Legal Medicine 17 (2015) 17–23

Contents lists available at ScienceDirect

Legal Medicine

journal homepage: www.elsevier.com/locate/legalmed

Trauma to the hyoid bone and laryngeal cartilages in hanging: Review of forensic research series since 1856

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ARTICLE INFO

Article history:
Received 3 July 2014
Received in revised form 22 September 2014
Accepted 25 September 2014
Available online 5 October 2014

Keywords:
Forensic medicine
Hanging
Neck injuries
Hyoid bone
Laryngeal cartilages
Methods – sensitivity and specificity

ABSTRACT

Since 1856 lots of forensic reports, concerning trauma to the hyoid bone and laryngeal cartilages in hanging, have been published. Differences in percentage of injured neck complexes ranged from 0 to 83.3%. Simple arguments suggest that the reason for discrepancy is difference in scientific approach (retro- or prospective) and use of various research methods. Comparative analysis of widely used techniques shows considerable variety in their effectiveness. Plain radiography and palpatory method have fairly low sensitivity (33–60% for different elements of the neck complex) with relatively high specificity (89–98.5%). Reported sensitivity of postmortem CT in identification of different lesions (including fractures) in trauma victims for the head/neck region is higher than 53% in different series with possible false-positive findings. In clinical setting the whole-body CT (pan-scanning) in blunt trauma patients showed sensitivity for head and neck injuries at the level of 84.6%, and specificity – 98.9% (Stengel et al., 2012 [68]). Only complete preparation allows to identify all the damages to the laryngopharynx framework, to avoid false diagnostics and ascertain the exact location, morphology, mechanism and intravital nature of the neck trauma. Currently complete preparation can be regarded as the method of "gold standard". Use of this method shows the frequency of discovered injuries in hanging to be about 70% of cases. In practical use, one should consider radiological techniques and palpation as preliminary and orienting methods (rather excluding, than revealing anterior neck trauma).

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1. Introduction

Importance of studying the general and peculiar medico-legal issues of hanging is determined by a number of circumstances. Mechanical asphyxia is amidst the most widespread causes of

Abbreviations: CrC, cricoid cartilage; HB, hyoid bone; LC, laryngeal cartilages; ThC, thyroid cartilage.

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http://dx.doi.org/10.1016/j.legalmed.2014.09.005
1344-6223/

unnatural death. As to strangulated asphyxia, taken by itself, it accounts for 10% of violent deaths [1]. Hanging is the most frequent form of strangulation, and in most countries it is the commonest mode of suicide. In recent years amount of hangings especially among young males tends to increase [2]. The number of medico-legal autopsies of hanging cases varies from 5–6% [3,4] to 12% [5]. As a matter of fact, different strength of neck compression is needed for serious disturbance of one or another vital function (venous or arterial blood flow, respiration, central nervous regulation) [6]. As in hanging the loop may be tightened using dissimilar strength, on different levels and unevenly on various neck surfaces, this determines the peculiarities of thanatogenesis and morphologic variety in each case. Violent manner of death requires careful proceedings, conducted by the state authorities, and taking of preventive measures.

Trauma to the hyoid bone (HB) and laryngeal cartilages (LC), including the thyroid cartilage (ThC) and the cricoid cartilage (CrC), is one of the important and long studied strangulation signs. Meanwhile, assessments of this hanging attribute in medico-legal textbooks and manuals differs from 'practically never occurs', 'is not common', 'rare symptom' to 'quite often' and 'usual event'.

Lesions of the HB and LC in hanging has been studied by forensic pathologists more intensively than in other types of blunt neck trauma, and this has its explanation. In medico-legal practice it is not difficult to collect material for statistical analysis, neck in hanging is usually exposed to one time impact, and almost in any case information on the level, direction and approximate force of compression is available. It seems natural to expect similar reliable results from the researchers, and making conclusions, which are non-contradictory to other authors'. As disagreements had arisen from the very first publications and still exist, it makes sense to look for the possible causes of misunderstanding.

2. Numerical data

The earliest to the author's knowledge article with quantitative data on injuries to the laryngopharynx framework in hanging was written almost 160 years ago [7], and lots of scientific papers have been published since (a considerable number of them were issued in Russia). Until the late 1960-s it was widely believed that in hanging mainly the HB is injured due to high position of the loop around the neck. So some authors [8–14] limited their scientific interests to the isolated HB (Table 1). It can be seen that in some samples fractured HB were rare, in other they made a significant part of cases.

Even more serious discrepancies are found in obtainable publications [3,4,7,15–63], devoted to trauma to the HB and ThC in hanging (Table 2). Differences in percentage of damage to the HB and/or ThC in ascending order amounted to 0–83.3%.

Table 2 could be arbitrary divided into the upper and lower halves. Reports from the upper half, judging by their titles and content, usually were performed retrospectively and based on archival material, so the only information source was the set of autopsy protocols from medico-legal institutions. Fractures to the neck complex in hanging were not the only aim of the study. The main problem was the epidemiological analysis of hanging cases, i.e. collecting of socio-demographic data, circumstances of suicide, appraisal of common and special morphological indications of hanging [8,15,17–23,25,26,33–35,39]. In a few articles a retrospective comparative assessment of the damage to the larynx in different types of blunt trauma was made [16,32].

Obviously, almost in every research the data on the damage to the laryngopharynx complex was obtained using visual and palpatory examination (in best case). It could be assumed that the incidence of fractures in these reports was determined by carefulness of the examination and thoroughness in registering the neck injuries by a doctor, performing the autopsy. And those pathologist, most likely, did not assume that his (or her) protocols would be further used in developing some fundamental scientific problems. Only these circumstances, taking into account the information, accumulated to date on trauma to the neck complex, could explain the fact that some researchers had not found any indication of fractures of the HB and LC in a large number of post-mortem protocols [15–18]. According to other authors' data, injuries were discovered in less than 15% of cases [19–29].

Furthermore, some other disproportions in the upper half of Table 2 can be mentioned. In retrospective papers (with double-digit index of anterior neck fractures) equally often a considerable predominance in percentage of fractures of the HB over the ThC was observed [7,28,33,34], as well as the reverse situation [27,31,35,38]. Besides, articles with approximately equal incidence of fractures of the HB and ThC were found [36,37], while the combination of injuries to the HB and ThC, as a rule, was occasional. This seems to be one more evidence of unsteady pathologist attention to each element of the laryngopharynx framework. Quite naturally, statistical processing or reliable factor analysis are impossible with such numbers of fractures found, and reliable conclusions are difficult to make. By the way, studies in the upper half of the table were published on the average 17 years before the works from the lower half.

As for the lower half of Table 2, percentage of fractures here is more than 35%. This part of the table can be called "analytical", as the majority of researchers tried to undertake factorial analysis and give a reasonable answer to the question: why this happens and what it depends on? Typically, prospective study was performed by the authors themselves or by trained staff with routine techniques including X-ray, preparation and experiments with corpses hanged up.

It should be noted that quite recently an interesting tendency appeared and still develops further, when more than 45% of cases with fractured HB and LC were registered by retrospective study in the departments with specially organized examination of the neck complex [4,48,53,57,58,61]. In some morgues the regulations were adopted concerning autopsy of strangulation cases with detailed procedure of studying the neck complex and documenting the findings. It turns out that even by means of visual examination

Table 1
Trauma to the hyoid bone in hanging.

No.	Author [Ref. No.]	Publication year	No. of cases	Injured hyoid bones	
				Cases	%
1	Maschka [8]	(1881)	153	2	1.3
2	Verevkin [9]	(1865)	18	2	11.1
3	Ignatovskiy [10]	(1910)	54	8	14.8
4	Mukhopadhyay [11]	(2010)	100	16	16.0
5	Zhukovskiy [12]	(1865)	63	12	19.0
6	Weintraub [13]	(1961)	33	9	27.3
7	Patenko [14]	(1884)	8	3	37.5