchial carc.	65	poor	correct
Bladder carc.	bladder carc.	73	poor	correct
	bronchial carc.			
Vater's papil stenosis	Vater's papil carc.	54	unclear	incorrect
Pancreatic carc.	benign ectopic pancreas tissue	50	good	incorrect
Nephrolithiasis	bladder carc.	51	unclear	incorrect

In 30 patients of the 77, complications of the primary disease were incorrectly diagnosed. A number of common complications will be described below.

As far as complications are concerned, bronchopneumonia was most frequently found: 39 cases, but of these only 27 were diagnosed clinically. The detection rate or sensitivity of the clinical diagnostic process for bronchopneumonia was 69%, the specificity 100%. Bronchopneumonia was missed as the clinical diagnosis in 12 instances, of which 8 occurred in patients from whom treatment had been withheld in the terminal phase.

Pulmonary embolism was diagnosed clinically in 5 patients, but was confirmed in only 3 of these. At autopsy the diagnosis was made in 10 cases. The detection rate or sensitivity was 30%, specificity was 97%.

The diagnosis of myocardial infarction showed a sensitivity of 33%, a specificity of 99% (4 false negatives out of 6 cases and 1 false positive diagnosis).

Fatal haemorrhage occurred in 9 patients, 4 were missed clinically (sensitivity 56%) Bleeding from the upper gastro-intestinal tract occurred in 6 patients, of which 4 were fatal These 4 cases (3 due to ulcers or erosions and 1 due to oesophageal varices) were all thought to have a poor prognosis and were treated correctly The other 5 cases of fatal haemorrhage were intra-abdominal bleeding in severe abdominal sepsis (4) and in 1 patient a probably manageable haemorrhage occurred three weeks after septic complications of an oesophageal resection

An insufficient or leaking gastro-intestinal anastomosis was present in 14 of 69 patients who underwent an operation (2 instances were due to recurrent tumour growth in the anastomosis area) The diagnosis was missed in 1 patient (sensitivity 93%)

Abdominal sepsis was present in 27 patients, with a detection rate or sensitivity of 85% In 15 of these patients with abdominal sepsis, bronchopneumonia also played an important role

Multiple Organ Failure (MOF) occurred in 13 patients in this group of 77 cancer patients The clinical diagnosis was correct in all instances There is some overlap between these diagnoses of leaking intestinal anastomoses, abdominal sepsis and MOF In 8 of these 13 patients with MOF, abdominal sepsis had been the underlying cause

Iatrogenic complications were 12 cases of leaking gastro intestinal anastomoses, 1 case of pancreatitis after partial gastrectomy, 1 case of perforation of the stomach after exploratory laparotomy for an irresectable gastric tumour and 1 case of gastric tumour perforation in failed endoscopic placement of a feeding tube

The direct mechanism of death was missed in 16 patients, pulmonary embolism, myocardial infarction and severe haemorrhage were each missed as the direct mechanism of death in 4 instances Sudden unexpected death occurred in 12 patients (n=77)

The 4 patients with a missed relevant contributory diagnosis were 3 patients with severe pre-existent coronary insufficiency of which 2 developed a postoperative myocardial infarction The 4th patient had a missed penetrating duodenal ulcer, which led to severe haemorrhage

Diagnostic steps taken to reach a clinical diagnosis were thought to have been correct in 68 patients In 65 of these the procedures had been helpful, but in 3 the results had been misleading, giving rise to false diagnoses in all 3 of these and in false treatment in 1 of these 3 patients

In 9 patients the diagnostic methods had been inadequate and had resulted in wrong treatment in 6 instances Statistical analysis was performed to study the relevance of the different factors investigated in this study This analysis in regard to accuracy of diagnosis or correctness of treatment showed no statistically significant dependence on the factors sex, age, time before operation (since admission to hospital), duration of hospital admission (before death) and year of death Several types of clinical diagnoses were also tested for their influence on accuracy of diagnosis and treatment no diagnosis dependent relationships could be detected with chi-square tests (all p-values >0.05) The presence of any iatrogenic complication was not significantly related to any inaccuracy of diagnosis or incorrect treatment either

A few factors proved to have statistically significant influence on correctness of treatment These were prognosis on admission, the occurrence of sudden death, the abstaining from treatment in 'lost cases' and the presence of inadequate or failed diagnostic methods

Patients with a poor prognosis on admission had undergone fewer incorrect therapies than the patients with unclear prognosis on admission (p=0.008) The occurrence of sudden, unexpected death was associated with a significantly higher number of treatment failures (p=0.02), as was the occurrence of inadequate diagnostic methods (p<0.001)

Abstaining from treatment in 'lost cases' never led to any incorrect management, which was significantly better than in cases with full treatment till the end ($p=0.03$).

For accuracy of diagnosis no statistically significant factors could be detected, except from the presence of failed diagnostic measures.

IV.4 Discussion

From the results of the analysis of the postmortem examination in deceased cancer patients it may be stated that the accuracy of important primary or secondary diagnoses is hardly any better than in previous studies. In 48% of the 77 patients all diagnoses were correct, comparable with the figures mentioned in the literature: approximately 60% of all diagnoses correct.^{3,4,5,6} One case of unrecognized malignancy was only found at autopsy, but 14% of cases had a wrong primary diagnosis. This result is an improvement on the figures of Wells and Stevanovic who found 20-25% of cancers only at autopsy and a total of 42% inaccurate diagnoses of malignancies.^{1,2}

Patients admitted for surgical treatment of cancer usually suffer from a localized malignancy. Our study presents a large number of gastro-intestinal malignancies. The fact that incorrect diagnoses of malignancies in surgical patients are found less often than in medical patients, could be due to the fact that surgeons often deal with solid tumours and the opportunity to diagnose at operation. It is, however, a known fact that cancer of the pancreas can be difficult to diagnose. In some patients with a palpable mass at laparotomy, histologic confirmation of the clinical diagnosis can not be obtained, despite biopsies under direct vision. Gudjonsson reported the error in diagnosis of pancreatic carcinoma by inspection or palpation alone at laparotomy to be as large as 25%.⁷ In this study, only 36% of cases had a tissue diagnosis of pancreatic carcinoma before death. In the 1970's, the reported rate for partial pancreatectomy for non-malignant pancreatic processes was 10-20%.

The 'missed' diagnosis of pancreatic carcinoma is also found by other authors.^{2,8,9,10} Stenbäck, in a study with an autopsy percentage of 94%, had a detection rate for pancreatic carcinoma of 37%.¹¹ These same studies as mentioned above, report the difficulties involved in diagnosis of bronchial carcinoma. In these cases, widespread metastases with a small primary tumour can be the underlying cause of the inaccuracy.

A recent autopsy study by Le Chevalier et al. showed that pancreas and lung were the most frequently encountered primary sites of malignancy in patients that died due to metastasis of a clinically not localized primary tumour.¹² As far as metastases are concerned, the extent of metastatic disease as found at postmortem examination depends to a certain degree on the accuracy of and the time spent in the gross examination, the number of organs examined and the number of excisions obtained from each organ. Clearly, a positive finding at autopsy has a greater meaning than a negative one.¹³

The total number of patients that showed an inaccuracy in diagnosis with clinical relevance was 10% (8/77). Two further patients received wrong treatment despite proper diagnoses. This means that in at least 1 out of every 10 cancer deaths in a surgical unit, relevant information can be obtained from postmortem examination.

The diagnosis of bronchopneumonia is frequently missed in the clinical situation, especially in patients who are severely ill or suffer from tumour cachexia. Stevanovic found a detection rate for bronchopneumonia of only 47%. Often the pneumonia is still the 'old man's friend', but patients

are not admitted to a surgical department or submitted for surgery to succumb due to treatable complications.

However, often the bronchopneumonia appears in the terminal phase of the disease process. Gastric contents in the air passages were found regularly at autopsy, most likely as a result of aspiration. Further clinical diagnostic examinations are apparently not very accurate in the terminal stage. Pulmonary embolism is clearly a difficult clinical diagnosis, often being confused with myocardial infarction. In cancer patients, the reported detection rate for pulmonary embolism was 16% and for myocardial infarction 76%.² Our figures were 30% and 33% respectively. Pulmonary embolism occurred in our patients despite a policy of the routine use of subcutaneous heparin as prophylaxis.

Severe bleeding was a frequent complication in our group of patients, being the direct cause of death in 9/77 patients. Apparently the diagnosis is also easily missed, especially when from the gastro-intestinal tract due to gastric erosions or peptic ulcers.² The other cases of fatal haemorrhage were mostly due to intra-abdominal bleeding in severe abdominal sepsis. Almost invariably, these patients were in a very poor general condition, admitted to the intensive care unit. In this group of cancer patients it appears that certain problems of a surgical nature were usually readily detected in a surgical department: leaking intestinal anastomosis, abdominal sepsis and Multiple Organ Failure had high sensitivity ratios.

The higher rate of accuracy in the younger age group, as found by other authors, could not be substantiated in the present study.^{11,14} The reported increase in accuracy for cancer patients with a longer hospital stay could not be found.¹¹ In contrast with this, Hartveit found an inverse relationship between duration of hospital stay and accuracy of diagnoses in cancer patients.¹⁵

Conclusions to be drawn from the statistical relevance of some of the reported factors in this study do not appear to be easy. It seems that the discrepancies between clinical diagnosis and postmortem diagnosis are not very alarming at individual patient level, but it is fortunate to observe that no treatment failures have occurred in clinically 'lost cases'. At the same time, patients with a poor prognosis from the start, suffered significantly less from incorrect therapies. The fact that instances of inadequate diagnostic methods frequently received incorrect treatment could have been anticipated. Sudden, unexpected death is apparently also associated with a higher failure ratio.

Approximately 11% of all patients, whose deaths are clinically attributed to cancer, undergo autopsy.¹⁶ Although this rate and the autopsy rate in our present study (51%) are below 65% as the suggested minimum¹⁷, above results indicate that autopsies in cancer patients still need to be emphasized; more so when new treatment strategies and new diagnostic imaging techniques are developed in the surgical management of localized cancers. In 1980, Cameron et al. already suggested to try to reach a 20% higher autopsy rate than the present one.¹⁸ Necessary fallibility and surgical error can only be clearly defined by increased autopsy rates.^{17,19}

IV.5 Conclusion

Even in a surgical department, with a well defined group of cancer patients, many diagnoses of important primary and secondary lesions are still missed in the clinical situation. In patients with solid tumours, the malignancy is usually not completely missed, but often incorrectly diagnosed. It is important to realize that cancer of the pancreas and of the bronchial tree can sometimes be difficult to diagnose. It seems even more important to be aware of the common complications of malignant disease and surgery in elderly patients: bronchopneumonia, pulmonary embolism, myocardial infarction and gastro- intestinal bleeding. Many of these complications occurred in severely ill patients or even in those with 'do not resuscitate' orders, but at the same time these complications may be preventable or treatable.

The presence of sudden death and the inadequate use of available diagnostic methods were associated with incorrect treatment strategies.

From the figures presented here, it is concluded that in at least 10% of cases of surgical cancer deaths in hospital, valuable information can be obtained from postmortem examination. The number of cases with unsuspected relevant diagnoses, whether missed or inaccurate, is probably as high as 50%. According to this analysis in cancer patients, a selection of cases sent for autopsy will give the surgeon a false feeling of confidence in the clinical process. The 'state of the art' calls for regular quality assessment.

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QUALITY CONTROL IN TRAUMA PATIENTS; WHY THE AUTOPSY?

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European Journal of Surgery, *accepted for publication*

V.1 Introduction

Few authors doubt the accuracy of clinical diagnoses in trauma patients. In some instances trauma deaths are only evaluated by a forensic pathologist for medico-legal purposes. As was shown in other groups of patients, even from surgical departments, autopsy can add to the insight in accuracy of diagnosis and management.^{1,2} In fact, postmortem studies have shown quite a number of discrepancies between clinical and autopsy findings. A few studies describe an evaluation of general trauma care according to autopsy studies.^{3,4,5}

This study on the correlation between clinical and autopsy findings in trauma patients, admitted to a general surgical or intensive care unit, was done to assess the value of the autopsy for the purpose of audit in trauma patients.

V.2 Patients and methods

In the 10-year period, from 1977-1987, a postmortem examination was requested for almost every patient who died in the Department of General Surgery in the Nijmegen University Hospital. Trauma cases were treated by this department, even when admitted to the intensive care unit. Approximately 500 trauma cases per year were admitted for their injuries in the period mentioned above. Patients with isolated cerebral injury were attended to by neurologists or neurosurgeons, but also initially assessed by a trauma surgeon. In the Netherlands an autopsy can only be performed after consent from the relatives, unless special medico-legal problems exist. Forensic cases and patients who were dead on arrival were excluded from this series.

A number of patients had been referred to the University Hospital for special trauma care and are included in the study. The accuracy of the diagnoses and the correctness of treatment prior to admission to our hospital could not be fairly judged.

Clinical notes were compared with autopsy results. All cases that showed discrepancies between clinical and postmortem findings were discussed with a senior surgeon and a senior pathologist. The accuracy of the primary diagnoses and the diagnoses of the complications of the first lesions or their treatment were considered. Diagnostic procedures were also studied, as well as the accuracy of relevant contributory diagnoses.

Statistical analysis by Chi-square tests for unpaired data was done by the unit of Mathematical Statistical Advice of the University of Nijmegen. False negative and false positive cases were counted and sensitivity and specificity of clinical diagnoses were assessed.

V.3 Results

In the period 1977-1987 autopsy was performed in 56 trauma patients, in whom case notes were evaluable by retrospective analysis. That is an estimated 40% of all the trauma patients who died in that period. Twenty patients were women, 36 were men. The mean age for this group of patients was 50.4 years (range 14-93 years). Twenty patients were below the age of 40 years, 18 patients were older than 70 years of age. The autopsy percentage for all surgical patients in this period was 51% (range over the years 36% - 62%).

Polytraumatized patients, with significant injury to more than 1 organ system, comprised a large proportion of this group. 32 cases. Isolated cerebral injury with or without insignificant extremity injury, occurred in 11 patients. Three patients had isolated blunt abdominal injury and another 3 patients had isolated blunt thoracic injury. Five patients had isolated hip or bony pelvis injury,

1 patient had burns and 1 patient with a direct traumatic bursitis died due to deep vein thrombosis with pulmonary embolism.

In 30 patients out of 56 an operation was performed: in 21 within 4 hours. In 26 patients an operation was not performed due to the absence of a clinical indication.

In 15 patients the prognosis on admission was good, in 24 patients the prognosis was judged to be poor. Five patients died during operation, 4 patients due to massive haemorrhage and 1 patient due to cerebral injury with early Adult Respiratory Distress Syndrome. In 2 patients treatment was withheld in the terminal phase of severe traumatic brain damage; both died due to septic complications for which no antibiotics were given. In 17 patients the prognosis on admission was unclear.

In 31 patients of 56 (55%), all clinical diagnoses were correct as compared to autopsy results (figure V.1). Despite correct diagnoses, incorrect treatment was given to 4 of these 31 patients.

The diagnoses of the primary injuries were correct in 52 patients (93%) (figure V.1). In 4 instances, each with multiple trauma, a primary injury was missed and in 3 of these led to incorrect treatment (table I).

The diagnoses of complications of the primary injury or its treatment was correct in 36 patients (64%) (figure V.1). In 20 patients an error occurred in the diagnoses of complications. The types of missed diagnoses of complications are shown in table II. Missed complications led to incorrect treatment in 2 cases: 1 case of missed deep vein thrombosis and resulting pulmonary embolism and 1 case of missed intra-abdominal bleeding 5 days after liver rupture (haematoma).

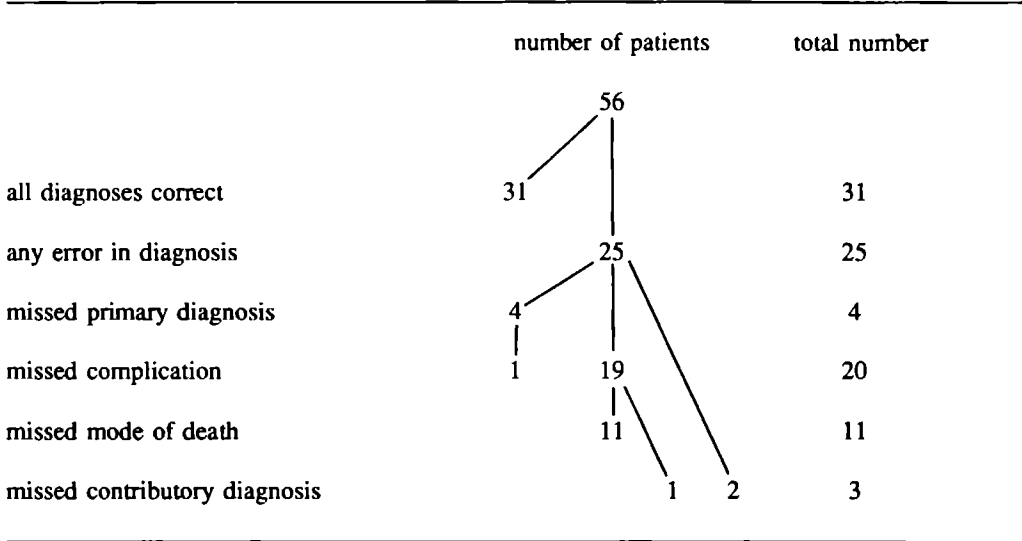


Figure V.1: Flow diagram: cases with error in different categories of diagnoses.

Table I: Missed primary diagnoses (n=4).

DIAGNOSIS	NUMBER OF PATIENTS
Left subclavian artery rupture	1
Liver rupture	1
Haemothorax	1
Intra-abdominal/retroperitoneal bleeding	1

The mode of death was correctly interpreted in the clinical situation in 45 patients (80%) (figure V.1). The diagnosis of the direct mode of death was incorrect in 11 patients, always in combination with a missed complication of the primary process. Unexpected death occurred in 9 patients, the underlying cause being pulmonary embolism in 4.

In 53 patients (95%) the diagnosis of a relevant contributory disease was correct (figure V.1). In 2 patients the presence of a significantly large astrocytoma was unknown until autopsy and in 1 patient severe obstructive airway disease and coronary insufficiency led to cardiorespiratory failure.

Table II: Missed clinical diagnoses of complications (n=20).

DIAGNOSES	NUMBER OF PATIENTS
Pulmonary infections	8
Other septic conditions	3
Pulmonary embolism	3
Adult Respiratory Distress Syndrome	2
Other non-septic conditions	4

According to assessment by postmortem examination the treatment was incorrect in 8 patients. In 4 of these, all diagnoses had been correct. Retrospectively, death had probably been preventable in all 8 patients. Table III shows which treatment errors occurred. Missed major haemorrhage was most important in the early stage of treatment in these cases of probably preventable death. The initial injuries at admission were thought to infer a good prognosis in 5 patients. The Injury Severity Scores (ISS) of these 5 patients were: 1, 4, 20, 38 and 43 in order of severity, but assessed with inclusion of the postmortem results. The 2 cases with low ISS were elderly patients. The prognosis had been unclear in 3 patients. The ISS of these 3 patients were: 18, 24 and 50 respectively.^{6,7}

Diagnostic procedures were correct and helpful in 50 patients. In 2 patients the results of the diagnostic methods, although properly used, were misleading. However, no treatment error occurred in these 2 cases. Diagnostic procedures were inadequate in 4 patients of 56. In all 4 patients this led to treatment failure. These were 3 instances of incomplete assessment of blood loss and 1 instance of an insufficient attempt to diagnose deep vein thrombosis.

Table III: 8 cases of wrong therapy and 'time since arrival' .

TYPE OF ERROR	TIME SINCE ARRIVAL
Failure to operate ruptured subclavian artery during laparotomy for splenic rupture	hours
Failure to operate ruptured liver/spleen	hours
Failure to insert chest drain in tension pneumothorax	hours
Failure to operate ruptured liver	5 days
Failure to heparinize in DVT/pulmonary embolism	hours
Heparin dosage too low in DVT/pulmonary embolism	7 days
Inadequate drainage of ileus/aspiration of food	8 days
Antibiotics given too late in bronchopneumonia	3 weeks

Iatrogenic factors contributed to the morbid events in 3 patients. These were not necessarily preventable: 1 case of leaking gastro-intestinal anastomosis after partial gastric resection for bleeding stress ulcer, 1 case of femoral vein thrombosis associated with intravenous catheter placement and 1 case of probable hypoglycaemia and aspiration of bowel contents in a patient with insulin infusion therapy.

Death due to brain damage occurred in 15 patients and was falsely attributed to it in another 3 patients: sensitivity or detection rate in the clinical situation was 100%, the specificity was 93%. Bronchopneumonia as a postmortem diagnosis was found in 20 patients, but only 14 of these were detected clinically. Two false positive diagnoses occurred. Sensitivity and specificity were 70% and 94%, respectively.

Thrombotic pulmonary embolism as an autopsy diagnosis was found in 5 patients, although 3 were missed clinically. In 2 further cases the diagnosis was made without postmortem confirmation. Sensitivity was 40%, specificity 96%. Heparin in adequate prophylactic dosages (twice daily 5000 U subcutaneously) was given to 4 patients, but in 3 instances out of these 4 deep femoral vein thrombosis was found at autopsy. The 5th patient with pulmonary embolism, a case with blunt chest trauma, received inadequate thrombosis prophylaxis.

Abdominal sepsis was clinically diagnosed in 4 patients, with only 3 cases confirmed at autopsy. Myocardial infarction was diagnosed in 2 patients, confirmed at autopsy in 1 case.

Diagnoses like Multiple Organ Failure (11 patients), and upper gastro-intestinal bleeding (2 patients) were never incorrect. Fatal haemorrhage, as a clinical entity, was discovered in each case (8 patients), although treated inadequately in 4 instances.

Brain damage was the direct mode of death in 15 patients, thereby being the most common single cause of death. Severe haemorrhage was the direct mode of death in 8 patients.

Fourteen patients died within 24 hours after admission to hospital. Out of these 14, 5 patients died due to severe haemorrhage and 6 due to brain injury. No cases of septic complications were encountered in this group. Fourteen patients died after more than 1 day of hospital admission but within 1 week: 5 cases of death due to brain damage, 2 with severe bleeding and 5 in whom septic complications played a major role.

Twelve patients died in the 2nd week of admission to hospital. Six (50%) suffered from septic complications, such as bronchopneumonia and abdominal sepsis. Death was still caused by brain injury in 4 patients in this group.

Septic complications and associated Multiple Organ Failure (MOF) were most commonly found in patients who died after the 14th day of admission: 15 patients out of 16 cases (94%).

Statistical analysis showed that the factors age, sex, time before operation (since admission to hospital), duration of hospital admission (before death) and year of death, had no statistically significant influence on clinical accuracy in diagnosis and therapy.

A few apparently significant relationships could be detected. Incorrect treatment had occurred more often in patients with iatrogenic complications than in those without ($p=0.008$). Treatment failure was also significantly related to erroneous diagnostic procedures ($p<0.001$) and the presence of the clinical diagnosis 'fatal haemorrhage' ($p=0.043$). The clinical diagnosis of death due to brain damage was significantly associated with correct treatment ($p=0.035$).

A significant dependence of accuracy of diagnosis could not be detected for any of the above mentioned factors.

V.4 Discussion

The autopsy rate in the Netherlands in trauma victims is between 10 and 20%.⁸ This rate is influenced by the fact that a relative's consent for autopsy is still required, unless the case is subject to coroner's investigation. Draaisma already stated that management errors occurred in 38% of trauma fatalities with preventable death being a general phenomenon in any hospital.⁸ These figures were derived from comparative studies together with autopsy reports.

Other studies have shown that inaccuracy of diagnosis occurs in approximately 30-40% of cases in a group of patients with mixed diseases. Error of management with adverse impact on survival, is stated to occur in approximately 10% of cases.^{9,10}

Some studies have indicated that autopsies in trauma victims could contribute to improvement in trauma care. This applies to general trauma care, for example referral of polytraumatized patients to specialized trauma centres.^{8,11} It also applies to care for individual cases: aggressive shock treatment, early stabilisation of fractures and prevention of thrombo-embolic complications.^{8,12,13,14} Error in diagnosis of the primary injury, according to autopsy findings, occurred in 4 out of 56 patients. However, error in diagnosis of complications occurred much more frequently (36%).

Septic complications were most important in contributing to the disease processes: 20 patients suffered from bronchopneumonia and 4 suffered from abdominal sepsis, a total number of 22 cases. Multiple Organ Failure (MOF) was present in 11 patients, 9 of these with a septic complication detectable at autopsy, one with previous sepsis but undetectable at autopsy and one with MOF due to severe injury.

Previous studies have indicated that death in trauma victims after admission to hospital is to a large extent caused by septic complications. Goris showed that death more than 7 days after blunt injury was caused by sepsis in 88% of his patients.¹² This is particularly true for cases of prolonged duration of intensive care management.

It appears to be likely that septic complications occur more frequently than several years ago. Modern surgical and traumatological practice led to survival of patients, who did not survive their trauma or its early complications in the past. With aggressive management, death due to early respiratory failure or acute renal failure, is not seen frequently any more. Probably also as a consequence of invasive monitoring techniques, sepsis nowadays has a chance to develop in trauma patients, despite the availability of many antibiotics.

The Orange County study showed that an autopsy study could lead to changes in trauma management.¹¹ The percentage of potentially salvageable deaths dropped from 73% to 9%.

According to the literature, the most frequently encountered management error for a group of hospitals, with different levels of trauma care, was failure to operate on patients with severe haemorrhage on arrival.^{8,11} In our series, death which could probably have been prevented, as assessed by postmortem examination, occurred in 8 cases (14%).

The present analysis did not demonstrate any significant relations between age, sex, duration of hospital stay, year of death on the one hand, and the accuracy of diagnosis and treatment on the other. Time lapsed before operation, as indicated by the clinical circumstances, was not significantly associated with accuracy of diagnosis and treatment either.

Treatment failure was significantly more frequent in patients with iatrogenic factors than in those without. The relationship between inadequate diagnostic procedure and treatment failure is quite understandable. The occurrence of fatal haemorrhage was significantly associated with treatment

failure. There was also a positive correlation between brain death and correct treatment which, of course, does not show any causal relation. It might only demonstrate lack of proper treatment strategies in severe brain injury and also the absence of treatment error for concomitant injuries or complications. In general, treatment failure was mainly associated with complications of the primary injuries.

Error in treatment, also designated as 'preventable deaths', occurred less frequently than error in diagnosis. Apparently, a missed diagnosis is not always relevant to the course of the disease. However, it leads one to think of the number of inaccuracies in death statistics and some accident statistics. Bias may have occurred in selecting cases for postmortem examination, although permission from relatives was routinely asked for in each case. Other studies have shown that selection of cases plays hardly any role in the outcome of these observations.¹⁵

Incorrect diagnosis and incorrect treatment occurred as frequently in trauma patients as in other groups of patients, and probably also as frequently as many years ago, although historical studies on this subject in trauma patients are unknown to us.

According to these and previous results, a plea should be made for autopsies in trauma victims, and not only for medico-legal purposes. The American College of Surgeons suggested the institution of a national Trauma Registry, in which autopsy data could be entered for research purposes.¹⁶ Registration of only medico-legal autopsy data would be insufficient because of the possible lack of clinical orientation by the forensic pathologist.¹⁴ Even recently, a plea for more autopsies in trauma victims in the Netherlands was made by Raaymakers.¹⁷ A national or international (European) Trauma Registry could be of value for quality control in major trauma care. A large contribution to this registration should be presented by autopsy analyses. For purposes of audit in major trauma care, the autopsy remains a most valuable tool.

V.5 Conclusion

The comparison of hospital records with autopsy findings in fatal trauma cases revealed a number of inaccuracies in diagnoses and a number of deaths which were probably preventable (14%). Septic complications were the most common causes of death in this group of patients, followed by brain damage and severe haemorrhage. Septic complications usually occurred after the first week of admission.

In 55% of cases all clinical diagnoses were correct. Most frequently missed were bronchopneumonia and the site or the clinically estimated amount of severe haemorrhage. Fatal haemorrhage was the most common preventable cause of death.

A significant relationship was found between iatrogenic complications and treatment failure. A similar relationship was found for inadequate diagnostic procedures and wrong treatment as well as for severe haemorrhage and wrong treatment.

A repeated plea should be made for autopsies in trauma fatalities, preferably performed by clinically orientated pathologists. The autopsy should be used for regular quality assessment in trauma care.

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AUTOPSY ANALYSIS IN PATIENTS WITH VASCULAR DISEASES

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Human Pathology 1992;23:178-182

VI.1 Introduction

Many investigators have expressed their concern about the accuracy of clinical diagnosis in their patients, and several articles in the past and present literature describe errors in clinical diagnosis as compared with the findings at autopsy.^{1,2,3} Assessment of the accuracy of the clinical diagnoses and the correctness of treatment, as compared with postmortem findings, has rarely been reported for surgical patients. In patients who were admitted for vascular surgery, this comparison of clinical data with autopsy findings has, to our knowledge, never been presented. We report our analysis of the accuracy of clinical diagnoses and therapy in patients who died after vascular surgery and were autopsied.

VI.2 Patients and methods

In the 10-year period from 1977-1987 a postmortem examination was requested for almost every patient who died in the General Surgical Department or in the Department of Vascular Surgery at the Nijmegen University Hospital. Autopsy was performed only after consent from relatives. In these cases clinical notes were compared with autopsy results. All cases that revealed discrepancies between clinical diagnosis and postmortem findings were discussed with a senior surgeon and a senior pathologist.

Presented in this report are patients who were admitted for noncardiac vascular surgery or its sequelae, as well as a small number of patients with inoperable arterial disease. All patients suffered from atherosclerosis. During the 10-year study period 3946 vascular operations were performed. We studied the accuracy of diagnosis of the primary disease, the complications of this primary disease, and the mode of death. Treatment and diagnostic procedures were evaluated in the light of autopsy findings. Relevant contributory diagnoses, not related to the primary disease, were also considered in this study.

Statistical analysis was performed by the Unit of Mathematical Statistical Advice of the University of Nijmegen using Chi-square tests for unpaired data. Sensitivity and specificity of clinical diagnoses were assessed after defining cases of false negative and false positive clinical diagnoses, as compared with autopsy diagnoses.

VI.3 Results

The mean autopsy percentage for the 10-year period was 51% (range 36%-62%) for the General Surgical and Vascular Departments, but the percentage for the Department of Vascular Surgery was between 30%-40%. In 68 autopsied cases a vascular disease had been the reason for admission and the primary diagnosis.

The mean age for this group of patients was 68.7 years (range 50-87 years). The group consisted of 56 men and 12 women.

In these 68 patients atherosclerosis had been the underlying disorder, presenting as arterial stenosis, occlusion, or aneurysm. In 24 patients the primary clinical diagnosis had been acute rupture of an abdominal or thoracic aneurysm. Four of these 24 patients developed rupture of the aneurysm during the hospital stay but could not be saved by emergency measures. In nine patients with an abdominal aneurysm elective surgery had been performed, but these patients died due to severe complications. In 12 cases elective surgery had been performed for stenosis or occlusion of the aorta or iliac arteries. In five cases an elective femoral bypass procedure had been carried out.

In nine patients who died and on whom autopsy had been performed, the principal process had been clinically diagnosed as acute thromboembolic occlusion of the aorta, iliac arteries or femoral arteries. In four cases aorto-enteric fistula had been the clinical diagnosis. In each of these cases a vascular prosthesis had been implanted several years previously.

In two cases rupture of a false aneurysm had been the underlying cause of death, one case being diagnosed clinically and the other being diagnosed at autopsy. In two cases infection of an aortic bifurcation prosthesis 3 and 6 years after implantation, respectively, had been the clinical diagnosis. Finally, one patient whose peripheral vascular disease led to the performance of a lumbar sympathectomy died due to postoperative complications.

Of these 68 patients, 17 were considered initially to have a good prognosis. Twenty-seven patients were considered to have a poor prognosis from the time of admission onward, either due to the severity of the primary vascular disease or to the general condition, with additional disease. Six patients received no further treatment because they were clearly in the terminal phase of their disease.

In 24 cases the prognosis was assessed as being 'unclear'. Seven cases of the 68 patients were not operated on for a variety of reasons.

In 36 of the 68 cases, all clinical diagnoses had been correct as compared with the autopsy results (53%). In 32 cases one or more incorrect diagnoses were found. A flow diagram shows the cases with incorrect diagnoses (figure VI.1).

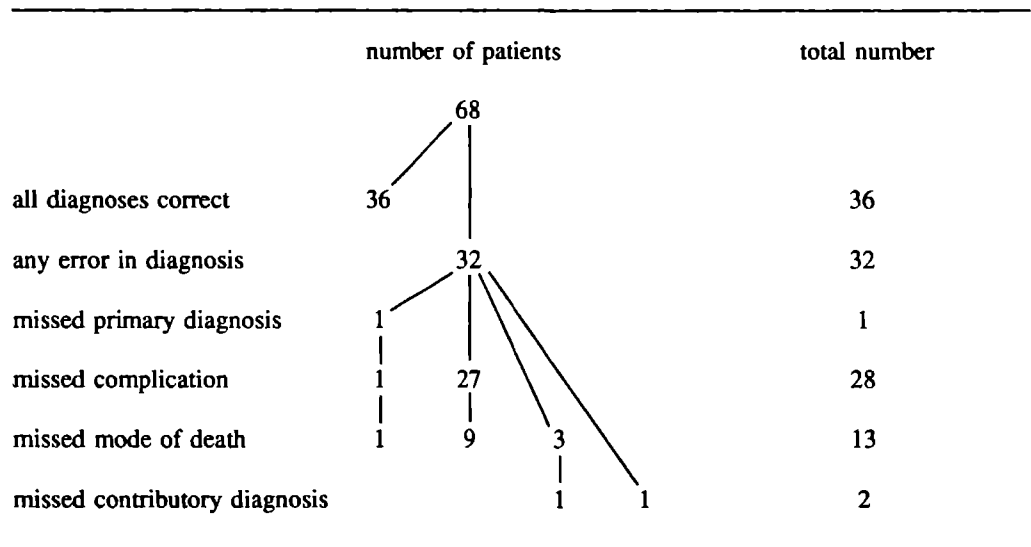


Figure VI.1: Flow diagram: cases with error in different categories of diagnoses.

The primary diagnosis had been correct in 67 cases and incorrect in one case. The latter case was a 61-year old man who presented with a painful swelling in the groin 9 years after an aorto-iliac bypass graft. The clinical diagnosis had been an acute infection involving the spermatic cord and epididymis, but after a few hours the patient died in shock. At autopsy, a false aneurysm that had formed at the distal anastomosis of the bypass graft was found to have ruptured retroperitoneally. Obviously, this missed primary diagnosis had been relevant to the course of the disease and to the treatment of this patient with an initially good prognosis.

The diagnosis of complications of the primary disease had been correct in 40 cases (59%) and incorrect in 28 cases (figure VI.1). In 18 cases error had occurred as a single discrepancy; in nine cases error had occurred together with missed mode of death. The missed diagnoses of complications, a total of 31, are shown in table I. The fact that a complication of the primary disease had been missed led to incorrect treatment in 11 patients.

Correct diagnosis of mode of death occurred in 55 cases (81%). The mode of death was missed in 13 cases (figure VI.1). Fatal bleeding had not been recognized as the mode of death in four cases.

Death had been sudden and unexpected in 11 cases. Of these 11 cases, the mode of death had been incorrectly diagnosed in three cases. Table II shows the causes of sudden, unexpected death.

Table I: Missed clinical diagnoses of complications (n=31 in 28 patients).

DIAGNOSES	NUMBER
Severe haemorrhage	9 (7 fatal)
Bronchopneumonia	5
Myocardial infarction	5
Pulmonary embolism	3
Infarction after aortic prosthesis	
mesenteric	1
renal	2
Miscellaneous	6

Table II: Immediate causes of sudden death (n=11).*

DIAGNOSES	NUMBER OF PATIENTS
Fatal haemorrhage	5
Myocardial infarction	4
Bronchopneumonia	1
Pulmonary embolism	1

* autopsy diagnoses

In 66 cases the diagnosis of a relevant contributory disorder had been correct (97%). In two cases the presence of a thoracic aneurysm, which ruptured during hospital admission for elective surgery for obliterating atherosclerotic disease, was missed.

Treatment was incorrect, as shown by postmortem examination, in 15 patients (22%). Of these 15 cases, all diagnoses had been correct in three. The omission of treatment or the application of incorrect treatment was harmful to the course of the disease in nine cases and doubtful in another six cases. Of the cases with incorrect treatment, eight had a good prognosis initially. The cases with incorrect treatment are shown in table III.

In 62 patients the diagnostic procedures were performed correctly and the results were helpful in the clinical process. In two cases the results of correctly performed diagnostic procedures had been overtly misleading, which led to treatment failure in one case.

Diagnostic methods had been inadequate or insufficient in four cases, which led to incorrect treatment in three patients.

Abdominal sepsis occurred in 11 cases and was correctly diagnosed in each. In five of these cases bronchopneumonia had played an important role in the clinical course. Graft infections were the underlying cause of the abdominal sepsis in five of 11 cases, with the infection in three cases due to aorto-enteric fistulas.

Pulmonary embolism was clinically diagnosed in one patient but not confirmed at autopsy (false-positive). In three patients the diagnosis of pulmonary embolism was made only at autopsy (false-negative). The specificity for this diagnosis was 98%. Prophylactic heparin or coumarin derivatives were routinely given to all patients, but were discontinued in one of the three cases with missed pulmonary embolism.

Bronchopneumonia was missed in five of 21 cases, as found at autopsy, a sensitivity rate of 76%. One false-positive case occurred, a specificity rate of 98%. Bronchopneumonia was not found in any of the cases in which treatment had been withheld in the terminal phase.

Myocardial infarction occurred almost as frequently as bronchopneumonia in this group of patients. In 17 cases, of which 12 were diagnosed prior to death, this diagnosis was made at autopsy. The sensitivity rate was 71% and the specificity rate was 88% (six false-positive cases).

Table III: Cases of incorrect treatment (n=15).

TYPE OF ERROR	NUMBER OF PATIENTS
Failure to reoperate in case of leaking vascular anastomosis	5
Failure to operate in case of aorto-enteric fistula	1
Failure to give antibiotics in case of bronchopneumonia	3
Failure to reoperate in case of peritonitis/duodenal bleeding	2
Insufficient prevention of stress ulcers	2
Heparin stopped 1 week before fatal pulmonary embolism	1
Surgery for abdominal aneurysm performed too late	1

Fatal haemorrhage is apparently a frequently occurring problem in this group of vascular patients; there were seven false-negative cases of a total of 21 cases found at autopsy (sensitivity rate 67%). There were no false-positive cases (specificity rate 100%). Of the 21 cases of fatal haemorrhage, nine were due to abdominal aneurysms, four to thoracic aneurysms, and two to thoraco-abdominal aneurysms. Upper gastro-intestinal ulcer bleeding had been the cause of the fatal haemorrhage in two cases, aorto-enteric fistulas in another two cases, and ruptured vascular anastomosis in two cases. Uncontrollable haemorrhage occurred in three of the 21 patients during emergency laparotomy.

Multiple Organ Failure (MOF) was clinically diagnosed in 12 patients; the diagnosis was confirmed by the postmortem examination in all 12 cases. In seven cases MOF was associated with abdominal sepsis; in five cases bronchopneumonia had been present in combination with MOF. In eight of the 68 patients, iatrogenic causes contributed to the morbid events that ultimately led to death. These iatrogenic factors were as follows: two cases of early leakage of a vascular anastomosis, two cases of complications after angiography and four cases of other complications.

Statistical analysis was performed to identify factors that were relevant to the accuracy of diagnosis and treatment. The following factors were tested for statistical significance: sex, age, time prior to operation (since admission to hospital), duration of hospital stay (before death), and year of death. With Chi-square tests no statistically significant dependence on any of these factors could be detected.

No specific type of autopsy diagnosis was statistically related to inaccuracy of diagnosis or treatment. The effect of iatrogenic complications, the occurrence of sudden unexpected death, and the abstinence from treatment in terminal cases were also tested for their relationship to accuracy of diagnosis and treatment; no statistically significant dependence was found.

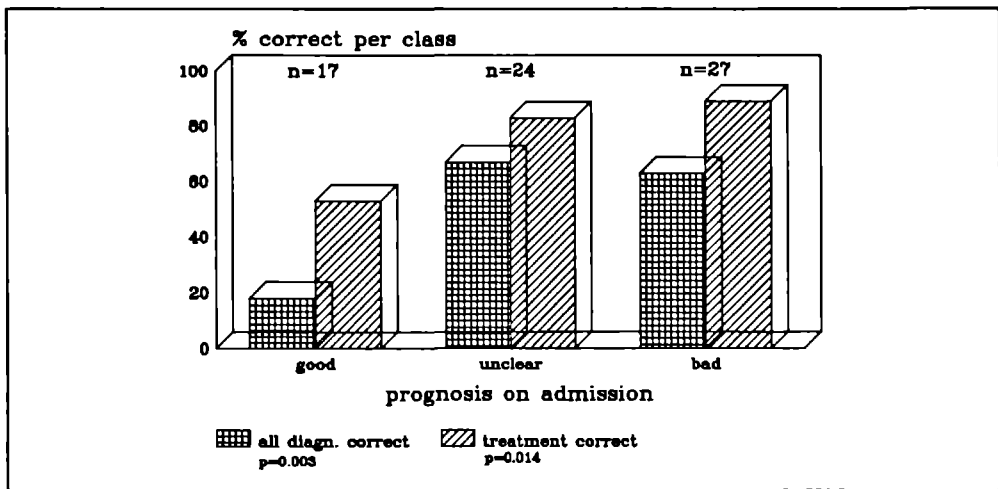


Figure VI.2: Influence of prognosis on admission on accuracy of clinical diagnosis and treatment.

The only factors that proved to be significantly related to accuracy of diagnosis and treatment were prognosis on admission (figure VI.2) and the use of inadequate diagnostic methods; the latter factor showed significance only for accuracy of treatment. Patients with an apparently good prognosis on admission, but who died during the course of the disease during hospital stay, had suffered significantly more frequently from error of diagnosis ($p=0.003$) and incorrect therapy ($p=0.014$). Patients in whom the diagnostic methods were performed correctly with helpful results had fewer treatment failures ($p=0.017$).

According to postmortem findings, abstinence from treatment in terminal cases did not lead to any errors in management.

VI.4 Discussion

The results of this analysis of postmortem examinations in deceased patients who were admitted for vascular surgery show that the clinical diagnosis of the primary vascular disorder had been correct in most instances (only one failure). However, the diagnoses of complications of this primary disease or its surgery had been incorrect in a number of cases.

Misdiagnosis occurred in 41% of cases. This figure corresponds very well with the error rates that are reported in the literature for a group of patients with mixed diagnoses from different departments.^{1,2,3} Missed major diagnoses with an adverse impact on survival have been shown to occur in approximately 10% of cases.

Complications that were most frequently missed were severe haemorrhage (nine cases, of which seven were fatal), bronchopneumonia (five cases), myocardial infarction (five cases), and pulmonary embolism (three cases) (table I).

Apparently, this group of patients is quite susceptible to unexpected and sudden events that lead to death; patients with vascular surgical disorders are usually of an advanced age and atherosclerosis is of a systemic nature in most of them.^{4,5,6} Many investigators state that most deaths are due to coronary or cerebrovascular disease.^{7,8} In patients admitted for acute arterial occlusion the mortality rate is still 15-30%, reflecting the underlying pathology.^{9,10}

A very important cause of death in our group of patients was severe haemorrhage, which occurred in 21 cases, of which seven were missed. Nine of these cases were due to ruptured aneurysms; seven of these were properly diagnosed but too massive to be saved by emergency surgery. Twelve occurred in the postoperative period, of which five were missed (three early anastomotic failures and two late failures).

Bronchopneumonia had been a major contributing factor in the events leading to death in 21 cases. Abdominal sepsis occurred in 11 cases; in five of these, bronchopneumonia was also present. Thus, a total of 27 patients suffered from infectious complications of vascular surgical disorders and treatment.

Sepsis, bronchopneumonia, and the associated MOF apparently play a more important role than in the past in the causes of severe morbidity and mortality in patients who undergo vascular surgery. Whereas associated atherosclerotic disease of coronary and cerebral arteries was the main cause of death a decade ago, mortality due to infectious complications has become more frequent according to our findings. Pulmonary complications of vascular surgery are rarely mentioned in the literature.^{6,7,10} Pulmonary disease, however, is one of the major limiting factors in patients with prolonged smoking habits who undergo vascular surgery.¹¹

This discrepancy with previous study results may be a reflection of the changing population of patients undergoing operation; many patients are older or more debilitated when accepted for surgery than was the case several years ago. The mean age at death of the patients in the first 3 years of this study was 65.7 years; it was 70.7 years in the last 3 years of this study.

Prolonged survival with invasive monitoring and support could also lead to the septic complications that are seen more and more frequently in major surgical cases. The increase in the number of septic complications of surgical procedures is a phenomenon also recognized in other fields of surgery.¹² Goldman et al. reflected on the increase in the number of systemic infections found at autopsy in the 1980s in a general hospital population.¹³

A second explanation for discrepancy with previous reports could be the inaccuracy of the clinical diagnostic process in several of these studies. Even in a mixed hospital population, circulatory disorders were most commonly overdiagnosed, although some underreporting occurred as well.^{2,14,15} Engel et al. reported a confirmation rate for acute myocardial infarction in a hospitalized population of 57% and Zarling et al. found correct antemortem diagnoses of acute myocardial infarction in only 53% of autopsy cases.^{14,16} According to Cameron and McGoogan, there is little doubt that myocardial infarction and its abbreviation 'AMI' are commonly used as convenient labels when the cause of an unexpected death is not known.¹⁵

Iatrogenic complications that were seen were usually associated with the surgical procedures itself. The fact that a complication was iatrogenic does not mean that it had been preventable. The statement does not necessarily imply that the treatment had been incorrect.

False treatment occurred in 22% of the patients: in nine cases with adverse influence on the course of the disease and in six cases with doubtful influence. This means that in at least nine of 68 cases (13%) the autopsy had provided valuable information on the disease processes.

Our analysis could not demonstrate any higher rate of accuracy for younger age groups than for older patients or any association with duration of hospital stay.^{3,17} The relationship between correct diagnostic methods and the correctness of the given treatment could have been anticipated.

The inverse relationship between prognosis on admission and accuracy of diagnosis and treatment is not likely to be a relationship of cause and effect. It might be an expression of the fact that a clinician will be very persistent in obtaining permission to have an autopsy performed in cases that were admitted with a good prognosis. Although other studies have shown that the clinician's expectations about the yield of the autopsy do not correspond with accuracy of diagnoses, this problem of bias due to selection of cases may have occurred in the present study as well as in other studies. Cameron and McGoogan have shown that even in those cases in which the clinician is quite certain about the diagnosis, an error rate of 25% occurs¹⁸

In this study, error in diagnosis and treatment was shown to be as common as it was many years ago.^{13,19}

VI.5 Conclusion

From these data it can be concluded that the clinical diagnoses in patients admitted for vascular surgical disease have been incorrect in quite a number of cases as compared with the autopsy results. The primary clinical diagnosis had been wrong in only one case, but complications were missed in 41% of the patients. Most frequently missed were severe haemorrhage, bronchopneumonia and myocardial infarction. These complications were also the most frequently encountered diagnoses in this group of patients. Apparently, infectious diseases presenting as complications after vascular surgical procedures are more common than in the past. Treatment error occurred in 22% of patients, with a clear impact on the course of the disease in 13% of cases.

Statistical analysis showed that patients admitted with an apparently good prognosis, but who died during the course of the disease, suffered more frequently from error in diagnosis and treatment. Awareness of the common complications of vascular surgery as mentioned here, together with knowledge that diagnostic inaccuracy and treatment failure are common occurrences, should lead the surgeon to a more careful evaluation of signs and symptoms in the postoperative vascular surgical patient.

This study demonstrates the value of postmortem examination as the final evaluation in this group of surgical patients who died due to severe vascular disease and its complications.

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THE RESULTS OF AUTOPSY OF PATIENTS WITH SURGICAL
DISEASE OF THE DIGESTIVE TRACT

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Surgery, Gynecology and Obstetrics, 1992;175 *in press*

VII.1 Introduction

Autopsy rates have declined during the past decades, but accuracy of clinical diagnosis has been questioned by a number of authors, especially as compared with autopsy findings.^{1,2} Several reports have been published on this issue for groups of patients with mixed diseases, and a few reports exist describing discrepancies between clinical findings and autopsy results in patients with disease of the gastro-intestinal tract.^{3,4,5,6,7}

It has been shown that autopsy adds to awareness of inaccuracy of the clinical diagnostic process and can help in detecting errors of management that might be of structural origin and thus, preventable.

In the current study, a comparison of clinical notes with postmortem findings in patients with surgical digestive disease is presented. Studies showing analysis of autopsy results in a group of patients who underwent surgical treatment have rarely been previously published.

VII.2 Patients and methods

During a period of 10 years, 1977-1987, a postmortem examination was requested for most patients who died while at the Department of General Surgery at the Nijmegen University Hospital. Consent from the relatives of the deceased was necessary. All patients with surgical diseases of the gastro-intestinal tract were treated by this department, even when admitted to the intensive care unit. Patients who were to have vascular shunt procedures, in instances of portal hypertension, were also admitted to the study.

Overall, between 2500 and 3000 operations were performed yearly at the Department of General Surgery. Clinical notes were compared with the postmortem findings for all patients. Each instance with a discrepancy between clinical diagnosis or management and the autopsy results was discussed with a senior surgeon and a senior pathologist.

The accuracy and complications of the primary diagnosis or treatment were assessed. The direct mechanism of death and relevant contributory diagnoses were evaluated as well. Treatment and diagnostic procedures were evaluated as a result of findings at autopsy.

Statistical analysis was performed, using the Chi-square test, by the unit of Mathematical Statistical Advice of the University of Nijmegen.

VII.3 Results

The mean autopsy percentage for the 10-year period was 51% (range over the years 36%-62%) for all patients who underwent surgical procedures. In 77 patients who underwent autopsy, a non-malignant disease of the digestive tract had been the primary diagnosis and the reason for admission. The mean age was 58.7 years (29-89 years). The group consisted of 38 women and 39 men.

The primary diagnoses are listed in table I: 79 primary gastro-intestinal diagnoses in 77 patients. Most important were acute haemorrhagic necrotizing pancreatitis; peptic ulcer disease; disease of the gallbladder or bile duct, or both, and cirrhosis of the liver.

Operation had been performed upon all but three patients and only one patient died during operation. The patient who died had acute pancreatitis and purulent peritonitis and died in a state of septic shock during laparotomy.

Of these 77 patients, 33 were considered to have a good prognosis for the primary disease. In 21 patients, the prognosis was poor because of the primary disease and ensuing complications or because of additional diseases. In 23 patients, the prognosis on admission had been unclear.

In one patient, treatment had been withheld in the terminal clinical phase. The patient had hepatic failure as a result of cirrhosis of the liver, was admitted with bleeding of the oesophagus and had a semi-acute mesocaval shunt procedure performed.

In 39 patients (51%), all clinical diagnoses had been correct as compared with the findings at autopsy. Despite correct diagnoses, treatment had been incorrect in one patient (a Clostridium-infected haematoma that was drained insufficiently).

In 73 patients (95%) the diagnosis of the primary disease had been correct. The four instances of missed primary diagnoses are given in table II.

The diagnoses of the complications of the primary disorder had been correct in 44 patients (57%) and incorrect in 33. The types of missed diagnoses of complications (35) are listed in table III. Incorrect diagnosis of complications led to incorrect treatment in 11 patients.

Table I: 79 primary (postmortem) diagnoses in 77 patients.

DIAGNOSIS	NUMBER OF PATIENTS
Acute haemorrhagic necrotizing pancreatitis	16
Peptic ulcer disease	13
Liver cirrhosis	10
Gallbladder/bile duct disease	10
Small bowel ischaemia	6
Peritoneal adhesions/radiation enteritis	5
Diverticulitis	4
Appendicitis	2
Oesophageal perforation	2
Strangulated external hernia	2
Other benign intestinal disease	9

Table II: Missed primary diagnoses (n=4).

DIAGNOSIS	NUMBER OF PATIENTS
Haemorrhagic necrotizing pancreatitis	1
Small bowel ischaemia (venous thrombosis)	1
Adenocarcinoma of the pancreas (patient with acute pancreatitis)	1
Open gastric perforation	1

Table III: 35 missed diagnoses of complications in 33 patients:

DIAGNOSIS	NUMBER OF PATIENTS
Bronchopneumonia	7
Abdominal sepsis	6
Purulent endo/myocarditis	4
Necrotizing pancreatitis	3
Purulent pyelonephritis	3
Intra-abdominal bleeding	3
Acute myocardial infarction	2
Pulmonary embolism	2
Gastro-intestinal bleeding	2
Other	3

Correct diagnosis of the direct mechanism of death was made in 61 patients (79%). Missed direct mechanism of death as a single error occurred only once. Usually, missed direct mechanism of death was a consequence of error in diagnoses of complications. Death had been sudden or unexpected despite the primary disorder in nine patients. In six of these nine patients, the direct cause of death had not been correctly estimated clinically. The most important causes of unexpected death were septic shock (three patients) and myocardial infarction (two patients).

Diagnoses of relevant contributory diseases had been correct clinically in 72 patients (94%). Missed diagnoses occurred in one patient who had multiple localizations of hepatocellular carcinoma coexisting with cirrhosis of the liver, one who had gallbladder stones with pancreatitis, one who had severe pulmonary emphysema and bronchiectasis, one who had severe generalized atherosclerosis and one who had myofibrosis and myocarditis.

According to findings at postmortem examination, the treatment had been incorrect in 12 patients (16%). In one patient, all diagnoses had been correct. In seven of the 12 patients, the error in management had clearly had an adverse effect on the course of the disease. In five patients, the harmful effect was unclear. The instances for which incorrect treatment was applied are given in table IV and V. Four of the patients who received incorrect treatment had a suspected good prognosis initially.

Diagnostic procedures had been performed correctly, according to postmortem findings, in 70 patients. Of these 70 patients, however, the results were completely helpful in only 36 patients, partly helpful in 30 and misleading in four patients. Of the four patients who had misleading results, two had an error in treatment.

Diagnostic procedures had been inadequate in seven patients and had led to false treatment in five patients.

Table IV: Instances of incorrect treatment with clear adverse effect (n=7).

TYPE OF ERROR	NUMBER OF PATIENTS
Failure to operate in duodenal stump leakage	1
Failure to operate in bleeding gastric ulcer	1
Failure to debride infected pancreatic haematoma	1
Failure to reoperate leaking intestinal anastomosis	1
Failure to reoperate intra-abdominal bleeding	1
Failure to drain liver abscesses/purulent peritonitis	1
Failure to debride pancreatic necrosis	1

Table V Instances of incorrect treatment with possible adverse effect (n=5)

TYPE OF ERROR	NUMBER OF PATIENTS
Failure to debride pancreatic necrosis	1
Failure to drain rest abscesses/faecal peritonitis	1
Inadequate early shock treatment (hypovolaemic/septic)	1
Failure to give antibiotics in bronchopneumonia	1
Failure to administer adequate coronary care	1

Abdominal sepsis occurred in 45 patients, whereas it was detected clinically in only 39 patients. Detection or sensitivity rate was 87%. According to findings at autopsy, no false-positive instances occurred (specificity of 100%). Abdominal sepsis was the result of acute pancreatitis in 19 patients, a result of leaking gastric or intestinal anastomosis in eight patients and a result of a combination of the two disorders in two patients.

According to findings at autopsy, Multiple Organ Failure (MOF) occurred in 23 patients. Of these 23, abdominal sepsis was present in 19. Multiple Organ Failure was associated with bronchopneumonia in three patients and with mediastinitis in one patient.

Bronchopneumonia was found in 44 patients at autopsy. In 37, pulmonary infection had been detected clinically. The sensitivity of the clinical diagnostic process for bronchopneumonia was 84%. False-positive instances did not occur.

In 58 patients, abdominal sepsis or bronchopneumonia had been present, while in 19 patients, no septic disorder had played a role. Of the patients with septic complications, 37 had been admitted to the surgical department for more than two weeks before death and 17 for even more than one month.

Acute pancreatitis occurred in 21 patients. In 16 patients it had been the primary diagnosis and in five patients, it developed as a complication of another benign disease of the gastro-intestinal tract. Acute pancreatitis had been detected clinically in 17 of the 21 patients (sensitivity 81%). One false-positive instance occurred (specificity of 98%).

Leaking gastric or intestinal anastomosis had been present in 14 patients. In 12 patients, the disorder had been detected clinically. The detection rate (sensitivity) was 86%. No false-positive instances occurred.

Bleeding from the gastro-intestinal tract discovered at autopsy had been missed clinically in three of 15 patients. One false-positive instance occurred. Haemorrhage was fatal in 11 patients, but the clinical diagnosis of the mechanism of death was missed in one patient and falsely attributed to it in another patient. In seven patients, the fatal haemorrhage was from the digestive tract, in four patients, bleeding occurred in the abdominal cavity (in two patients with haemorrhagic necrotizing pancreatitis, in one patient, after cholecystectomy and in one, an aortic aneurysm ruptured during hospitalization).

Pulmonary embolism was a difficult clinical diagnosis: three instances were found at autopsy, but only two were detected before death. Five false-positive instances occurred. Sensitivity and specificity were 66% and 93%, respectively.

The diagnosis of myocardial infarction was also difficult: two false-negative instances (eight found at autopsy) and four false-positive instances. Sensitivity and specificity were 75% and 94%, respectively.

Many unexpected autopsy findings, clinically unimportant retrospectively, were noted: one patient had an ulcerating gastric carcinoma without metastasis, another had two duodenal carcinoid tumours, another patient had widespread distant metastases of a carcinoma of the prostate and one patient had a Grawitz tumour (6 mm. in size). One patient with acute pancreatitis also had carcinoma of the pancreas.

Iatrogenic complications had been present in 21 patients. Ten patients had leaking anastomosis, of whom four had been referred from another hospital where the first operation had been done. Of the other 11, five had been referred from elsewhere. Iatrogenic pancreatitis after surgical treatment of the stomach or gallbladder occurred in four patients.

Statistical analysis was performed, using Chi-square tests, to detect any factors that influenced the accuracy of diagnosis or treatment. No significant relation between accuracy of diagnosis or treatment could be found for the factors of age, gender, preoperative time (since admission), duration of hospitalization (until death) or year of death. The presence of any specific or other disorder of the gastro-intestinal tract was not significantly related to discrepancy rates as was the situation in the presence of any iatrogenic complication.

Failed or inadequate diagnostic methods had significantly more often resulted in false diagnosis ($p < 0.001$) and wrong treatment ($p = 0.011$).

Significantly more often, sudden or unexpected death led to false diagnosis ($p = 0.012$).

VII.4 Discussion

Discrepancies between clinical diagnoses and autopsy findings have been reported to occur in approximately 40% of autopsies performed at hospitals.^{2,6,8} The impact of the discrepancies on the clinical course or even on survival, is said to be present in approximately 10% of autopsies.^{3,9} These figures are taken from studies that describe mixed hospital populations, with some studies in Scandinavia reporting autopsy percentages of more than 90%.⁹ One study describing discrepancy rates in patients with disease of the gastro-intestinal tract reported a rate of 32%.⁷ The results of a study by Kircher reported that diseases of the gastro-intestinal tract were most often underdiagnosed.⁶

The figures in the current study demonstrate that for patients with surgical disorders of the digestive tract, almost the same rates of error can be found. In 51% of the patients, all diagnoses had been correct, with one or more discrepancies in 49% of the patients. Most frequently missed were complications of the primary disorder or the treatment; the primary diagnosis had been correct in 95% of the patients.

The most important finding is the suspected treatment error as assessed by the examination at postmortem: in seven patients (9%), the error had clearly had a negative impact on the clinical course; in five (6%), the harmful effect had still been likely. Thus, in at least 9% of patients, the autopsy revealed essential information on the course of the disease.

Of the seven patients given incorrect therapy, five were because of failure to treat intra-abdominal sepsis adequately by laparotomy or re-laparotomy. Fry reported that death from abdominal sepsis is often a consequence of insufficient surgical drainage.¹⁰

In the current study, incorrect treatment occurred less frequently than incorrect diagnosis.

The most common finding in the group of patients is the problem of septic disease: abdominal sepsis occurred in 45 patients, most frequently because of pancreatitis or leaking intestinal anastomosis. Bronchopneumonia is frequently present at an early phase in patients with septic abdominal disease, although a number of patients have bronchopneumonia terminally. Multiple Organ Failure is a common consequence of these disorders in the patient who is severely ill and admitted to the intensive care unit.¹⁰ Multiple Organ Failure can still be present clinically in the absence of positive bacterial cultures.¹¹ In each instance in this group of patients, however, sepsis had been the underlying cause of Multiple Organ Failure.

According to findings at autopsy, abdominal sepsis or bronchopneumonia, or both, were present in most of the patients described in the current study. Bronchopneumonia and abdominal sepsis were also the most frequently missed diagnoses of complications. Another important missed diagnosis of septic disease, is endocarditis with purulent myocarditis, revealing positive findings of bacterial cultures of material taken at autopsy (four patients).

Other authors have reported that infectious diseases are found more often in examinations at postmortem.¹² This development does not seem to be hindered by the widespread availability of broad spectrum antibiotics, and may even be enhanced by it. When older and more debilitated patients are operated upon and invasive monitoring devices and treatment facilities are used with increasing frequency, the reasons for increasing numbers of septic disease are apparent and indeed widely recognized clinically.

The large proportion of instances of acute haemorrhagic necrotizing pancreatitis in the current study demonstrate that the disorder still presents difficulties with treatment. Infection and the Adult Respiratory Distress Syndrome are common significant consequences of pancreatitis.^{10,11,13} The diagnosis was missed once as the primary disease and missed as a complication of another benign disease of the gastro-intestinal tract in three patients. The results of an autopsy study by Battle reported 26% of instances of pancreatitis being missed clinically.⁸ One instance of carcinoma of the pancreas in acute pancreatitis was missed, but was clearly an extremely difficult combination of clinical diagnoses.^{14,15}

It must be stressed that an iatrogenic complication, for example, a leaking intestinal anastomosis, does not necessarily have to be a preventable complication. The statement does not imply that the treatment had been wrongly applied.

There were low detection rates for pulmonary embolism and myocardial infarction (66% and 75%, respectively). These diagnoses are known to cause difficulty in the clinical situation, as has been described elsewhere in other analyses of autopsies.^{3,8,9} Previous reports have indicated that increased age or prolonged duration of hospitalization could lead to lower accuracy rates as assessed by autopsy, but could not be substantiated in the present study.^{8,16} The only factors with a clear negative influence on accuracy of diagnosis were failed diagnostic procedures and sudden death. Failed or inadequate diagnostic procedures also had a significant adverse impact on treatment. These findings were probably expected.

This indicates that selecting instances, referred for autopsy, is not going to lead to a greater benefit from the postmortem examination. Cameron already stated this and even unsuccessfully attempted to improve accuracy rates by increasing autopsy numbers to eliminate any bias by difficult cases.¹⁷ Apparently, the same applies to patients with surgical disorders of the gastro-intestinal tract. The era of new technical diagnostic equipment did not lead to improved accuracy rates in the patients we studied, although, clearly, a number of new diseases have developed. The types of diagnoses that were missed some decades ago are different than the diagnoses missed now.^{12,18}

VII.5 Conclusion

In a group of patients with surgical disorders of the gastro-intestinal tract, a number of diagnoses were missed in the clinical situation. Most frequently missed were diagnoses of complications of the primary disease or the treatment: bronchopneumonia, abdominal sepsis and purulent myocarditis.

This analysis indicated the common occurrence of septic complications in this group of patients who underwent surgical treatment: 58 cases.

According to autopsy analysis, incorrect treatment was given in 12 instances (16%), with a clear impact on clinical course in seven patients (9%).

Statistical analysis showed that only sudden, unexpected death and failed or inadequate diagnostic procedures had a significant negative influence on clinical accuracy.

Selection of patients for autopsy is not desirable. Autopsy presents a valuable source of information about the clinical processes in patients with surgical gastro-intestinal pathologic factors. The decline in autopsy rates, also noted among surgical cases, should be reversed.

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**AUTOPSY ANALYSIS IN SURGICAL PATIENTS WITH DISORDERS
OF MISCELLANEOUS ORIGIN**

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VIII.1 Introduction

As has been described in the previous chapters, according to the results of postmortem studies error in diagnosis occurs in a number of patients. In most scientific articles, these errors in diagnosis, some with impact on the clinical course of the disease, were shown to be present in medical patients. Earlier chapters of this thesis deal with error in diagnosis and treatment, as detected by the autopsy, in surgical patients with oncological, traumatic, vascular or gastro-intestinal disorders.

Chapter VIII describes the findings of an autopsy study in patients with disorders of miscellaneous origin. For these cases, surgical management had become necessary due to a complication of the primary medical disease.

VIII.2 Patients and methods

In the 10-year period, from 1977-1987, an autopsy was requested for most patients who died in the Department of General Surgery of the Nijmegen University Hospital. Of 312 surgical cases in which postmortem examination was performed, a primary medical disorder had been the underlying cause of death in 34 patients.

Table I: Primary autopsy diagnoses in 34 patients with miscellaneous disorders.

DIAGNOSES	NUMBER OF PATIENTS
Haematological disease	
leukaemia	7
lymphoma	6
M. Vaquez	1
Cardiac disease	3
Metabolic disease	3
Renal disease	3
Pulmonary disease	2
Liver disease	2
Suicidal intoxication	2
Miscellaneous	5

The primary autopsy diagnoses in these 34 patients are shown in table I. The methods for comparing clinical notes to autopsy findings, the assessment of clinical accuracy and the statistical analysis were already described in the previous chapters.

VIII.3 Results

This group of patients consisted of 21 men and 13 women. The mean age was 56.2 years (range 17-84 years).

The prognosis on admission was thought to be good in 3 patients. In 16 patients the prognosis was considered to be poor and in 15 patients it was unclear. In 5 patients treatment was purposely withheld in the terminal phase of the disease.

In 16 patients (47%) all clinical diagnoses were correct according to postmortem assessment. In these instances without any diagnostic discrepancy, treatment error was found in 1 case (failure to intubate a soporous patient who was admitted to the surgical department with a lower abdominal mass; the diagnosis meningitis with urinary retention was made and the patient died on the neurological ward).

In 32 patients (94%) the primary diagnoses were correct according to the postmortem examination. In 21 patients (62%) the diagnoses of the complications of the primary disorder or its treatment were correct. In 13 patients an error in the diagnosis of complications was found, with relevance to the course of the disease or the treatment in 5 instances. The cases of missed primary diagnoses and diagnoses of complications are shown in tables II and III respectively. The direct mode of death was correctly assessed clinically in 25 patients (74%). Sudden death had occurred in 3 patients, with error in assessment in 2. Relevant contributory disorders, not related to the primary disease, were correctly diagnosed clinically in 31 patients (91%).

Table II: Missed primary diagnoses (n=3).

DIAGNOSES	NUMBER OF PATIENTS
Primary biliary cirrhosis	1
Malignant lymphoma	1
Cardiac failure in severe pulmonary emphysema	1

Table III: Missed complications (n=13).

DIAGNOSES	NUMBER OF PATIENTS
Bronchopneumonia	6
Open tuberculosis (during immunotherapy)	1
Leukaemic pulmonary infiltrates	1
Purulent peritonitis	1
Amputation stump abscesses	1
Generalized cytomegalo virus infection	1
Severe haemorrhage in mediastinum	1
Cardiac tamponade (chylus)	1

The autopsy showed that diagnostic procedures had been correct in 27 patients (79%) In 1 patient the diagnostic procedure had been adequate, but the results had been misleading. In 6 patients (18%) the diagnostic methods had been inadequate

According to the postmortem examination, treatment had been correct in 28 patients (82%) In 6 patients (18%) a treatment error had occurred in the clinical phase. The patients who received erroneous treatment are shown in table IV

Sensitivity and specificity for a number of clinical diagnoses were tested, especially those with frequently occurring complications.

Bronchopneumonia was a common diagnosis, 18 cases were found at postmortem examination. Seven cases were missed in the clinical period: sensitivity or detection rate 61%. Three false positive diagnoses were detected: specificity 81%.

Abdominal sepsis was found at autopsy in 8 instances, of which 1 was missed clinically. Sensitivity was 88%. False positive diagnoses did not occur: specificity was 100%. Abdominal sepsis was usually found together with bronchopneumonia (7 patients).

Multiple Organ Failure was found in 4 patients, both clinically and at autopsy: sensitivity and specificity were 100%.

Bleeding from the gastro-intestinal tract was found at postmortem in 7 patients; the diagnosis was false positive in 1 patient: specificity 96%.

Iatrogenic complications were present in 7 patients, as shown in table V. These complications were not necessarily preventable.

Table IV: Cases of incorrect treatment (n=6).

TYPE OF ERROR	NUMBER OF PATIENTS
Failure to laparotomize in ileus with sepsis	1
Failure to re-explore neck in haemorrhage	1
Failure to drain pericardial tamponade	1
Failure to perform higher leg amputation in sepsis	1
Failure to administer tuberculostatic drugs	1
Failure to intubate comatous patient (aspiration)	1

Table V: Iatrogenic complications (n=7).

DIAGNOSES	NUMBER OF PATIENTS
Subphrenic abscess after splenectomy	2
Pancreatitis after splenectomy	1
Haemorrhage during immunotherapy/coumarin therapy	2
Ligation proper hepatic artery	1
Bilateral vocal cord paralysis (neck dissection)	1

Statistical analysis with the Chi-square test showed that patients with a good prognosis on admission had significantly more often suffered from wrong treatment than those with a dubious or poor prognosis ($p=0.01$). Patients receiving adequate clinical diagnostic procedures had significantly fewer treatment failures than those with inadequate diagnostic procedures ($p=0.004$). Statistical analysis did not show any significant dependence of accuracy of treatment or diagnosis on the factors: sudden death, presence of iatrogenic complications, age, sex, duration of last hospital stay and year of death. Neither did delay of operation since admission, nor a specific type of clinical diagnosis provide any significant detectable influence.

A few notable postmortem findings should be reported at this stage: one patient who had suffered a previous clinically diagnosed myocardial infarction, had been receiving a coumarin derivative for four years. This patient was admitted with uncontrolled bleeding in the abdominal wall and finally died due to complications. At autopsy there was no evidence of past or recent myocardial infarction.

A further patient was found at autopsy to have cavernous tuberculosis, which of course had far reaching implications for this patient's contacts. One patient with alpha-1-antitrypsin deficiency and liver cirrhosis with portal hypertension, in whom bile duct exploration was performed for the presence of gallstones, had deterioration of liver function postoperatively. The postmortem examination showed a ligated proper hepatic artery.

VIII.4 Discussion

The analysis in this group of patients showed that, as in the previous groups, diagnostic accuracy in the clinical phase is quite low as compared to autopsy findings. All diagnoses were correct in approximately half of the patients. The primary medical diagnosis had often been correct, 91%, which is probably a good result in view of other studies which described medical patients.^{1,2,3} In the previous chapters it was shown that primary surgical diagnoses were of similar high accuracy.⁴ Complications of the primary medical disorder or its treatment were often missed clinically: 62% had correct diagnoses of complications. This figure is also comparable with the error rates for complications in the previous chapters.

Treatment error occurred in 6 patients (18%). Although the clinical diagnoses were correct in 1 of these patients, it can be argued that the autopsy added to the insight in the clinical processes in at least 18% of the patients.

The largest proportion of this group of primary non-surgical disorders was formed by leukaemia and malignant lymphoma. Ten of these 13 patients underwent splenectomy. In these and other patients, septic complications played a major role, which is again stressed by the postmortem examination. Bronchopneumonia was the most common postmortem finding. Pulmonary embolism did not occur frequently.

When deciding which cases to select for autopsy, statistical analysis proved of little value. A number of factors which were of statistical influence on accuracy rates in other studies, did not reach significance in the present analysis. Apparently, selection of cases for autopsy is not desirable, which is as true for this group of patients as for the groups described in the previous analyses.

The 3 cases, which illustrate the errors as analyzed in the 'results' section, show how very interesting autopsy findings can be. Even these 3 cases themselves must have had a large influence on the individual attitude of the surgeon and the physician, as well as on the relatives of these patients.^{5,6,7,8}

The results described in the analysis of this chapter do not give rise to any conclusions other than those shown before.

VIII.5 Conclusion

Primary non-surgical disorders, which lead to complications that must be dealt with by surgeons, were usually accurately diagnosed clinically, as shown by postmortem examination. Complications were still frequently missed, with impact on the clinical course in 15% of the patients (5 cases). Bronchopneumonia was the most common autopsy finding, presenting a low accuracy rate (61%). Statistical analysis showed that patients with a good prognosis on admission and patients with failed diagnostic procedures, suffered significantly most often from incorrect treatment. This chapter also shows that small numbers of cases for autopsy, following death after surgical management, do not give enough insight into diagnostic and therapeutic accuracy.

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CASE REPORTS

IX.1 Introduction

Individual cases of unexpected findings in autopsied patients alert the clinician. An analysis of postmortem detected errors in clinical diagnoses and treatment, as described in the previous chapters, appears to have a scientific value. However, certain cases showing discrepancies between pre-mortem and post-mortem diagnoses are interesting enough to be described. John Prutting¹ described a case which appealed to the imagination of the readers: a retired man, with a past history of myocardial infarcts, was recuperating at home from the resection of an abdominal aortic aneurysm. He stood up to go to bed, stumbled against a bedside table, fell across the bed and died. Instead of assuming that death was caused by another myocardial infarct, his physician insisted on a postmortem examination: a ruptured spleen was found with a large accumulation of blood in the abdomen. This chapter lists a number of interesting case histories, some of which have been briefly mentioned in previous chapters. No attempt is made to summarize these cases in a logical way. These should only be read as an illustrative adjunct to the previous chapters.

Cases

CASE A:

An 81-year old woman fell from the stairs and was admitted with an unstable fracture of the femur being the only apparent injury. The fracture was treated by plate fixation on the day of admission. Postoperatively, the patient was commenced on a coumarin anticoagulant. On the 5th postoperative day the patient developed signs of hypovolaemic shock, distension of the abdomen and falling haemoglobin levels. Despite correction of the reduced coagulability state and blood transfusions, the patient died a few hours later. Adequate diagnostic procedures to detect the cause of bleeding had not been undertaken. The clinically suspected cause of death was a ruptured abdominal aneurysm.

Autopsy

A subcapsular liver haematoma with rupture on the dorsal side of the left lobe was found together with 1.5 litre blood in the abdomen. Severe atherosclerosis was also found. The direct mechanism of death was stated to have been severe haemorrhage. The heart showed terminal ischaemic cardiomyopathy of the left ventricle.

Comment

The missed liver haematoma with rupture led to the death of this elderly patient. Anticoagulant treatment and delay in diagnostics steps may have added to the fatal outcome.

CASE B:

A 46-year old man was initially admitted to another hospital after a severe road traffic accident. The patient had a known history of alcohol abuse. Injuries noted initially were fractures of the skull base, left ankle and hand and an anterior luxation of the left shoulder. Widening of the mediastinum, found on chest X-ray, aroused suspicion of an aortic lesion, for which the patient was transferred to the Nijmegen University Hospital. On arrival the patient was in shock, but responded well to intravenous resuscitation. Angiography showed dissection of the descending aorta, during emergency thoracotomy a vascular prosthesis was inserted. In the immediate postoperative period further shock developed and laparotomy was performed, three litres of blood

was found in the abdomen, this being caused by a mesenteric injury.

The patient was admitted to the intensive care unit, supportive measures were undertaken by means of artificial ventilation, antibiotics and heparin in prophylactic dosages (Calparine^R 5000 U. subcutaneously b.d.). After 3 days the patient breathed spontaneously and was extubated. Due to poor access of the subclavian veins, the patient received intravenous alimentation via a femoral vein catheter for a period of 11 days. On the 9th post-trauma day enteral feeding was commenced, but stopped a few days later because of biochemical signs of pancreatitis. On the 11th day the chest X-ray showed left basal atelectasis, which was treated by bronchoscopic suction and antibiotics.

On the 12th day after the trauma, the patient suddenly became dyspnoeic, recovered for a short period of time, but died suddenly despite cardiac massage and mechanical ventilation. In the clinical notes no mention was made of any swelling of the extremities. On clinical grounds the cause of death was thought to be a pulmonary embolism.

Autopsy:

Massive pulmonary embolism and thrombosis of the left (and also the right) femoral vein were found. Atelectasis of the left lung was confirmed with left sided haemorrhagic pleuritis (thoracotomized side) and fibrinous pericarditis. Small areas of pancreatic necrosis were found. The vascular anastomoses were intact.

Comment:

The deep venous thrombosis was missed clinically; prophylactic administration of heparin apparently did not prevent this. Higher dosages of anticoagulants might have been necessary to prevent the massive embolism. Other relevant diagnoses had all been correct.

CASE C:

A 68-year old man was admitted for palliative surgery for an obstructing and metastasized adenocarcinoma of the sigmoid colon. At laparotomy, which also showed carcinosis of the peritoneum with ascites, a loop colostomy was made. Postoperatively the general condition remained poor. The patient received Morphine epidural as treatment for pain. On the 12th postoperative day the patient died suddenly, the clinical cause of death was unknown.

Autopsy:

The diagnosis of adenocarcinoma of the colon with widespread metastasis was confirmed. An unexpected finding was a large penetrating duodenal ulcer, which had eroded the gastro-duodenal artery. Severe haemorrhage had been the direct mechanism of death.

Comment:

Although the final events had not been properly diagnosed, the treatment had been correct in the light of the poor general condition and prognosis of this patient.

Case D:

A 70-year old man was admitted to undergo surgery for an adenocarcinoma of the gastric cardia. The patient had a history of coronary insufficiency (old myocardial infarction) and received medication for this condition.

Distant metastasis could not be detected and a thoraco-abdominal approach was carried out.

Resection was done and an intrathoracic oesophago-gastrostomy was performed together with pyloroplasty and splenectomy. Liver biopsies were negative for tumour and the final histologic examination showed tumour free margins and negative lymphnodes. Postoperatively, the patient remained on the intensive care unit for 1 week and was then transferred to the surgical ward. On the 8th postoperative day a contrast X-ray of the oesophagus showed a leaking intrathoracic anastomosis with an encapsulated cavity. Drainage was performed with a chest drain and parenteral alimentation continued. Antibiotics and cimetidine were administered. The patients general condition remained stable but on the 15th day the temperature rose, despite surgical drainage of a chest wall abscess. The patient became hyperglycaemic with a raised potassium level and the arterial bloodgas analysis deteriorated. The chest X-ray showed pleural effusions and haemoglobin levels were slightly low. Antibiotics were continued and adjusted to culture results. On the 20th postoperative day the patient died unexpectedly. The direct mode of death was clinically unclear.

Autopsy:

A leaking oesophago-gastric anastomosis was found with fibrinous pleuritis on the right side. Bronchopneumonia and purulent bronchiolitis were found; there were also several focal pancreatic necroses with pus accumulation and a subphrenic abscess on the left side. Additional findings were pulmonary emphysema, a small Grawitz tumour of the left kidney and signs of chronic coronary heart disease.

Pus cultures and cultures from the gall bladder revealed growth of bowel bacteria. The direct mechanism of death was cardiorespiratory failure due to bronchopneumonia, pleuritis, pancreatitis and localized peritonitis.

Comment:

The prognosis on admission was unclear regarding to the type and location of the tumour and the atherosclerotic coronary heart disease. However, the resection had probably been curative. A number of septic complications were missed clinically; diagnostic steps to detect infradiaphragmatic complications were not taken (for instance ultrasound, CT-scan or re-laparotomy). Surgical drainage of the intra-abdominal abscesses might have improved the patient's chance of survival.

Case E:

A 75-year old man was admitted to the emergency department after collapsing and complaints of abdominal discomfort. On examination the patient was found to be in shock, and had a pulsating mass in the abdomen. The patient was also known to have moderate renal failure, but was not receiving dialysis.

Emergency laparotomy revealed a ruptured aneurysm of the infrarenal aorta. The aorta was clamped proximal to the renal arteries, the vascular prosthesis was anastomosed distal to them. In the early postoperative phase the patient was returned to the operating theatre for intra-abdominal bleeding. Afterwards he was transferred to the intensive care unit and, after excluding coagulation disturbances, supportive measures were undertaken (artificial ventilation, vasopressive and inotropic drugs and antibiotics). On the second postoperative day the blood pressure dropped again and could not be corrected with intravenous support. A re-laparotomy was performed and again diffuse bleeding was found. Haemostasis could not be obtained and the patient died in the operating theatre.

Autopsy

Rupture of the abdominal aneurysm was of course confirmed, but the right renal artery was also found to be ruptured. A total of 3 litres of blood was found retroperitoneally and in the mesenteric root. Both ventricles of the heart were dilated and the lungs, liver and spleen were congested. The kidneys showed arterio- and arteriolonephrosclerosis with atrophy and several cysts. The cause of death was profuse terminal haemorrhage.

Comment

Although the patient's general condition on admission had not been very good, the rupture of the major arteries had been more extensive than clinically estimated. The lesion of the right renal artery could have been caused by extension of the rupture of the aortic aneurysm or iatrogenically during operation. Repair of this renal artery lesion should probably have been done at the initial operation, which would have increased chances of survival despite risk of complete loss of renal function.

CASE F:

A 73-year old man with a long history of intermittent claudication was admitted with persistent pain and necrosis of two toes. He had received an ilio-femoral bypass graft on the right side 11 years previously and an ilio femoral bypass graft on the left side 3 months previously. Angiography was performed, which showed an occlusion of the left superficial femoral artery. The patient took digoxin for mild cardiac failure and for urethral stricture a bacteriostatic drug (nitrofurantoin).

On the 4th day after admission a femoro-popliteal bypass graft with autologous vein was performed and necroectomy of 2 toes was done. Postoperatively an anticoagulant was administered (acenocoumarol). The initial postoperative results were good and ischaemic changes did not extend. On the 13th day after operation urine retention had to be temporarily treated and a urethrotomy was done by a urologist on the 20th day after the vascular procedure.

On the 21st day after the first operation, bloodpressure dropped and ECG changes were suggestive of a myocardial infarction. The patient was transferred to the Coronary Care Unit, although enzyme changes could not confirm the clinical diagnosis of myocardial infarction. The chest X-ray showed signs of pulmonary congestion and cardiac failure. Heart function was supported medically, but the patient's condition slowly deteriorated. On the 24th day after the vascular operation, 4 weeks after admission, the patient died with the clinical diagnosis cardiac failure. Antibiotics had not been given since the urethrotomy.

Autopsy

Moderate to severe generalized atherosclerosis was found. Areas of gangrene were found around the amputation wounds on the left foot and on the external genitals. Bilateral bronchopneumonia with bilateral pulmonary oedema and pleural effusion were found. The heart was hypertrophied and showed mild terminal subendocardial ischaemic cardiomyopathy of the left ventricle. There was no evidence found to suggest myocardial infarction. Postmortem examination indicated bilateral bronchopneumonia, with additional sepsis due to gangrene, as the cause of death.

Comment:

This was apparently an old patient in generally bad state of health. The clinical detection of the deterioration of the cardiac status postoperatively was correct. What remains unclear is whether bronchopneumonia played an early role or only a terminal role in the train of events that led to the death of this patient. Antibiotics had not been prescribed for this patient, as mentioned before.

Case G:

A 62-year old woman, with a history of rheumatoid arthritis and using indomethacin regularly, was admitted to the emergency department with severe epigastric pain, which had started spontaneously a few hours before. In the past the patient underwent a cholecystectomy and a hysterectomy. Examination showed no clear signs of free perforation and additional investigations supported a conservative approach. On the second day after admission a laparotomy had to be performed in view of the patient's deteriorating condition, whereby a perforated pyloric ulcer was found with pus in the abdominal cavity. Drainage was performed, the perforation was oversewn and antibiotics together with intravenous alimentation were commenced.

On the first postoperative day a subcutaneous wound dehiscence occurred, which was treated conservatively. Two weeks following surgery the condition again declined with a rising body temperature, a fall in blood pressure and deteriorating renal function. Blood cultures showed staphylococcus aureus. A re-laparotomy showed intact viscera, an old abscess cavity in the upper abdomen but no obvious pus. Postoperatively the patient was taken to the intensive care unit for mechanical ventilation, administration of vasopressive drugs, appropriate antibiotics adapted to culture studies and anti-arrhythmia drugs.

Heart rate became irregular (despite treatment), pulmonary infiltrates developed and epidermolysis caused by staphylococci occurred. Renal function remained fair without dialysis. Various antibiotics were used according to culture results, together with antifungal drugs. A further dehiscence of the abdominal wall had to be repaired operatively, but despite all steps taken, the patient died on the 36th day following admission. The final event was cardiac failure with ventricular fibrillation, which could not be corrected.

Autopsy:

The autopsy confirmed the state after perforation of the pyloric ulcer. A chronic bilateral bronchopneumonia, bacterial endocarditis and purulent myocarditis were found. A bilateral metastatic purulent nephritis also existed. Liver and spleen were found to be congested. The cause of death was central septicopyaemia due to extensive bacterial endocarditis with terminal cardiac failure caused by metastatic myocarditis.

Comment:

The direct mode of death had been assessed correctly, but the foci of the continuous sepsis were not found clinically. Additional investigations could have indicated these localizations, but would probably not have saved this patient.

CASE H:

A 30-year old woman was under treatment for morbid obesity and following exclusion of various medical and psychological disturbances she was admitted for surgical treatment of her obesity. The pre-operative lung function tests were all normal with the use of bronchodilating drugs. The day after admission the patient underwent an elective gastric partitioning operation, without any

operative problems. As prophylaxis she received intravenous antibiotics for 1 day, intravenous cimetidine and subcutaneous heparin. Bronchodilators were continued.

On the first and second postoperative day the patient was feverish, on the third day also dyspnoeic despite O₂-administration, bronchodilators and physiotherapy. The chest X-ray showed an elevated diaphragm and pulmonary atelectasis with pleural effusion on the left side. Antibiotics were restarted, the abdomen revealing no clear signs on physical examination.

The 4th day was uneventful, but on the 5th postoperative day the patient complained of abdominal cramps, became restless and suffered from an unexpected circulatory failure. Resuscitation failed and the patient died. The clinical diagnosis of the direct mode of death was pulmonary embolism.

Autopsy:

Intra-abdominally a subacute duodenal ulcer was found with a closed perforation and a severe acute necrotizing pancreatitis with fat necrosis in the surrounding tissues. Ascites was present with liver steatosis and septic swelling of the spleen. There was 400 ml. of haemato-hydrothorax on the left side with atelectasis and intrapulmonary bleeding. The kidneys displayed vacuolar nephrotubulopathy and the heart showed terminal circular subendocardial cardiomyopathy of the left ventricle. Cultures from the heart and the pancreas revealed growth of bowel bacteria. Pulmonary embolism or bronchopneumonia were not found; signs of chronic obstructive airway disease were present. The cause of death was toxic-septic shock in acute pancreatitis.

Comment:

The operative complications in this patient had not been recognized clinically and no diagnostics steps had been undertaken to look for any intra-abdominal complications. Possibly, a re-laparotomy and admission to the intensive care unit could have changed the fatal outcome of these severe complications.

CASE I:

A 36-year old man was admitted to the medical department with renal failure, cough, dyspnea, signs of gastro-intestinal bleeding and petechiae. One month previously he was found to suffer from Henoch-Schönlein vasculitis (renal biopsy) for which treatment on corticosteroids was commenced. The patient was transferred to the intensive care unit in a state of shock, with pulmonary infiltrates and poor bloodgas analysis. He had to be ventilated mechanically, received haemodialysis treatment and the circulation had to be supported by vasopressive agents. Antibiotics were commenced and adjusted to culture results (sputum and blood cultures showed gram-negative bacteria). Intravenous corticosteroid treatment was continued. On the 13th day after admission a surgeon was requested to see the patient because of paralytic ileus, distension of the abdomen and worsening haemorrhagic diarrhoea. A perforation of the bowel was considered, but signs on physical examination and X-ray investigation were inconclusive. Over the next 2 days the general condition deteriorated, sepsis increased, petechiae became more numerous despite thrombocyte donations and the patient died on the 15th day of admission in sepsis with persistent gastro-intestinal haemorrhage, manifesting generalized convulsions.

Autopsy:

Henoch-Schönlein vasculitis was confirmed by the autopsy. In the abdomen a diffuse, acute necrotizing enteritis of the ileum was found with a perforated ulcer. A severe faecal and purulent peritonitis was found. Signs of haemorrhagic diathesis were seen in all organs, but thrombo-embolism was found in one of the major branches of the left pulmonary artery and in

both renal arteries. Cerebral oedema was present. The cause of death was septic shock caused by peritonitis.

Comment:

The initial medical diagnosis had been correct, but the small bowel perforation was missed clinically. The clinical symptoms must have been masked in this patient being ventilated, receiving corticosteroids and antibiotics. Recovery of the septic state caused by the persisting severe peritonitis was very unlikely.

CASE J:

A 47-year old woman suffering from myelofibrosis with extra-medullary haematopoiesis and anaemia was admitted with an enlarged liver and spleen, the latter causing abdominal discomfort. There was an increasing need for blood transfusions. Clotting tests were all within normal limits. On the day after admission the patient underwent an elective splenectomy. On the same day re-laparotomy had to be performed for intra-abdominal bleeding. Diffuse bleeding was encountered and thrombocytes were donated. Postoperatively the patient developed Adult Respiratory Distress Syndrome, for which mechanical ventilation was necessary. A catheter was placed in the left subclavian vein for monitoring and intravenous alimentation. Fever developed and antibiotics were administered despite negative microbial cultures. Ultrasound examination of the abdomen, performed on the 6th day after operation, did not demonstrate any fluid collections. Thrombocyte counts were borderline low and anticoagulants were not given. On the 7th day after operation the general condition improved slightly and it was possible to wean the patient from the ventilator. Fever was still present. On the 8th postoperative day the patient became more dyspnoeic, the chest X-ray showing infiltrates on the right side and atelectasis with pleural effusion on the left side. Antiviral and antifungal agents were additionally given.

On the 9th day after splenectomy, unexpected circulatory collapse occurred and resuscitation was performed. A new chest X-ray taken at this time showed an enlarged heart and a widened mediastinum with congested lungs. Resuscitation was unsuccessful and the patient died of cardiac failure.

Autopsy:

Myelofibrosis with extramedullary haematopoiesis in the liver (spleen) and lymphnodes was confirmed. The most impressive finding was a thrombosis of the left subclavian vein which obstructed the entrance of the thoracic duct. This had led to congestion of the mediastinal lymphvessels with accumulations of chylus in both pleural cavities. Both lungs were found to be collapsed. The most important complication however, was an accumulation of 550 ml. of chylus in the pericardium, which had caused a cardiac tamponade.

Comment:

The complications of medical and surgical treatment that occurred in this patient were very exceptional. If, however, these complications had been recognized in time, treatment would have been possible (pericardial and pleural drainage). The placement of an intravenous catheter in the left subclavian vein probably added an iatrogenic component to the occurrence of this rare complication.

CASE K:

A 73-year old man was admitted to the surgical department with a tender, pulsating abdominal mass. Angiography and ultrasound examination showed a 13 cm. wide aneurysm of the infrarenal aorta. ECG showed conduction disturbances, for which the patient received a pacemaker.

The aneurysm was operated upon semi-electively: an aortic prosthesis was placed just below the renal arteries extending to the aortic bifurcation. In the postoperative phase signs of renal failure slowly developed, however a renal perfusion scan showed normally perfused kidneys. A persistent thrombocytopenia was found from the 3rd postoperative day onwards. During this period the patient was unable to be weaned from artificial ventilation, his chest X-ray showing infiltrative changes resembling Adult Respiratory Distress Syndrome. On the 5th postoperative day haemodialysis became necessary and the circulation had to be supported with inotropic drugs (Dopamine). Antibiotic treatment, already given in the perioperative phase, was revised when blood cultures revealed gram negative bacteria.

In the next weeks, the general condition slowly deteriorated, pulmonary infiltrates became more extensive, a right sided lobar pneumonia developed and the patient became icteric with poor liver function tests; spontaneous bleeding from mucous membranes occurred as well as unexplained hypoglycaemic periods. The patient died on the 27th postoperative day due to Multiple Organ Failure.

Clinical diagnoses of the involved organ systems were: Acute Tubulous Necrosis, ARDS and pneumonia, cardiac failure, sepsis, liver failure, coagulation failure.

Autopsy:

Severe atherosclerosis of the aorta and coronary arteries was found. Vacuolar nephrotubulopathy was seen in the kidneys; the lungs showed a confluating bronchopneumonia and hyaline membranes with intra-alveolar bleeding (consistent with ARDS), the airways showing pseudomembranous tracheitis and bronchitis. Bilateral pulmonary oedema was present as well as 1 litre of pleural transudate. The heart was hypertrophic with a transmural toxic-ischaemic cardiomyopathy and dilatation. The liver was congested (2310 grams) and showed a pattern of diffuse cholestasis. The spleen was also congested (300 grams) and contained multiple haemorrhagic infarctions. Both adrenal glands also showed infarctions. A few scattered necroses were seen in the pancreas.

The aortic prosthesis was not affected by signs of infection or haemorrhage.

Comment:

Apparently, the clinical findings in this patient were fully confirmed by the postmortem examination. The clinical descriptions may not be completely similar to the pathological terms, but this was not a sign of inaccuracy or discrepancy.

The case was shown to illustrate the fact that nowadays, many surgical patients are threatened by complications of the primary disease or its treatment, which may result in a long term stay on an intensive care unit. Some pathological anatomical findings in this case of Multiple Organ Failure were illustrated.

CASE L:

A 71-year old man was admitted to the department of general surgery after an episode of severe vomiting, which in turn was followed by retrosternal pain and pain in the back. On admission he appeared to be in shock, whilst the chest X-ray showed a pneumomediastinum and a left sided pleural effusion. Radiographically, a suspected oesophageal rupture, which had occurred more or

less spontaneously (Boerhaave syndrome), was confirmed.

A left sided thoracotomy was performed and a distal intrathoracic oesophageal rupture was found. The lesion was oversewn, 2 chest drains were inserted and antibiotics and parenteral nutrition were commenced. Despite the septic shock on admission and the developing mediastinitis, the patient remained in a stable condition for the initial postoperative days. On the 4th postoperative day a wound abscess required drainage and a positive blood culture led to a change in the antibiotic regime. The general condition gradually deteriorated, necessitating continuation of mechanical ventilation. A pulmonary infiltrate developed on the right side and the patient lapsed into a coma. The electroencephalogram showed signs of toxic encephalopathy. Due to the worsening cardio-vascular state, inotropic drugs were implemented and a pacemaker implanted. Liver function test showed deterioration. On the 17th postoperative day the patient died with the clinical diagnosis of persistent sepsis, whilst bloodcultures remained negative.

Autopsy:

A partly oversewn, partly open perforation of the distal oesophagus was found with fibrinous mediastinitis and serofibrinous bilateral pleuritis. A circumscribed empyema in the region of the right lower lobe was found together with bilateral pulmonary oedema. The spleen and liver were swollen and there was also steatosis of the liver. The kidneys displayed vacuolar nephrotubulopathy. The heart was hypertrophied and dilated with signs of transmural ischaemic cardiomyopathy in both ventricles. Brain stem and cerebellum revealed multiple foci of ischaemic necrosis. Signs of chronic pulmonary emphysema with bronchiectasis and generalized atherosclerosis were also seen.

Microbial cultures from the pleural empyema, the spleen and the right atrium of the heart showed growth of *Pseudomonas Aeruginosa*, *Morganella Morganii* and *Streptococcus Faecalis*.

Comment:

Although the pleural empyema was not clearly diagnosed in the clinical situation, an obvious error had not been made. On review, the case would not have been managed differently. An interesting aspect is again the pattern of oedema and swelling exhibited by several organs, changes which are consistent with Multiple Organ Failure. In this case, microbial cultures of autopsy material were positive. Many cases have occurred with negative cultures both in the clinical period and at autopsy.

References

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Summary

This thesis was written to describe the results of an autopsy study, performed in a general surgical department. A 10-year period was chosen to obtain a sufficient number of patients who were autopsied following death as a result of a surgical disorder or its complications.

Chapter I presents a general introduction to the topic, briefly outlining the history of the autopsy and also describing the autopsy procedure itself. The role of the autopsy in hospital practice, and present perceptions of the autopsy provide details of the views of medical practitioners, scientists and lay public towards the postmortem examination. The aim of the study is to answer questions of incorrect diagnosis and treatment in a group of surgical patients, as assessed by the autopsy. The question of the value of the autopsy as a means of quality control was raised. Definitions and limitations of this retrospective study were given in the final paragraphs of chapter I.

Chapter II begins with a more extensive historical review, discussing the developments in awareness of clinical inaccuracy. Although the types of missed diagnoses have changed in the past century, the frequency of discrepancies between clinical and postmortem diagnoses have not changed as much as would be expected. Whether these inaccuracies have an influence on vital statistics is discussed in paragraph II.2, along with the problem of proper completion of death certificates. Declining autopsy rates have so far not been reversed, the reasons for this are stated in II.3. The Dutch situation is similar to the universal one, which calls for proper attention and accessibility to the postmortem examination, as well as the need for autopsy as a means for quality control.

The present state of accuracy of diagnosis is reported in II.5; according to figures taken from the literature, the percentage of major unexpected findings is approximately 30-40%, with an adverse impact on the clinical course in approximately 10% of cases which were autopsied. These figures mostly originate from medical departments or from hospital autopsy services, which give no clue to inaccuracy in surgical patients as a separate entity. Questions on selection of cases for postmortem examination and on completeness of autopsy are raised in paragraph II.6. The issue of 'necessary fallibility' in medicine and surgery is introduced, which apparently incurs that some error must be deemed 'unpreventable and thus acceptable'.

Chapter III gives a description of the autopsy results in the total group of 312 patients who died in the department of surgery in the 10-year period, 1977-1987. Primary clinical diagnoses were correct in 93% of the patients, complications of the primary disorder or its treatment were correct in 60% of the patients. The direct mode of death was properly diagnosed in 79% of patients, while relevant contributory diseases were diagnosed correctly in 95% of patients. Diagnostic procedures were found to have been inadequate in 10% of the patients. A treatment error could be found, according to postmortem results, in 16% of the patients. In 11% of cases a clear adverse impact on the course of the disease was suspected.

Septic conditions apparently played a major role. Clinical detection rate or sensitivity was low for bronchopneumonia, pulmonary embolism, myocardial infarction and severe (terminal) haemorrhage. Statistical analysis showed that the occurrence of sudden death, inadequate diagnostic procedures and the presence of an iatrogenic complication were significantly associated with error in treatment. Influences on accuracy of diagnosis or treatment could not be demonstrated for factors such as age, sex, duration of hospital stay, time before operation, year of death or any type of primary clinical diagnosis.

Chapter IV discusses the results of an autopsy study of a group of 77 patients with surgical cancer (solid tumours). Pancreatic carcinoma and bronchial carcinoma were the most commonly missed primary diagnoses. Pulmonary embolism was frequently found at autopsy, but detected clinically in only 30% of cases. Patients with a poor prognosis on admission had rarely received incorrect therapy, those in whom treatment was withheld in the terminal phase of the disease were never managed incorrectly. Bronchopneumonia appeared to be a common phenomenon in the terminal processes, with frequent detection of gastric contents in the air passages at postmortem.

Chapter V presents the results of the postmortem study in 56 patients who died after trauma (but excluding death on arrival). Complete correspondence between autopsy results and clinical findings was found in 55% of cases. According to the autopsy, error in treatment occurred in 8% of the cases.

Brain injury and severe haemorrhage were the most common causes of early hospital death after injury, but septic complications and Multiple Organ Failure were among the causes of death in 94% of patients who died after the 14th hospital day. Fatal haemorrhage was the most common preventable cause of death in the group of trauma patients. For trauma cases, a plea is made for autopsy to be performed by clinically orientated pathologists.

Chapter VI describes the results of the autopsy analysis of 68 patients with vascular surgical disorders. All patients suffered from atherosclerosis with obliterative disease or aneurysm formation. All but one primary diagnoses were correct. Complications of the primary disorder or the treatment were correctly diagnosed in 59% of the patients. Fatal haemorrhage was most commonly seen in this group of patients, many due to ruptured aneurysms. This autopsy study revealed that septic complications and bronchopneumonia were more common than the occurrence of myocardial infarctions.

Chapter VII gives an account of the results of an autopsy analysis of 77 patients with surgical digestive tract disease. The most common primary diagnoses were: acute haemorrhagic necrotizing pancreatitis, peptic ulcer disease, gallbladder/bile duct disease and liver cirrhosis. Primary diagnoses were correct in 95% of patients, complications were correctly diagnosed in 57% of patients. Septic disorders were again of major importance. Statistically significant factors for clinical inaccuracy were: unexpected death and inadequate diagnostic procedures. The most common type of error in treatment was failure to perform a re-laparotomy in cases of abdominal sepsis.

Chapter VIII describes the autopsy results in 34 patients in whom a primary medical disorder had been the underlying cause of death. These patients were treated surgically after a complication of the primary medical disorder. Fourteen patients suffered from a haematologic disease. The results were similar to the findings in the previous chapters.

Chapter IX describes a number of case histories to illustrate the different findings in the autopsy study. Some common errors are reported, but several were described in the aforementioned chapters.

Conclusions

The questions of error in clinical diagnosis and treatment in a surgical department were raised at the beginning of this thesis. It must be concluded that clinical accuracy, as assessed by the postmortem examination, does not appear to be greater in a surgical patient than in any other patient. Although primary (surgical) diagnoses were often correct, complications were missed in more than one out of every third patient autopsied. In approximately 10% of cases the autopsy findings indicated that the error might have had an impact on the course of the disease.

The direct mode of death was found to be stated correctly in approximately four out of five patients; relevant contributory diagnoses were seldom missed.

These findings show that some error must be unavoidable in surgical practice and should probably be called acceptable. The autopsy therefore remains a very valuable means to assess clinical accuracy in diagnosis and surgical treatment, despite a number of relatively new diagnostic procedures. This study was mainly performed on patients with severe surgical disorders, with eventual fatal outcome, which implies that patients with a good prognosis on admission were underrepresented in the analysis. However, the conclusions are similar to previous reports on the subject in medical patients.

A way to deal with detected error rates is for the surgeon to be aware of the clinical fallibility. This should also lead to minimal autopsy rates (e.g. 60-65% of deaths according to Anderson) and regular clinico-pathological autopsy conferences. Audit can be based on careful postmortem observations.

Selection of cases for the autopsy is hardly possible, even with the knowledge of the results of this analysis. Sudden death appears to be significantly related to unsuspected findings at postmortem examination, but many demographic and clinical factors were not significant. In surgical patients the following diagnoses were most often missed: pulmonary embolism, bronchopneumonia, myocardial infarction and terminal haemorrhage.

As a primary diagnosis pancreatic carcinoma was difficult to detect in a number of cases. During the study period, septic disorders were of great importance in all subgroups.

The findings again cast some doubt upon the reliability of vital statistics. One way to reduce the number of errors found on death certificates, is to delay the completion of the certificate until the autopsy is performed. This implies a few administrative adaptations. The storage and retrieval of autopsy data should be computerized.

The final conclusion is that the autopsy remained a very important instrument in clinical quality control. Regular surgical audit and continuous registration of autopsy findings and complications in surgical patients should have a firm place in modern surgical practice and teaching.

Samenvatting

Deze dissertatie werd geschreven met het doel de resultaten bekend te maken van een obductie-studie, welke werd verricht binnen een algemeen chirurgische afdeling. Een periode van tien jaar werd gekozen ten einde voldoende gegevens te verkrijgen van patiënten die werden geobduceerd, na te zijn overleden als gevolg van een chirurgische aandoening of de complicaties hiervan.

Hoofdstuk I geeft een algemene inleiding tot het onderwerp met een korte schets van de geschiedenis van de obductie en een beschrijving van de gang van zaken bij de obductie zelf. In de paragraaf over de rol van de obductie in de ziekenhuis-praktijk en over de huidige waarde van de obductie, wordt inzicht gegeven in de mening van medici, wetenschappers en leken over het postmortale onderzoek. Het doel van de studie is vragen te beantwoorden over onjuiste klinische diagnoses en therapie bij chirurgische patiënten, zoals kon worden vastgesteld ten tijde van de obductie. Een vraagteken werd gezet bij de waarde van de obductie als middel voor kwaliteitscontrole.

Definities en een aantal beperkingen van deze retrospectieve studie worden beschreven in de laatste paragrafen van hoofdstuk I.

Hoofdstuk II vangt aan met een bredere historische beschouwing, met een discussie over de ontwikkeling van bekendheid met klinische onnauwkeurigheid. Hoewel de soorten gemiste diagnoses in de afgelopen eeuw gewijzigd zijn, is de frequentie van optreden van discrepantie tussen klinische en postmortale bevindingen niet zo veel veranderd als zou zijn verwacht. In hoeverre deze onnauwkeurigheden invloed hebben op statistieken van doodsoorzaken wordt besproken in paragraaf II.2, evenals het probleem van een juiste invulling van het formulier van doodsoorzaakverklaring. De trend van afnemende obductie percentages en de redenen hiervoor staan vermeld in II.3. Zowel de internationale als de Nederlandse toestand vraagt om meer aandacht voor en een betere beschikbaarheid van postmortaal onderzoek als methode voor kwaliteitscontrole.

De huidige stand van diagnostische nauwkeurigheid wordt gerapporteerd in II.5; volgens eerdere studies komen belangrijke onverwachte bevindingen voor bij 30-40% van alle obducties. Bij ongeveer 10% van obducties zou dit wijzen op een ongunstige invloed op het klinisch verloop. Voor de meeste van deze studies geldt dat zij resultaten beschrijven vanuit interne afdelingen of van algemene ziekenhuisobducties, waardoor geen beeld kan worden verkregen van de klinische onnauwkeurigheid bij chirurgische patiënten. Een beschouwing over selectie van gevallen voor postmortaal onderzoek en over volledigheid van de obductie volgt in paragraaf II.6. Het onderwerp van 'onvermijdelijke feilbaarheid' in de genees- en heekunde wordt hier naar voren gebracht. Klaarblijkelijk moet een bepaalde onjuistheid als 'niet te voorkomen en daarom acceptabel' worden beschouwd.

Hoofdstuk III geeft een beschrijving van de obductieresultaten in de totale groep van 312 patiënten die overleden op de chirurgische afdeling in een periode van tien jaar, van 1977-1987. Bij 93% van de patiënten was de primaire klinische diagnose correct, terwijl de complicaties van de primaire chirurgische aandoening of van de therapie correct werden bevonden bij 60% van de patiënten. Het directe mechanisme van overlijden was correct gediagnostiseerd in 79% van de gevallen en relevante bijkomende aandoeningen waren correct in 95% van de gevallen.

Volgens de resultaten van de obductie waren diagnostische methoden inadequaat gebruikt bij 10% van de patiënten. Bij 16% werd een onjuiste behandeling vastgesteld, met een duidelijke ongunstige invloed op het klinisch beloop bij 11% van de patiënten.

Infecties en sepsis speelden een belangrijke rol. Het klinisch detectie-percentages ofwel sensitiviteit was laag voor bronchopneumonie, longembolie, myocardinfarct en ernstige (ver-)bloeding. Statistische analyse toonde een significante relatie tussen het optreden van plotse dood en onjuiste therapie; inadequate diagnostiek en iatrogene complicaties waren eveneens geassocieerd met foutieve behandeling. De factoren leeftijd, geslacht, duur van ziekenhuisopname, tijdsduur tot aan operatie, jaar van overlijden en type primaire klinische diagnose hadden geen significante invloed op nauwkeurigheid van diagnose en therapie.

Hoofdstuk IV geeft een beschouwing over de resultaten van een obductie studie bij een groep van 77 patiënten met solide maligne tumoren. Onder de meest frequent gemiste primaire diagnoses waren pancreascarcinoom en bronchuscarcinoom. Longembolie werd vaak bij obductie aangetroffen, doch slechts in 30% van de gevallen in de klinische fase ontdekt. Patiënten met een slechte prognose bij opname hadden slechts zelden een onjuiste behandeling ondergaan; patiënten bij wie in de terminale fase een abtinerend beleid werd gevoerd, hadden geen onjuiste behandelingen ondergaan.

Bronchopneumonie bleek een dikwijls optredende aandoening in het terminale ziektebeloop; bij obductie werden regelmatig aanwijzingen gevonden voor maaginhoud in de luchtwegen.

Hoofdstuk V toont de resultaten van de postmortem-studie bij 56 patiënten die ten gevolge van een ongeval overleden (uitgezonderd werden patiënten die overleden voor aankomst in het ziekenhuis). Volledige overeenkomst tussen obductieresultaten en klinische bevindingen werd vastgesteld bij 55% van de patiënten. Volgens de obductie had bij 8% van de patiënten een andere behandeling gegeven moeten worden.

Hersenbeschadiging en ernstige bloeding waren de meest frequente oorzaken van vroege ziekenhuissterfte na het ongeval, maar septische complicaties en 'Multiple Organ Failure' konden bij 94% van de patiënten aangewezen worden onder de oorzaken van overlijden na de 14de ziekenhuisdag. De belangrijkste te voorkomen oorzaak van overlijden in de groep van trauma-patiënten was verbloeding. Voor trauma-gevallen werd een pleidooi gehouden voor obducties, die dienen te worden verricht door klinisch georiënteerde patholoog-anatomen.

Hoofdstuk VI beschrijft de resultaten van de obductie-analyse bij 68 patiënten met chirurgische vaataandoeningen. Bij alle patiënten was atherosclerose het onderliggend lijden, met obliteratieve of aneurysmatische vaatveranderingen als gevolg. Bij alle patiënten, op één na, was de primaire diagnose correct. Complicaties van de primaire aandoening of van de therapie waren correct gediagnostiseerd in 59% van de gevallen. Verbloeding werd het meest gezien bij deze groep patiënten, dikwijls als gevolg van een geruptureerd aneurysma. In deze obductie-studie kwamen septisch complicaties en bronchopneumonie vaker voor dan het myocardinfarct.

Hoofdstuk VII beschrijft de resultaten van een obductie-analyse bij 77 patiënten met chirurgische aandoeningen van de tractus digestivus. De meest voorkomende primaire diagnoses waren: acute haemorrhagisch necrotiserende pancreatitis, peptische ulceratie, aandoeningen van galblaas of galwegen en levercirrhose. De primaire diagnoses waren klinisch correct in 95% van de gevallen en de diagnoses van complicaties waren in 57% juist. Opnieuw waren septische aandoeningen van het grootste belang. Statistisch significante factoren met betrekking tot klinische onnauwkeurigheid waren: onverwachte (plotse) dood en inadequate diagnostiek. De meest voorkomende onjuistheid

in behandeling was het nalaten van een relaparotomie bij abdominale sepsis

Hoofdstuk VIII beschouwt de resultaten van de obductie bij 34 patienten bij wie een primair niet-chirurgische (interne) ziekte het onderliggend lijden had gevormd. Deze patienten werden chirurgisch behandeld na een complicatie van de primaire interne ziekte. Veertien patienten leden aan een haematologische aandoening. De resultaten waren vergelijkbaar met die uit de voorafgaande hoofdstukken.

Hoofdstuk IX geeft een beschrijving van een aantal ziekte-geschiedenissen om de verschillende bevindingen uit de obductie-analyse te illustreren. Enkele veel gemaakte vergissingen worden genoemd, maar andere werden vermeld in de eerdere hoofdstukken.

Conclusies

Aan het begin van deze dissertatie werden vragen gesteld omtrent juistheid van klinische diagnose en behandeling binnen een chirurgische afdeling. Geconcludeerd kan worden dat de klinische nauwkeurigheid, zoals vastgesteld wordt door postmortaal onderzoek, bij chirurgische patienten niet groter is dan bij niet-chirurgische patienten. De primaire (chirurgische) diagnoses waren vaak correct, maar complicaties waren gemist bij meer dan één op de drie patienten die geobduceerd werden. In ongeveer 10% van de gevallen gaven de obductiebevindingen aanwijzingen voor beïnvloeding van het klinisch beloop door de onjuistheid. Het directe mechanisme van overlijden was in vier van de vijf gevallen correct weergegeven, relevante bijkomende diagnoses waren zelden gemist. Deze bevindingen geven aan dat een bepaalde mate van onjuistheid in het chirurgisch handelen onvermijdelijk is en daarom acceptabel genoemd moet worden. De obductie blijft een zeer waardevolle methode om klinische nauwkeurigheid vast te stellen voor diagnose en behandeling, ondanks ontwikkeling van allerlei nieuwe diagnostische procedures. De studie werd verricht bij patienten met meestal ernstige chirurgische aandoeningen, met een fatale afloop bovendien, zodat patienten met een goede prognose bij opname ondervertegenwoordigd waren in de analyse. Toch zijn de conclusies vergelijkbaar met resultaten van eerdere studies die waren verricht bij niet-chirurgische patienten.

Een gevolgtrekking van de in deze studie gevonden foutenpercentages is, dat chirurgen zich ervan bewust moeten zijn. Het zou moeten leiden tot getallen voor minimaal vereiste obductiepercentages (bijv. 60-65% van de in het ziekenhuis overleden patienten, volgens Anderson) en regelmatige klinisch-pathologische obductie besprekingen. Waarnemingen bij postmortaal onderzoek kunnen een belangrijke basis zijn voor de laatste beoordeling van het klinisch handelen.

Selectie van gevallen voor obductie is nauwelijks mogelijk op grond van de klinische gegevens, zelfs niet met de resultaten van deze analyse. Bij statistische bewerking van de resultaten bleek alleen het optreden van plotse dood significant gerelateerd met het voorkomen van onverwachte relevante obductiebevindingen. Een aantal demografische en klinische factoren waren niet statussch significant. Bij chirurgische patienten waren de volgende diagnoses het meest frequent gemist in de klinische situatie: longembolie, bronchopneumonie, myocardinfarct en verbloeding. In een aantal gevallen was de primaire diagnose pancreascarcinoom moeilijk te stellen geweest. In de gehele studie waren septische complicaties van groot belang in alle diagnose-subgroepen.

Door de resultaten wordt opnieuw enige twijfel aangegeven betreffende de betrouwbaarheid van statistieken van doodsoorzaken. Een manier om het foutenpercentage in de statistieken te verkleinen, is het invullen van het B-formulier voor het Centraal Bureau voor de Statistiek pas nadat een eventuele obductie heeft plaatsgevonden. Hiervoor zijn wat administratieve veranderingen noodzakelijk. Er behoort een data-bank te zijn voor de opslag en mogelijke bewerking van obductiegegevens.

Tenslotte wordt geconcludeerd dat de obductie nog steeds een belangrijk instrument is voor klinische kwaliteitsbewaking. Regelmatige 'audit' na de behandeling van chirurgische patiënten en een continue registratie van complicaties en van obductiebevindingen verdienen een vaste plaats in de moderne chirurgische praktijk en bij de opleiding tot chirurg.

Dankwoord

Bij het tot stand komen van een proefschrift zijn meer personen betrokken dan de auteur alleen; het past daarom een woord van dank te richten tot allen die aan de analyse of aan de publicatie ervan hebben meegewerkt.

Prof. Dr. H.H.M. de Boer, door Uw interesse in de obductiebevindingen bij chirurgische patiënten en inzicht in het belang van klinische kwaliteitsbewaking werd een begin gemaakt met de analyse. Door Uw regelmatige stimulering werd deze ook als promotiestudie voltooid.

Dr. K. Kubat, Uw kennis van de pathologische anatomie en enthousiasme over de studie, maakte iedere bespreking met U een leermoment, maar betekende ook duidelijkheid in de soms zeer uitgebreide obductieverslagen. De uitspraak dat de patholoog-anatoom zeer zorgvuldig is met het aanwijzen van een foutieve klinische diagnose of behandeling, werd door U bevestigd.

Joanne Postma, jij hebt vele uren doorgebracht met de correctie van het Engels. Jouw belangstelling was oprecht; door wat jij moest meemaken beseftte ik nog meer hoe gelukkig ik was dat ik kon doorzetten.

Dr. Hans Kerckamp, jouw aanwijzingen brachten mij een eind verder met het gebruik van 'onze computer'. Uiteindelijk heb je me ook in de laatste fase zowel geestelijk als fysiek bijgestaan.

Dr. G.F. Borm en Dhr. A.G.M. Reintjes hebben de statistische bewerking volledig voor hun rekening genomen.

Collega-assistenten en oud-assistenten van de afdeling Algemene Chirurgie van zowel het Canisius Wilhelmina Ziekenhuis als het Academisch Ziekenhuis Nijmegen hebben mij gelegenheid gegeven om aan het onderzoek te werken. Ook de chirurgen van beide afdelingen (CWZ Hoofd: Dr. H.J.M. Joosten; AZN Hoofd: Prof. Dr. R.J.A. Goris) past hiervoor mijn dank. Voor het beschikbaar stellen van gegevens ben ik natuurlijk veel dank verschuldigd aan de afdeling Pathologische Anatomie van het AZN (Hoofd: Prof. Dr. D.J. Ruiter). Eveneens aan de afdeling Intensieve Zorg van het AZN (Hoofd: Dr. J.S.F. Gimbrère), de afdeling Interne Geneeskunde van het AZN (Hoofd: Prof. Dr. A. van 't Laar) en de afdeling Neurologie van het AZN (Hoofd destijds: Prof. Dr. B.P.M. Schulte) voor het beschikbaar stellen van klinische gegevens. Voor enkele gevallen was ik afhankelijk van de medewerking van het Centraal Bureau voor de Statistiek; toestemming hiervoor werd verkregen van de Geneeskundig Hoofdinspecteur van de Volksgezondheid, Drs. W.J.Chr. van Gestel.

Geduld is een schone zaak, diegenen die mij dierbaar zijn weten dit. Zij hebben er veel van opgebracht!

Curriculum vitae

Wouter Bastiaan Barendregt werd geboren op 20 mei 1957 te Amsterdam. Aan het Johannes Calvijn Lyceum te Rotterdam behaalde hij in 1975 het diploma Gymnasium β . In december 1981 werd de studie Geneeskunde aan de Erasmus Universiteit Rotterdam afgesloten met het arts-examen.

Van januari 1982 tot februari 1986 was hij werkzaam als 'medical officer' in het Gelukspan Community Hospital in Bophuthatswana, één van de zogenaamde thuislanden van Zuid-Afrika. In deze periode, in 1985, werd het eerste examen van het 'Fellowship of the College of Surgeons of South Africa' (FCS part I) met succes afgelegd.

Op 1 april 1986 werd de opleiding tot algemeen chirurg aangevangen in het Academisch Ziekenhuis St. Radboud te Nijmegen (destijds hoofd: Prof. Dr. H.H.M. de Boer, later: Prof. Dr. R.J.A. Goris). Vanaf 1 april 1989 tot 1 april 1992 werd het perifere deel van de opleiding genoten op de afdeling algemene chirurgie van het Canisius Wilhelmina Ziekenhuis te Nijmegen (hoofd: Dr. H.J.M. Joosten).

Sinds 1 april 1992 werkt hij als algemeen chirurg in vervolgopleiding (CHIVO) in de longchirurgie in het Canisius Wilhelmina Ziekenhuis (opleider Dr. H.W.O. Deleu).

STELLINGEN

behorende bij het proefschrift

AUDIT IN CLINICAL SURGERY

AN AUTOPSY STUDY

W.B. BARENDREGT

Nijmegen, 6 oktober 1992

1

De obductie is, ook in de moderne chirurgie, onmisbaar als methode voor kwaliteitsbewaking.
(dit proefschrift)

2

Postmortaal onderzoek leidt bij ongeveer 30% van geobduceerde chirurgische patiënten tot onverwachte bevindingen. (dit proefschrift)

3

Missers en fouten in diagnose en behandeling zijn voor een deel onvermijdbaar. (dit proefschrift)
Het 'publiek' dient hiervan op de hoogte te zijn.

4

Veelal worden complicaties van primair chirurgische aandoeningen gemist, niet de primaire diagnose zelf. (dit proefschrift)

5

Het B-formulier voor de doodsoorzaken-statistiek dient, in geval van te verrichten postmortaal onderzoek, pas volledig te worden ingevuld na de obductie, bij voorkeur na overleg tussen klinisch specialist en patholoog-anatoom. (dit proefschrift)

6

Verbetering van de gezondheidstoestand van de zwarte bevolking in Zuidelijk Afrika is in de eerste plaats afhankelijk van politieke en socio-economische veranderingen.
(S Afr Med J 1987;72:143-144)

7

De operatieve behandeling van tibia-fracturen geschiedt bij voorkeur met gebruikmaking van de niet-geboorde grendelpen.

8

Tussen ziekenhuismanagement enerzijds en 'werkers van de vloer', artsen en verpleegkundigen, anderzijds, bestaan vaak grotere controversen dan voor een goed lopend bedrijf acceptabel is.

9

De natuurwetenschappen verschaffen ons wel feiten en inzicht in processen, maar leren ons niet wie de Bron is.

10

In de laatste levensfase van de terminale patiënt moeten alle betrokkenen streven naar het thuis kunnen sterven.

11

Het medisch dossier: een moeilijke balans tussen onbeschreven en onleesbaar.

12

Vooralsnog heeft het computer-tijdperk de stapels papier alleen maar groter gemaakt.

13

Het manuscript wordt niet meer geschreven.

