

A medico-legal view on the importance of the external examination of the traumatized patient

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Abstract: *Introduction.* the correct registration of the external traumatic lesions is extremely important in the clinical management of the trauma, as well as in its forensic and judicial assessment. Nevertheless, the quantity and quality of the information registered in the observation charts may be suboptimal, thus significantly affecting the forensic assessment regarding the cause of death, the relationship between lesions and death, and therefore the judicial implications of the case.

Material and method. We have conducted a study on a sample of 77 consecutive deaths by violence, all examined at the Institute of Legal Medicine in Iasi. A comparative analysis was conducted of the external lesions documentation in the observation chart and the forensic autopsy report, and a degree of consistency was established between the two. For each case a series of data was collected and then statistically analyzed in order to observe the existence of a correlation between the degree of accordance and of the two examinations and the registered parameters.

Results. the present study has found 62.3% discordant cases. From the selected parameters, three were correlated to the degree of concordance, having the capacity to foretell whether an external lesion would be registered correctly in the observation chart: the biochemical analysis level - patients who received complete blood investigations were more frequently subject to complete skin examination in the clinic; the existence of a surgical intervention - concordance was higher in patients who suffered a surgical intervention during hospitalization; cause and context of death - patients who died as a result of burns or electrocution showed perfect concordance in 100 % of cases, while less than 3 % of patients who died in the context of aggression were recorded all types of injury.

Conclusions. Better documentation of external injuries in hospital is many times essential for the medico-legal evaluation and the subsequent judicial implications. While there are factors that may explain the disregard of the registration of all traumatic marks, in the context of lack of time and the need for quick delivery of treatment, the importance of the observation sheet as a document of medico-legal and legal value must be recognized by all physicians.

Key Words: injuries, clinic, autopsy, description, concordance.

Correctly recording and documenting external traumatic injuries is particularly important because it allows for, on the one hand, the appropriate therapeutic approach, and on the other hand, for the correct medico-legal and judicial evaluation [1].

The lack of correct and comprehensive registration of the external traumatic injuries present on the victim's body on admission can lead to incorrect medico-legal interpretations and, inferentially, to avoidable judicial errors [2], and may also raise suspicions of malpractice if

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the lesions are considered to have been acquired during hospitalization [3].

However, the quality and quantity of information recorded in the national registers of trauma or observation sheets are often insufficient [4]. This aspect can adversely affect autopsy findings, particularly in the case of violent death, since establishing cause and mechanism of death and causality often depends on the macroscopic examination of the surface of the skin. Moreover, if the patient dies after a long period of hospitalization, certain external injuries may disappear, in which case the skin changes/damages recorded on the observation sheet upon the victim's admission in the hospital unit become essential for the medico-legal assessments.

MATERIAL AND METHOD

Study design

We performed a retrospective study on a sample of 77 cases examined post-mortem at the Institute of Legal Medicine in Iasi. The inclusion criteria were: the type of death (violent deaths), the existence of documentation concerning the patient's clinical examination registered in the hospital (pre-mortem) and the record of a change in the skin and/ or mucous membranes in the autopsy report.

Cases were the consecutive autopsies that have met the criteria for inclusion in the study. In all of the analyzed cases, the autopsy was performed upon the investigator's request, under the provisions of laws in effect in Romania, which state that forensic autopsy is mandatory in all cases of violent death (The Romanian Code of Criminal Procedure, art. 185). All post-mortem examinations were performed at least 24 hours after the declared time of death, and the examination technique was similar in all cases.

A comparative analysis of the registration of external injuries on the observation chart and the autopsy report was performed, the documents being

obtained from the archives of the Institute of Legal Medicine in Iasi. The comparison of the two documents was performed by three specialists in internal medicine, orthopedics- traumatology and forensic medicine. A degree of concordance (C1) of the external examination of the skin and mucous membranes was established. We performed a stratification regarding the degree of concordance (Table 1) to facilitate subsequent statistical comparisons. The registration included in the autopsy report was considered the reference.

External injuries resulting from vein puncture and cardio-pulmonary resuscitation, as well as any change at skin level that occurred after the initial examination at admission (for example post-surgical scars, bedsores, etc.) were excluded from the analysis of concordance.

Using the observation charts and autopsy reports we collected a series of data for each case, which were organized as follows: demographic data (sex, age, origin), clinical data (the hospital and ward where death occurred, number of days of hospitalization, whether the patient was transferred or not, whether the patient was subject to an inter-clinical consult or not; also, both the biochemical as well as the imagistic analysis performed was recorded) and information regarding death and post-mortem examination (histological, toxicological and serological examinations, cause and mechanism of death, as well as the context of the occurrence of death – traffic accident, fall, crash, burn/ electroshock, poisoning, etc.).

Data analysis

The collected data were analyzed using SPSS version 20; descriptive and inferential analyzes were performed. The potential influence of each parameter over the degree of compliance (r ratio) was tested; if the analysis indicated a degree of influence, we analyzed the potential statistically significant connection between said parameter and the degree of concordance. Considering that the collected data was of the parametric as well as the non-parametric type, the t and the Mann - Whitney U

Table 1. Classification used to determine the degree of correspondence between the results of the clinical skin and mucosal examination and the post-mortem external examination

Correspondence between the results of the clinical skin and mucosal examination and the post-mortem external examination (C1):	
CLASS	
1	all injuries were recorded in both documents (clinical observation chart and the autopsy report)
2 a < 1 cm b > 1 cm	injuries located in the traumatized area were not noted in the observation chart (caused by recent trauma or which led to hospitalization)
3 a < 1 cm b > 1 cm	injuries outside the area affected by trauma were not noted in the observation chart
4	the "skin examination" section on the observation chart remained blank- no injuries were recorded
5	no injuries were recorded on the observation chart, neither in the traumatized area, nor outside of it

tests were both used. Statistical significance was defined as $p < 0.05$; variables were considered independent for the statistical analysis.

Limits of the study

The design of this study is retrospective and it is based on the premise that the data recorded in the clinical and medico-legal documents is correct. The study was conducted in a single medico-legal institute, thus the results cannot be compared to similar data from other centers in Romania. Also, the number of cases is relatively small. These issues, as well as the results, suggest the need to extend this study in order to include a larger number of cases, possibly from several regions.

RESULTS

Descriptive analysis

Demographic data. Descriptive data analysis revealed no statistically significant differences in gender (68.8 % of patients were male and 31.2% female) and area of origin (62.3% of patients came from a rural areas, while 37.7% were urban); average age was 56.5 years (standard error = 8.77).

Clinical data. Distributing the patients according to the hospital where death occurred showed a predominance of cases in neurosurgery and neurology hospitals (68.8 %), which we interpreted in the context of the high incidence of road accidents, often associated with polytrauma and a high death rate.

The distribution of patients by ward was uneven, as the number of deaths in surgical departments (neurosurgery, general surgery, traumatology) were predominant - 90.9 % vs. 6.5% in emergency wards and 2.6% in medical units.

We also found a higher frequency of cases in which samples for basic laboratory examination were collected (84.2 % vs. 15.8% of patients who were subject to examination specific to their pathology) and complex imaging investigations were performed - CT, MRI (63.2 % versus 36.8 % of patients who only received basic imaging investigations).

Average number of days of hospitalization was 5.5, with a minimum of 0 days (death in the emergency receiving unit within 24 hours of presentation) and a maximum of 27 days (violent death by burning).

In 56% of cases there was a transfer between hospitals or wards ante -mortem, 52.6 % of the victims required an inter-clinical consultation and 61 % were treated by surgical means for their injuries.

Data related to death and post-mortem examination. In over half of the cases there was a microscopic examination (63.6%) and a toxicological blood analysis (76.7%); determining blood alcohol concentration and urine alcohol concentration was performed only in cases where the period of

hospitalization was less than 24 h (27.3 % of the cases). Most of the deaths were caused by mechanical factors (81.8 %), most commonly in the context of falling (41.6 %) and traffic accidents (27.3 %).

Concordance of external examination

Descriptive analysis of the concordance (C1) between skin examination recorded in the observation sheet and skin examination recorded in the autopsy report revealed that a 100% concordance - all external traumatic injuries recorded in both medical records (observation chart and autopsy report) - was noted in 37.7 % of the cases. Most commonly, these patients died due to burns (in all cases of death due to burning and electrocution, all injuries were correctly recorded in the hospital) or cranio-cerebral trauma.

Twenty two percent of patients in the study had external injuries observed at medico-legal examination, but none of them were recorded on the observation chart, the "skin and mucosal examination" section remaining blank or containing the phrase "uncharacteristic" (complete discordance between the external examination at the hospital and the examination performed at the autopsy). 40.3 % of the cases presented lesions over 2 cm in size, located either in the traumatized area or outside it, which were not specified in the external examination written on the observation chart (partial disagreement).

Analysis of factors that could influence the concordance between injuries recorded on the observation sheet and recorded on the autopsy report.

Analysis of the data collected to identify those factors that could influence the rate of concordance between skin and mucosal examination results recorded in the observation sheet and autopsy report revealed a statistically significant relationship between C1 and the following parameters: biochemical analysis, surgical treatment, the cause and context of death.

1. Biochemical analysis

In our study, dividing investigations into "core analysis" and "investigations targeting at the organ" regarded their level of specificity and was adapted to the situation and procedures in Romania.

The predominance of the cases where basic biochemical analyzes were performed (84.2% of cases) can be explained either by the average hospital stay of 5.5 days, indicating the lack of time needed to carry out complex investigations, or by matters related to cost and availability.

In those patients that have been subject to investigations targeted on an organ, these being considered complex investigations, we observed a higher frequency of complete concordance (75 % of patients vs. 31.2 % of patients with basic investigations were classified in category 1). This statistically significant result ($p = 0.007$) can be explained by the fact that those patients

who underwent only basic analysis died on average in a shorter time than those who have been subjected to more complex investigations.

2. Surgery

Distribution of the sample dependant on whether or not a surgical procedure was performed on the patient during hospitalization (61 % vs. 39 %) may seem surprising in the context of correlation with the number of cases admitted to surgical wards, but can be explained by two mechanisms: firstly, there is a number of burn patients (10 % of the cases), which until the time of death were monitored in a surgical unit without the need for surgical intervention; secondly, some patients were considered to be unstable, this contraindicating surgery, while others were hospitalized for too short a period of time to be operated.

We found a statistically significant difference ($p = 0.01$) between patients who underwent surgery (52.7 % of them were classified in class 1 of correspondence) and those who did not necessitate surgical management (only 28.8 % of them were classified in class 1). Moreover, the "skin examination" section remained blank in most cases (31.1 % vs. 18.1%) in the group without surgery. This result can be explained by the fact that pre-operative preparation of the patient requires a careful clinical examination.

3. Cause and context of death

Most of the deaths in the study group were caused by mechanical factors, most often in traffic accidents (81.8%) with traumatic brain or spinal cord injuries. In these cases, considered to be medico-legal cases from the start, there was often a discrepancy between the external injuries recorded in the observation chart and the ones recorded in the autopsy report - only 25 % of patients were classified in category 1; moreover, if 27 % of the observation sheets, "skin examination" section remained blank and 31.7 % of cases it was considered "normal" while the external injury marks appear in most mechanically caused deaths.

Less than 3 % of patients who died in the context of aggression had all of the traumatic injuries recorded on the observation chart. Only 23.8 % of deaths in the context of road and rail accidents and only 24.2 % of deaths due to falling were included in class 1 of concordance.

Concordance analysis regarding deaths caused by burning (14.3 % of patients) revealed, in all cases, a correct and comprehensive clinical examination of the skin - in this subcategory 100 % of cases are in class 1 of correspondence ($p = 0.003$).

This result can be explained by the fact that in the case of burns, both traumatized skin analysis and the analysis of other skin surfaces were instrumental in the therapeutic decision or allow the evaluation of the option

of grafting.

For deaths from poisoning- most commonly from alcohol intoxication- we also found a large percentage of cases considered to belong to the first class of correspondence (66.7 %, $p < 0.001$).

DISCUSSION

Accurate and complete documentation of external injuries of trauma patients is essential from therapeutic as well as medico-legal, legal, epidemiologic and health system management perspectives [1]. Some countries use the documents filled out in the hospital for trauma patients admitted consecutively, in order to perform epidemiological studies and to estimate budgetary resources [5].

These aspects also have practical applicability, for example in terms of improving vehicle safety systems (one of the main causes of violent death are road accidents) or optimizing strategies for the prevention of death due to falling [1].

An incomplete record may lead to uncertainty regarding the mechanism of action of the traumatic force, affecting the physio-pathological understanding of the injury, not only upon presentation at the emergency unit, but also during hospitalization. In addition, full documentation allows medico-legal experts to evaluate initial lesions and their evolution in time, allowing for relevant assessment of the cause of death, with important legal implications.

There are many situations where external examination at admission is particularly important. For example, in the case of a longer hospital stay when various changes may occur at skin level: bruising, pressure sores, hematomas - if they are not properly differentiated from existing injuries on admission, they may influence the medico-legal expert in terms of reconstructing the chain of events that resulted in death and lead to a classification of the type of death in a different legal category than the real one. Another possible situation involves those injuries that occurred shortly before death, which sometimes are difficult to distinguish from post- mortem lesions, especially if the body was improperly handled (abrasions or wounds most frequently) [6].

Post- mortem, important skin changes occur. The most common are cadaveric lividity, red -bluish colored areas of the skin of the lower parts of the body [7] relevant to diagnosing death. These changes must be differentiated [8] from bruises that are valuable clues to the mechanism of production and age of trauma [2]. Differential diagnosis becomes difficult in situations where bruising overlaps areas where cadaveric lividity is formed. An additional source of error may come from the fact that some bruising occurs later, rather than immediately after the aggression [9].

In a 2001 study [10], a comparison was made between medical records and autopsy reports of patients who died due to trauma after a period of hospitalization to assess diagnostic accuracy. Study results showed in 9% of cases a perfect correlation between the two documents and 452 errors for the 122 cases included in the study, which suggested the need to include data obtained from autopsy in the databases for trauma. Runyan *et al.* [11] analyzed the medical records of 129 ER type departments in terms of the type of information recorded and their accuracy, highlighting not only the significant variability of the documents and information, but also the lack of details concerning the external cause of injury.

The discrepancy between external injuries noted in the medical records and medical reports was also highlighted by other authors [1], especially given that in some countries there is a practice of trauma registries which note various characteristics of trauma patients that have been medically examined.

The May & co. study [1] comparatively analyzed data entered in the register of trauma of an emergency unit as well as its autopsy reports, in terms of accuracy of external lesions records; results indicated an average of 11.6 lesions per patient not recorded in the emergency unit with a concordance rate of about 29 %, comparable to the data obtained in this study.

This discrepancy between external injuries recorded in the observation charts and the forensic reports can be explained by the frequently unstable and severe status of patients (traumatic brain injury, spinal cord injury, etc.) requiring emergency medical or surgical intervention [12].

Other authors [13, 14] found that the stressful work environment and lack of staff are in turn important factors contributing to the defective recording of external injuries.

Moreover, some authors [1] have investigated the potential factors that could influence the accuracy of

registration of external lesions, considering demographics (age, gender) as well as the severity of lesions, without finding a statistically significant relationship, aspect that correlates to the results obtained in our study.

The results of this study indicate a significant rate of discordance (62.3%) between external injuries recorded in the observation charts and the ones noted at autopsy. Although there are objective factors explaining this discrepancy, it is important to note that with a certain category of deaths (the ones due to burns), the concordance was 100 % in all cases, probably due to the impact that adequate documentation of all injuries has on treatment in these cases.

CONCLUSION

Better documentation in hospital of external injuries suffered by victims of various types of trauma is essential both for the health system and for the judicial system. While there are factors that may justify the neglect of recording all traumatic marks, in the context of lack of time, low number of health care professionals and urgent need for treatment delivery, this study showed a rate of 37.7 % of the cases in which the correlation between the observation chart and the autopsy report was perfect. Furthermore, this study identified certain factors correlated to the likelihood that external injuries be correctly and comprehensively recorded: need of surgery, hospitalization due to burns or electric shock and complex biochemical investigation.

Emphasis among health professionals of the importance of the observation chart as a document of medico-legal and legal value and extending the analysis of the correlation between the records of the observation chart and the autopsy report as part of the audit of medical activity, could contribute to improving degree of consistency of the records in the clinical medical chart and the autopsy report.

References

1. May AN, Fulde GW, Duflou J, Mengersen KL, Read-Allsopp C. External injury documentation in major trauma victims is inadequate: grounds for routine photography in the emergency department? *Emerg Med Australas.* 2008 Dec;20(6):500-507.
2. Pollanen MS. Forensic pathology and the miscarriage of justice. *Forensic Sci. Med. Pathol.* 2012; 8:285-289.
3. Sauvageau A, Racette S. Postmortem changes mistaken for traumatic lesions: a highly prevalent reason for coroner's autopsy request. *Am J Forensic Med Pathol* 2008; 29(2):145-147.
4. Harviel JD, Landsman I, Greenberg A, Copes WS, Flanagan ME, Champion HR. The effect of autopsy on injury severity and survival probability calculations. *J Trauma.* 1989; 29(6):766-772;
5. Alexandrescu R, O'Brien SJ, Lecky FE. A review of injury epidemiology in the UK and Europe: some methodological considerations in constructing rates. *BMC Public Health* 2009; 9:226-248.
6. Hammer U, Buttner A. Distinction between forensic evidence and post-mortem changes of the skin. *Forensic Sci. Med. Pathol.* 2012; 8:330-333.
7. DiMaio DJ, DiMaio JM, editors. *Forensic pathology*, 2nd edn. New York, NY: Elsevier Science Publishing Inc, 2001;91-116.
8. Carson HJ. Patterns of ecchymoses caused by manner of death and collateral injuries sustained in bruising incidents: decedent injuries, profiles, comparisons, and clinicopathologic significance. *J Forensic Sci.* 2010 Nov;55(6):1534-1542.
9. Vanezis P. Interpreting bruises at autopsy. *J Clin Pathol* 2001; 54:348-355.

10. Marx WH, Simon HM, Jumbelic M, Sposato E, Nieman G. Severity of injury is underestimated in the absence of autopsy verification. *J Trauma*. 2004;57(1):46-49;
11. Runyan CW, Bowling JM, Bangdiwala SI. Emergency department record keeping and the potential for injury surveillance. *J Trauma*. 1992;32(2):187-189.
12. Enderson BL, Reath DB, Meadors J, Dallas W, DeBoo JM, Maull KI. The tertiary trauma survey: a prospective study of missed injury. *J Trauma*. 1990;30(6):666-669;
13. Esposito TJ, Rotondo M, Barie PS, Reilly P, Pasquale MD. Making the case for a paradigm shift in trauma surgery. *J Am Coll Surg*. 2006;202(4):655-667.
14. Huang MS, Yang YF, Lee CH. Evaluation of staff workload during resuscitation of trauma patients. *J Trauma*. 2002;52(3):492-497.