THE ACCURACY OF DIAGNOSIS OF MYOCARDIAL INFARCTION : A CLINICO-PATHOLOGICAL STUDY.

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The clinical syndrome produced by myocardial infarction has been recognised for a comparatively short time, but even in 1919, within ten years of the first description of the dominant clinical features, Herrick said with some confidence that "..... these symptoms will often enable one to make a reasonably certain diagnosis of acute obstruction of the coronary artery." Since then, with the increasing incidence of the disease (Cassidy, 1946; Morris, 1951; Stevens, 1953), and with the added awareness of clinicians of the manifold ways in which it may present, the number of diagnoses of myocardial infarction has increased enormously. In the 1920's students rarely saw a case, and in 1923 only 3 cases were discovered in 471 autopsies done at the Royal/

Royal Infirmary, Edinburgh. And now, in the same hospital, still supporting the same number of medical beds about 500 cases are diagnosed annually.

Accuracy in the diagnosis of myocardial infarction, apart from being academically desirable is of considerable social, economic and medico-legal importance, not only to individuals but also to commercial and national institutions. It was therefore felt in view of the large numbers of diagnoses now being made that a critical assessment of the present standards of clinical diagnosis of the condition, with and without electrocardiographic assistance, would be of value.

Method:

In the Royal Infirmary of Edinburgh all cases submitted for post-mortem examination are accompanied by a form on which is given a provisional diagnosis and a brief abstract of the patient's history. When the pathologist's final report is made the provisional diagnosis and clinical note are included for comparison with the pathological diagnosis. The 1646 post-mortem reports for 1954 and 1955 were reviewed and all those cases suspected clinically of having had a recent myocardial infarct, or found at autopsy to have had one, were selected for study. No case was included in which only an old infarct was found at autopsy, unless a recent infarct had been suspected clinically; nor those in which the clinical history related only to old episodes. The cases

selected/

selected were then divided into three groups.

(i) Group I. Those in which the clinical diagnosis of a myocardial infarct was substantiated at post-mortem.

(ii) Group II. Those in which the clinical diagnosis of myocardial infarction was not confirmed at autopsy.

(iii) Group III. Those which were sent to autopsy with a provisional diagnosis other than myocardial infarction, but were found at autopsy to have had, though not always to have died from, a myocardial infarct.

From the central electrocardiographic files it was possible to find out which cases had had an electrocardiogram, its date and the electrocardiographic diagnosis made at the time. The electrocardiographic interpretations were then correlated with the autopsy findings. In all cases 12 leads were recorded routinely, additional precordial leads being occasionally recorded if indicated by the initial 12 lead tracing.

During the period under study the hearts of nearly all the cases known to have had, or suspected of having had a myocardial infarct were specially examined by pathologists with a particular interest in coronary artery disease and using either injection or serial slicing techniques.

Results; /

Results:

In 1954 and 1955 a total of 1075 cases of myocardial infarction were diagnosed in this hospital, and, of these, 247 died giving a mortality rate of 24%. A post-mortem examination was done on 214 of the cases that died.

The findings in the various groups were as follows, (Table I).

(i) Group I. Cases in which the clinical diagnosis of infarction was confirmed. There were 57 cases in this group in 1954 and 61 in 1955, making a total of 118 cases.

(ii) Group II. A clinical diagnosis of infarction without post-mortem confirmation. This group contained 55 cases in 1954 and 41 cases in 1955: total, 96 cases.

(iii) Group III. Cases found at autopsy to have had myocardial infarcts unsuspected clinically. There were 29 such cases in 1954 and 23 in 1955 : total, 52 cases.

These figures showed that of the cases suspected clinically of having had infarcts, groups I & II, almost as many were found not to have had infarcts as were found to have had them. A detailed analysis of the final pathological diagnosis in every case in group II was therefore made (Table II). These final diagnoses could be divided into four main groups - cardiovascular diseases, pulmonary diseases, deaths associated with operations, and a small group of miscellaneous diseases.

The/

ABLE I.

GROUP	DIAGNOSIS	1954	1955	TOTAL
I	Clinically - myocardial infarct			
	Autopsy - myocardial infarct	57	61	118
II	Clinically - myocardial infarct			
	Autopsy - other diagnosis	55	41	96
III	Clinically - other diagnosis			
	Autopsy - myocardial infarct	29	23	52
	TOTAL	141	125	266

TABLE II.

FINAL DIAGNOSES IN CASES SENT TO POST-MORTEM AS ? MYOCARDIAL INFARCT, AND FOUND TO HAVE DIED FROM OTHER CAUSES.

FINAL DIAGNOSIS	1954	1955	TOTAL
I CARDIOVASCULAR.			
Pulmonary embolus	7	7	14
Gross coronary sclerosis (no infarction)	4	10	14
Congestive failure: pulmonary oedema	6	6	12
Aortic aneurysm, ruptured or dissecting	5	2	7
Pericarditis	4	2	6
Cor pulmonale	4	1	5
Mesenteric embolus	1	-	1
Aortic stenosis	1	-	1
II PULMONARY.			
Pneumonia, pleural effusion	10	3	13
Atelectasis	-	2	2
Carcinoma	1	-	1
III ASSOCIATED WITH OPERATIONS.			
Shock : bleeding	8	4	12
Fat embolism	-	1	1
IV OTHER CONDITIONS.			
Ruptured oesophageal varices	-	1	1
Ruptured gall bladder	-	1	1
Ruptured gastric ulcer	-	1	1
Disseminated lupus erythematosus	1	-	1
Meningo-vasc. syphilis	1	-	1
Haemochromatosis : cancer of liver	1	-	1
Lymphosarcoma	1	-	1
TOTAL	55	41	96

The cases with gross coronary atheroma, sometimes with occlusion but without infarction, and those with pulmonary emboli accounted for almost one third of the diagnostic errors. Pneumonia was the final diagnosis in thirteen cases. Peripheral shock was considerable in these patients and most of them died soon after admission.

Twelve cases died within a few hours of operation, usually having "collapsed" a varying time before death. There was usually found to have been haemorrhage at the site of operation or no cause for death could be found, other than the operation itself. Forty-eight patients were sent to autopsy from surgical wards with a provisional diagnosis of myocardial infarction; but an infarct was found in only 13 of these cases. However, in 18 additional cases from surgical wards myocardial infarcts were found when they had not been suspected clinically.

The provisional diagnoses with which the 52 patients in groups III were sent to autopsy were also analysed, (Table III). Cases with a diagnosis of congestive or left sided heart failure formed the largest group. Those thought to have had pulmonary emboli were next in frequency, and this diagnosis was often made because of the suddenness of the death. The four cases with extensive carcinomatosis also had myocardial infarcts, and, similarly,/

TABLE III.

CASES SENT TO AUTOPSY WITH OTHER DIAGNOSIS AND FOUND TO HAVE HAD A MYOCARDIAL INFARCT.

CLINICAL DIAGNOSIS	1954	1955	TOTAL
Congestive failure : left ventricular failure	9	6	15
Pneumonia	3	1	4
Pulmonary embolus	4	5	9
Extensive carcinoma	2	2	4
Uraemia	1	2	3
Cerebral haemorrhage	5	1	6
Post-operative shock	1	4	5
Bronchial carcinoma	2	-	2
Multiple emboli	1	1	2
Ruptured aortic aneurysm	1	-	1
Septic wound	-	1	1
TOTAL	29	23	52

simlarly, the 6 cases dying from cerebrovascular accidents had both conditions simultaneously.

All the cases that died shortly after admission, or before there was time to complete the necessary investigations, and all those dying unexpectedly, even although they had been in the ward for some time, were classed as cases of sudden death. Many of these cases were sent to autopsy with a provisional diagnosis of myocardial infarction or pulmonary embolism.

In 1954 there were 64 cases of sudden death, 48 from medical wards and 16 from surgical, and 33 of these actually had myocardial infarcts. In 1955 there were 68 such cases, 47 medical and 21 surgical, with 41 deaths from myocardial infarction, (Tables IV A & B). In the whole period 74 cases of sudden death died from myocardial infarction, and in 55 of these there was previous evidence of coronary artery disease in the form of a history of angina or previous infarction, or a previous electrocardiogram showing the changes of infarction or myocardial ischaemia. Some of the cases died suddenly during the course of an admission following a myocardial infarct.

Fifty-three of the cases of sudden death had previously had an electrocardiogram. In thirty-five instances a recent record indicated infarction, and in 33 cases recent infarction was found at post-mortem. The two cases not showing pathological evidence of recent infarction had electrocardiograms indicating old/

TABLE IV

"SUDDEN" DEATHS

NUMBERS FROM MEDICAL AND SURGICAL WARDS.

	MEDICAL	SURGICAL	TOTAL
1954	48	16	64
1955	47	21	68
TOTAL	95	37	132

TABLE IV

NUMBERS WITH AND WITHOUT MYOCARDIAL INFARCTS.

	1954	1955	TOTAL
With myocardial infarct	33	41	74
Without myocardial infarct	35	23	58
TOTAL	68	64	132

old infarction, and they both collapsed and died in minutes some days after their last electrocardiogram. There was a recent coronary occlusion in both cases and it was thought that insufficient time had elapsed between the onset of the attack and death for the pathological changes of infarction to develop. Only one case died suddenly of an infarct having had a recent electrocardiogram which gave no evidence of this. The electrocardiogram which was taken 6 days before death showed only non-specific T wave changes, and at autopsy a very recent anterior infarct was found.

In 1954, of the 141 cases whose post-mortem reports were studied 60 had had an electrocardiogram done recently, before death. A "recent" electrocardiogram was taken to mean one done not longer than a month before the patient's death, and preferably during the course of the final admission. In 1955 there were 125 cases studied, of which 56 had had a recent electrocardiogram. Thus, of the 266 cases in all groups, 116 had had a recent electrocardiogram, (Table V).

The patients in groups I & II were all sent to autopsy with a provisional diagnosis of myocardial infarction. Therefore the cases in these two groups might reasonably have been expected to have had their electrocardiogram recorded, if time permitted, in/

TABLE V.

	NUMBER OF CASES STUDIED	NUMBER WITH RECENT ECG.
1954	141	60
1955	125	56
TOTAL	266	116

in order to clarify or confirm the diagnosis. There were 214 patients in these two groups, 97 of whom had recent electrocardiograms; so the majority of patients with recent records were found in these two groups.

In correlating the electrocardiographic interpretations with the autopsy findings a correct electrocardiographic diagnosis was considered to be one which definitely indicated the myocardial damage later confirmed at autopsy. In some instances the precise localisation of the infarct was incorrectly made electrocardiographically; but if the electrocardiogram was reported as showing recent damage and such damage was found at autopsy then the report was regarded as "correct", for practical diagnostic purposes. Such a correct interpretation was made in 91 out of the 97 cases that had a recent electrocardiogram. (Table VI).

There were six "incorrectly" diagnosed cases. In three of these left bundle-branch block was present and there were non-specific changes in the others, interpreted as possibly due to myocardial ischaemia (Table VII). There was recent through and through infarction in the three cases with left bundle-branch block, subendocardial damage in two of the others, and a recent apical infarct in the sixth, a patient who died eight days after the last electrocardiogram.

Fifteen/

TABLE VI

	No. OF CASES IN GROUPS I & II	No. WITH RECENT E.C.G.	CORRECT E.C.G. DIAGNOSIS
1954	112	54	51
1955	102	43	40
TOTAL	214	97	91

TABLE VII

ANALYSIS OF "INCORRECT" ELECTROCARDIOGRAMS

	TIME OF E.C.G. BEFORE DEATH	E.C.G. DIAGNOSIS	PATHOLOGICAL DIAGNOSIS
1.	8 days	Abnormal: ? ischaemia	Recent apical infarct.
2.	2 days	Left bundle branch block	Recent apical infarct.
3.	Day of death	ST shifts: acute ischaemia	Subendocardial infarct.
4.	Day of death	Left bundle branch block	Recent posterior infarct.
5.	Day of death	Left bundle branch block	Recent antero-lateral infarct.
6.	6 days	Abnormal: ? ischaemia	Subendocardial infarct.

Fifteen of the patients in group III had been electrocardiographed at varying times before death, (Table VIII). In one case (No.4) the clinical diagnosis was that of peripheral and pulmonary emboli, although an electrocardiogram on the day of death showed clear-cut evidence of recent antero-septal infarction, which was later found at post-mortem. The patient died very soon after the electrocardiogram had been taken and before a report was available A clinical diagnosis of myocardial infarction was not made before death, and the case was therefore included in this group. In some of the cases the myocardial infarction obviously occurred after the last electrocardiogram, but in others an equivocal electrocardiographic report of possible myocardial damage was evidently not accepted as sufficient support for a diagnosis of myocardial infarction.

Many of the patients in groups I & II who were believed to have sustained myocardial infarcts died suddenly before adequate investigations could be carried out but the patients whose deaths were not sudden had all been in the wards for a sufficient time for investigations to be carried out and a reasonably firm diagnosis made.

There were 96 non-sudden deaths in groups I & II, and only 59 of these were found to have had infarcts. Fifty-nine of the 96 patients had had a recent electrocardiogram; but the patients who/

TABLE VIII

E.C.G. FINDINGS IN CASES FOUND AT POST-MORTEM TO HAVE HAD A RECENT MYOCARDIAL INFARCT UNDIAGNOSED CLINICALLY.

	CLINICAL DIAGNOSIS	TIME OF ECG BEFORE DEATH	ECG FINDINGS	P.M. FINDINGS
1	Congestive failure	4 days	Old anterior infarct	Recent apical infarct
2	Left sided failure	4 days	?posterior damage	Recent post. infarct
3	Congestive failure	10 days	?posterior damage	Recent post. infarct
4	Peripheral & pulm. emboli	day of death	Antero-septal infarct	Recent ant. infarct
5	Carcinomatosis	1 month	Non-specific changes	Recent post-lat infarct
6	Pulmonary embolus	5 days	Old posterior infarct	Recent ant. infarct
7	Congest. failure: pulmonary infarct	2 days	Old posterior infarct	Recent post. infarct
8	Cerebral haemorrhage	1 year	Non-specific changes	Recent ant. infarct
9	Pneumonia	10 days	digitalis effects	Recent post. infarct
10	Congestive failure	6 days	Old anterior infarct	Recent (3 day) ant. infarct
11	Congestive failure	2 days	Recent post. ischaemia	Recent post. infarct
12	Pulmonary oedema	Day of death	Acute ischaemia	Recent post. infarct
13	Congestive failure	5 days	Non-specific changes	Subendocardial infarct
14	Left sided failure	12 days	Non-specific changes	Recent apical infarct
15	Pulmonary embolus	6 weeks	Posterior infarct	Old & recent posterior infarct

who had electrocardiograms were not necessarily the ones in whom infarcts were found at autopsy. In 1955 27 patients with non-sudden deaths had autopsy proven infarcts; but 32 patients had electrocardiograms, some of them dying from causes other than myocardial infarction (Table IX).

There were 23 patients in 1954 and 14 in 1955 who were diagnosed clinically as having died from myocardial infarction, who did not die suddenly and in whose cases no electrocardiograms were taken to substantiate the clinical impression. Only 13 of these 37 cases actually had myocardial infarcts, while 24 did not (Table X). The final diagnoses in those patients who did not have myocardial infarcts, although clinically thought to have had them, are given in Table XI.

Discussion

This study was designed to answer three main questions. How accurate are the present methods of diagnosis? What conditions are confused with myocardial infarction, and what conditions may mask it? How accurate is electrocardiography in diagnosing myocardial infarction, and how does a clinical diagnosis alone, without electrocardiographic aid, compare in accuracy with that confirmed by an electrocardiogram?

Any investigation based on post-mortem examination reports necessarily has inherent faults (Mainland, 1953). The group studied is selected, and in this series some of the cases were sent

to/

TABLE IX

	1954	1955	TOTAL
Non-sudden deaths in Groups I & II	50	46	96
Number with myocardial infarct	32	27	59
Number with E.C.G.	27	32	59

TABLE X

NON-SUDDEN DEATHS IN GROUPS I & II WITHOUT A PREVIOUS ECG

	1954	1955	TOTAL
Total number	23	14	37
With myocardial infarct	8	5	13
Without myocardial infarct	15	9	24

TABLE XI

FINAL DIAGNOSIS IN 24 CASES NOT DYING SUDDENLY AND DIAGNOSED AS HAVING MYOCARDIAL INFARCTS WITHOUT E.C.G. CONFIRMATION.

P.M. No.	FINAL DIAGNOSIS
192/54	Calcified pericardium.
198/54	Coronary sclerosis: myocardial fibrosis.
275/54	Uraemic pericarditis.
281/54	Malignant prostate (known): broncho-pneumonia.
293/54	Broncho-pneumonia: pleural effusion.
341/54	Coronary sclerosis: myocardial fibrosis.
367/54	Miliary T.B.: pulmonary oedema.
472/54	Coronary sclerosis: myocardial fibrosis.
505/54	Haemochromatosis: portal vein thrombosis.
542/54	Post-operative aspiration of vomit.
644/54	Mitral stenosis: mesenteric embolus.
665/54	Lobar pneumonia: pleural effusion.
712/54	Hypertension: congestive failure.
5/55	Dissecting aortic aneurysm.
87/55	Aortic regurgitation, rheumatic.
138/55	Coronary sclerosis: cerebral haemorrhage.
213/55	Pulmonary embolism.
247/55	Acute pericarditis.
289/55	Fat embolism
436/55	Cerebral infarction: pulmonary thrombosis.
741/55	Ruptured oesophageal varices.
760/55	Post-cholecystectomy haemorrhage.
801/55	Coronary sclerosis: myocardial fibrosis.
844/55	Pulmonary embolus.

to autopsy either because the clinician responsible for their care in life was particularly interested in coronary artery disease or because there was sufficient doubt about the diagnosis to warrant an autopsy for clarification. However, since 86% of the cases dying in the hospital of myocardial infarction were autopsied a fair sample was probably obtained.

The development of knowledge about a disease by clinico-pathologic methods progresses through two stages. In the first the clinical histories of patients found at autopsy to have died from the disease are studied to correlate, retrospectively, the clinical features with the pathological changes. In the second stage the information thus obtained is used to predict during life the changes that will be found after death. The majority of the clinico-pathologic studies of myocardial infarction have used the first method only, and the accuracy of the clinical impressions on which the diagnosis is inevitably based, whether corroborative investigations are done or not, has not been critically analysed.

Baer and Frankel (1944a, 1944b), in an extensive study of cases of myocardial infarction over a 21 year period selected 378 case records for detailed analysis out of 508 in their hospital files in which the final diagnosis had been myocardial infarction. In the remaining 130 cases there was insufficient clinical, electrocardiographic or pathological evidence on which an unequivocal diagnosis/

unequivocal diagnosis of myocardial infarction could be based. Thus, in 130 cases out of 508 a diagnosis of myocardial infarction was made, apparently without conclusive evidence.

Meakins (1932) and Wood (1950) both believed that the diagnosis of myocardial infarction was made too frequently. However, Yater, et al (1948) in a pathological study of myocardial infarction in young soldiers, aged 18-39 years, found a diagnosis accuracy rate of only 58%. And Zinn & Cosby (1950) found an accuracy rate of 70% for clinical diagnosis alone, without electrocardiographic aid.

In this series it was found that an incorrect diagnosis, taking all the patients in groups II & III, was made more frequently than a correct one, as there were 148 autopsy proven incorrect diagnoses and only 118 correct.

This might seem to be a reflection upon the diagnostic skill of the physicians responsible, but almost half the cases died suddenly. Insufficient time was available for complete investigations and in many cases the patient died so unexpectedly that the diagnosis of myocardial infarction was made largely because of the precipitancy of the death. However, although the numbers were small, an impression was gained that the purely clinical diagnosis of myocardial infarction is inaccurate. In the group of "non-sudden deaths" sent to post-mortem with a diagnosis of myocardial infarction, but without electrocardiographic proof there were/

were only half as many (13) correct as incorrect (24) diagnoses.

The clinical features of the classical case of myocardial infarction have been described with brilliant clarity by many authors (Herrick, 1912, 1919; Hamman, 1926; Parkinson and Bedford, 1928; Levine, 1929) and such cases seldom give rise to diagnostic errors, except in those instances, of which there were fourteen in this series, when typical, severe symptoms are due to gross coronary artery sclerosis alone without actual infarction. Acute upper abdominal emergencies have long been cited (Levine & Tranter, 1918) as differential diagnoses; but only two errors of this type were found in this investigation, in a hospital dealing with hundreds of abdominal emergencies and myocardial infarctions yearly. Clearly a careful history and physical examination distinguish between the vast majority of these cases.

Parkinson and Bedford (1928) defined three types of clinical presentation, one with sudden death, another with characteristically severe pain and a third with breathlessness, or other signs, but without pain. It is in the first and last types of case that the errors in diagnosis, both of omission and commission, are made.

Any condition that presents with severe chest pain or breathlessness - dissecting aortic aneurysm, acute left ventricular failure, pericarditis, cor pulmonale, pneumonias - may be a source of/

of error; and the number of cases of pneumonia in this series considered to have had myocardial infarcts was surprisingly high (13).

The differential diagnosis between massive pulmonary embolism and myocardial infarction may be very difficult (Hamman, 1934), but is often only of academic interest as the patient dies within a very short time. The difficulties may be judged from the fact that almost as many patients were thought to have had pulmonary emboli and found to have had myocardial infarcts, (9), as were thought to have had infarcts and found to have had emboli (14). One patient who had already developed a deep vein thrombosis suddenly became acutely dyspnoeic and died within an hour, but from massive myocardial infarction and not from pulmonary embolism.

It was found that of the patients dying suddenly from myocardial infarction a high proportion (74%) had a previous history of coronary artery disease; and all those with electrocardiographic evidence of coronary artery disease before death who died suddenly died from myocardial infarction. Therefore a previous history of ischaemic heart disease in a patient who collapses or dies suddenly weighs heavily in favour of a diagnosis of myocardial infarction.

There are few conditions that will produce sudden death, and the majority of reports refer to coroner's cases, the patient's dying suddenly in the street or at their work. Hamman (quoted by Harvey, 1955) found that non-valvular heart disease accounted for 48% of cases of sudden death. Bedford (1938) reviewing 198 cases seen/

seen between 1910-1930 found a cardiac cause to be present in 122 cases, 87 of these being non-valvular lesions; and 80 deaths were ascribed to coronary artery disease. The circumstances of death in this series are not entirely comparable for the patients had nearly all been under observation for some time before they died. In the two years under study 132 patients died suddenly in the wards, and of these, just over half (74) actually died from myocardial infarction.

Patients who collapse or die suddenly during or shortly after operation present difficult problems in differential diagnosis. Forty-eight patients from surgical wards were sent to autopsy with a provisional diagnosis of myocardial infarction, only 13 of whom were found to have had infarcts; and in 18 other surgical patients in whom myocardial infarction had not been suspected it was found at autopsy. Most of these patients had been operated on within five days of death and failed to recover or unexpectedly deteriorated after a few days, without giving any history suggesting myocardial infarction.

The difficulty of diagnosing myocardial infarction in the post-operative period has been recognised for a long time (Menard & Hurxthal, 1931; Master, Dack, Jaffe, 1938). The chief difference between the usual and the post-operative syndrome is the frequent absence of pain in the latter (Jacobs, 1951). The incidence of this complication was found to be 0.75% (15 cases in 20,000 operations by/

by Wroblewski and LaDue (1952). It usually occurs within the first 3-5 days after operation, and carried a mortality rate of 40-60% (Master, et al, 1938; Wroblewski, et al, 1952), and hypotension during and after the operation appears to be of particular aetiological importance. The more frequent use of electrocardiography in the investigation of unusual post-operative syndromes was urged twenty-five years ago (Menard, et al, 1931) and this is still, perhaps, a lesson incompletely learned.

The conditions diagnosed clinically in the patients in group III are those that mask myocardial infarction. Cases presenting as congestive and left sided heart failure predominate. Robertson (1954) has already drawn attention to the aetiological relationship of silent myocardial infarctions to unexplained pleural effusions in people over 40 years, and the findings were emphasised that congestive failure is not a diagnosis by itself, especially in the elderly, for the average age of the 14 patients in group III sent to autopsy with a provisional diagnosis of congestive or left sided heart failure was 73.9 years. The onset of unexplained heart failure in this age group should raise the suspicion of underlying myocardial infarction.

The simultaneous occurrence of cerebro-vascular accidents and/

and myocardial infarcts has been previously noted by Bean (1949) who drew attention to those cases in which the hemiplegia resulted neither from cerebral haemorrhage nor thrombosis but from ischaemic changes secondary to hypotension. However, in this series all the cases had either cerebral haemorrhages, or major thrombosis, but in none of them was there evidence that the cerebral damage was due to embolism from mural thrombi adherring to a recent myocardial infarct. That myocardial infarcts and cerebro-vascular accidents not uncommonly occur coincidentally draws further attention to the unity of degenerative vascular disease, presenting now in one way, now in another, but never affecting a single section of the vascular tree alone. In a recent survey in the Department (Oliver, 1956) of the electrocardiographic findings in 50 unselected cases of cerebral haemorrhage and thrombosis, not a single case was found to have an entirely normal electrocardiogram, and almost 15% were found to have had myocardial infarcts, old or recent.

Much has already been written about the accuracy of electrocardiographic diagnosis (Barnes, 1935; Feil, Cushing, Hardesty, 1938; Katz, Goldman, Langendorf, Kaplan, Killian, 1942; Baer, Frankel, 1944; Failey, 1949; Zinn, Cosby, 1950; Gray, 1953). So far as the clinicians is concerned the question to be answered by taking an electrocardiogram is,"Has the patient had a myocardial infarct?." Therefore the accuracy of the electrocardiogram in determining/

determining the precise site of infarction is of minor importance and has not been considered here. If the electrocardiogram showed definite evidence of recent infarction, or if changes sufficiently suggestive were present to make the reporter say that myocardial infarction was highly likely, although typical changes had not been recorded, then the electrocardiogram was regarded as having given a correct diagnosis. Using other criteria of correctness or incorrectness various grades of diagnostic accuracy from 52-94% have been reported (Baer, et al, 1944; Failey, 1949). Most authors agree that old infarction may be very difficult or impossible to diagnose electrocardiographically, but that the diagnosis of recent infarction is very accurate, and, certainly no case with a recent infarct will have an entirely normal electrocardiogram.

Feil, et al, (1938) found a correct electrocardiographic diagnosis had been made in 28 out of 34 cases, using three standard leads and two chest leads. They found an accuracy rate of 100% with single recent infarcts, and a rate of 70% when combined old and recent infarcts were present. Gray (1953) using 12 leads found that 77% of acute infarcts were diagnosed correctly, but only 30% of old infarcts. After a detailed study of the electrocardiographic findings in 149 consecutive autopsy cases, Katz, et al, (1942), concluded that the criteria used by them in diagnosis were accurate, and in no case was a patient with any abnormality of the electrocardiogram found at autopsy to have a normal heart. One of the defects/

defects in several of these studies has been that no precise information of the date of the electrocardiogram in relation to the clinical episode or death of the patient has been given, and some of the interpretations in the older papers might now be altered in favour of according greater accuracy to the electrocardiogram.

It has been our experience that the electrocardiographic diagnosis of recent myocardial infarction is very accurate, only six incorrect diagnoses being made in 97 cases. And since left bundle branch block, a pattern known to mask nearly all the changes of infarction, was found in half the cases, and, pathologically, subendocardial infarction only was found in two of the others, the degree of accuracy was, if anything, greater than represented.

The need for serial tracings and multiple chest leads if the greatest possible accuracy is to be obtained has previously been emphasised (Katz, et al, 1942; Hill, 1950). Failey (1949) and Zinn and Cosby (1950) found a significant increase in diagnostic accuracy by the use of augmented unipolar limb leads and 6 precordial leads. The use of these additional leads increased the possibility of a correct diagnosis by 20-40%, and meaned that errors were due to faulty interpretation rather than lack of information.

In view of these findings, and since the purely clinical diagnosis of myocardial infarction tends to be inaccurate, it would seem inadvisable to rule out this diagnosis until adequate electrocardiographic investigations have been undertaken with serial 12 lead tracings;/

tracings; and it would further seem that in even the most typical cases the diagnosis should be confirmed electrocardiographically as soon as possible, for the purpose of both directing treatment and documenting for future reference the correctness of the clinical impression.

Summary

(1) The 266 post-mortem records of those found to have died from or suspected of dying from myocardial infarction in The Royal Infirmary, Edinburgh, in 1954 and 1955 have been reviewed.

(2) The accuracy rate in the diagnosis of myocardial infarction is surprisingly low, being 44% when the cases only discovered at autopsy are taken into account. The major diagnostic errors occur in patients who died suddenly or present in an atypical way.

(3) A greater awareness of the possibility of underlying myocardial infarction in elderly patients with unexplained heart failure or pleural effusions, in cases with cerebro-vascular accidents, and in post-operative patients whose condition inexplicably deteriorates might lead to a decrease in diagnostic errors.

(4)/

(4) About 50% of sudden deaths are due to myocardial infarction; and anyone who dies suddenly having given previous evidence, either clinical or electrocardiographic, of coronary artery disease, is almost certain to have died in this way.

(5) The electrocardiographic diagnosis of recent myocardial infarction is very accurate, and a clinical diagnosis alone without electrocardiographic corroboration, when this is available, is no longer justifiable.

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