Original Research Article

Fracture of the hyoid bone in mechanical asphyxial deaths and its medico-legal significance

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Abstract

Introduction: Hyoid bone is a unique structure in the neck that has great medicolegal importance in cases of asphyxial deaths. Its complete examination can reveal important clues to the mode of death. We in the current study tried to evaluate the incidence of fractures of the hyoid bone in mechanical asphyxial deaths reported to our Hospital. **Methods**: This cross-sectional observational study was conducted in the Department of Forensic Medicine and Toxicology, Rajiv Gandhi Institute of Medical Sciences, [RIMS], Adilabad. A total of n=100 cases of compression of the neck by ligature due to hanging and Garroting were included.Detailed examination of the neck and surrounding structures was done.**Results**: Hyoid bone was found to be fracture with n=9(10.11%) cases out of n=89 cases of hanging. In garroting cases out of total n=11, all 100% were found to have hyoid bone fractures along with a fracture of the thyroid cartilage. In cases of garroting/strangulation cases, n=8 cases were fractured at the greater horn. N=2 fractures were found at the lesser horn and n=1 was found to have a fracture at the body of the hyoid bone. **Conclusion**: The fractures of hyoid bone were found with higher frequency in patients with age > 50 years. Multiple factors influence the fractures of the hyoid bone. Additionally, not only the hyoid bone but the surrounding soft tissues must be carefully examined for extravasation, because extravasation in soft tissues around the fracture reveals a true fracture.

Keywords: Hyoid bone fractures, Hanging, Medico-legal importance, Mechanical Asphyxia.

Introduction

The hyoid bone is a part of the viscerocranium. It is placed between tongue and thyroid cartilage and connected to the thyroid by the thyrohyoid membrane. Itsname is derived from the Greek word *hyoeides* meaning U (upsilon) shaped.[1-3]Hyoid bone is of considerable importance in ForensicSciences because of its susceptibility to fracture during manual strangulation, hanging, and other forms of neck compression. [4, 5] It has been found that the hyoid bone fractures in one-third of all homicidal strangulation. Postmortem detection of hyoid fracture often reveals the diagnosis of strangulation. [6]The hyoid bone is fractured by direct pressure on its greater horns or by indirect pressure on the thyrohyoid membrane. [7]It is ossified at the age of about 40 years when it tends to become hard and inelastic making it more prone to fractures as compared to the younger age group where it is elastic and cartilaginous.[8, 9] Some reports have suggested that hyoid bone fracture increases with using of hard ligature for hanging and strangulation. Therefore, several factors are involved in fractures of hyoid bone which include the manner of constriction, level of application of ligature, the force of constriction, long drop or short drop suspension, age of the victim, sex, etc. In India strangulation has been reported as the 4th commonest cause of medicolegal deaths accounting for 16.64% of the cases.[10]Kateri et al., [11] have shown that 14.7% of cases of hyoid bone fractures were present in victims of neck strangulations. Similarly, Charoonnate et al., [12] have reported 25% of cases with hyoid injury with strangulations. Nikolic et al., [13] have observed 68% of fractures of the hyoid bone in strangulations. Studies have evaluated the morphological peculiarities of hyoid bone fractures in terms of their susceptibility to fracture in cases of blunt injury or strangulations.[14] It has been reported that certain characteristics such as the length of hyoid bone or steepness of the greater horns can influence the rate of hyoid bone fractures. [15]The hyoid bone morphology implicating V-shaped hyoids were more prone to fractures in cases of violent deaths than U-shaped hyoid bone.Sometimes flexible joints between the hyoid body and its greater horns or elastic connections of the thyroid superior horns with thyroid body for fractures. [16]Therefore, the examination of the hyoid bone is of prime importance in cases where hanging or strangulation determine the cause of death. With this background, we in the current study tried to evaluate the patterns of hyoid bone fractures and their forensic significance.

Material and Methods

This cross-sectional observational study was conducted in the Department of Forensic Medicine and Toxicology, Rajiv Gandhi Institute of Medical Sciences, [RIMS], Adilabad from Jan 2017 to Dec 2018 (2-years). Institutional Ethical Committee clearance was obtained for the study. A total of n=100 cases of compression of the neck due to hanging and Garroting were included. Thorough information regarding the scene of crime investigative findings and photographs were collected and relevant papers produced by the police officers were studied. A standardized autopsy procedure was done on every dead body included in the study. After observation of related findings of hanging, ligature strangulation, or throttling based on the case the hyoid bone was dissected out for detection of its fracture. All the relevant information was uploaded on an MS Excel

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spreadsheet and the descriptive data was obtained by SPSS version 19 on windows format.

Results

A total of n=100 cases were identified and included in the study reported to RIMS, Adilabad during the span of 2 years fromJan 2017 to Dec 2018. As shown in Table-1 (the demographic profile) majority of cases were from 21 to 40 years. The mean age of male cases in thestudy was 33.5 years and the mean age of female cases was 28.0 years. A male predominance was observed with 59% of cases were males. The majority of cases were belonging to poor socio-economic status. The Adilabad district has a predominance of poor tribal people therefore, the total number of cases from rural/tribal areas predominant.

Stratification of age with outcome variable is depicted in Table-2, hyoid bone was found to be fracture with n=9(10.11%) cases out of n=89 cases of hanging reported in the study. Out of n=9 cases of hyoid bone fracture n=6, were males and n=3 were females. In garroting cases out of total n=11 all 100% were found to have hyoid bone fractures. Out of n=11 cases, n=4 were males and n=7 were females (Graph 1). In the hanging cases with fracture of hyoid bone n=7 cases were fractured at the greater horn of hyoid bone, with n=1 was fractured at the lesser horn and n=1 case was found to have a fracture at the body of the hyoid bone. In cases of garroting n=8 cases were fractured at the greater horn. N=2 fractures were found at the lesser horn and n=1 was found to have a fracture at the body of the hyoid bone.

Table 1: Socio-Demographic Profile of the cases included in the study

Category	Male	Female	Frequency (%)
Age Group			
< 20	4	17	21
21-30	16	8	24
31-40	21	10	31
41-50	9	5	14
> 50	9	1	10
Total	59	41	100
Economic Status			
Poor	56	38	94
Average	3	2	5
Good	0	1	1
Total	59	41	100
Settlement Area			
Rural	49	37	86
Urban	10	04	14
Total	59	41	100

Table 2: Modalities of strangulation with Fracture of Hyoid

Age Group	Modalities of Strangulation					
	Hanging	%	**Garroting**	%	**Throttling**	%
< 20	0	0	1	5	0	0
21-30	0	0	4	20	0	0
31-40	3	15	3	15	0	0
41-50	0	0	2	10	0	0
> 50	6	30	1	5	0	0
Total	9	45	11	55	0	0

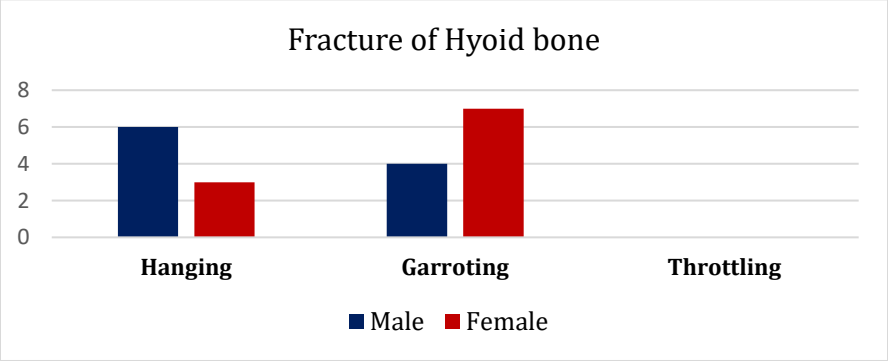

Fig 1: Modalities of neck strangulation and fracture of Hyoid bone with gender

In the current study, a total of n=20 cases of hyoid bone fracture and n=11 cases of thyroid cartilage fracture were found. The age-wise distribution of cases is given in Table 3. In all the n=11 cases of garroting, there was both fracture of hyoid bone as well as thyroid cartilage observed. In hanging cases out of n=9 hyoid fractures n=6, the right side and n=2 were left side and n=1, were bilateral. In garroting cases out of a total of n=11 hyoid fractures n=7 cases were on the right side n=2, were on the left side and bilateral fractures were found in n=1 case and body fracture was found in n=1 case. The shape of the hyoid bone in cases of fractures revealed out of n=20 fractured hyoid bone n=15 was V-shaped and n=5 was U-shaped.

Table 3: Hyoid bone fractures and thyroid cartilage fractures

Age Group	Hyoid bone fracture		Thyroid cartilage fracture	
	No	Yes	No	Yes
< 20	20	1	20	1
21-30	20	4	20	4
31-40	25	6	28	3
41-50	12	2	12	2
> 50	03	7	09	1
Total	80	20	89	11

The observation of the neck region revealed multiple abrasions and contusions caused by ligature or finger, thumb, and nails which are characteristics for all cases of strangulation depicted in table 4. The anatomical and distribution of level of application of constriction force in the neck found the majority of cases the constricting force 88% above the level of thyroid cartilage whereas in most of the cases of ligature strangulation the level of force was at the level of the thyroid cartilage. In one case the levels were below the level of the thyroid cartilage. The fracture of hyoid bone along with thyroid cartilage was found in all the n=11 cases where the level of application of force was the level of the thyroid cartilage.

Table 4: **Level of application of force and its relationship to fracture of the hyoid bone**

Cause of death/ level of constricting force	Hanging	Ligature Strangulation	Manual Strangulation	Fracture of Hyoid Bone
Above the level of thyroid cartilage	88	0	0	8
At the level of thyroid cartilage	1	10	0	11
Below the level of thyroid cartilage	0	1	0	1

Discussion

Fractures of laryngohyoid structures can occur in cases of blunt force injury either as an isolated trauma event or it may be due to complex damage involving head and neck structures. [18, 19] However, the incidence of fractures of laryngohyoid complex in hanging cases is a topic that is contradictory owing to the wide range of reported frequencies from 0% to 100%. [20]Godin et al.,[21] in a meta-analysis have reported a mean incidence of 37% for laryngohyoid fractures in cases of hangings. Some authors have reported that the thyroid cartilage is more susceptible to fracture in cases of hanging as compared to hyoid bone or any other tracheolaryngeal structures. In this study, we found the incidence of fracture of hyoid bone was 20% in various modalities of neck strangulation. MA Ali et al., [22] found fracture of hyoid bone wasin 20.7% of cases.T Azher et al., [23] in a similar study found an incidence of hyoid bone fracture of 11.9%.In the present study, hanging was found to be more common in 89% of cases and garroting was in 11% of cases. Sharma et al.,[9] in their study similarly found 69% of cases of hanging. HK Afridi et al.,[24] in their study found 52.23% cases of hanging followed by 25.37% cases of strangulation. In this study, we found all the n=11 cases of garroting were associated with fracture of the hyoid bone. Sheikh MI et al., [25]reported the incidence of fracture of hyoid bone 14.28% in cases of ligature strangulation, and Chormunge Patil et al., [26]reported the incidence of fracture of the hyoid bone in 12.5% cases. In the current study injury to thyroid cartilage was found in 11% of cases in all these cases the level of application of force was at the level of thyroid cartilage (Table 4). Based on the side involved right side was involved in 13% of cases and left side involvement was seen in 4% of cases 2% were bilaterally involved and 1% was fracture of the body of the hyoid bone. There was an insignificant male predominance of 59% versus a female of 41%.In the current study out of n=11 cases of thyroid cartilage fractures, all the fractures occurred at thyroid plates no case of involvement of superior thyroid horns was seen. Sharm et al., [9] found a higher incidence of thyroid plate fractures than thyroid horns.Our study revealed that n=7 cases of n=20 (table 3) were fractures of the hyoid bone in cases > 50 years of age. Because the ossification of hyoid starts after 40 years and as the age advances it becomes brittle making it more susceptible to fracture. Singh B et al., [27] have reported a greater incidence of fractures of the hyoid bone in older victims due to ossification and brittleness. An incomplete hyoid bone if found with a skeleton, incomplete ossification must be considered first. If the separated margins are irregular and broken a postmortem fracture must also be ruled out. If postmortem fracture is ruled out inspection for antemortem fracture must also be considered. If the premortem fracture is confirmed, then the nature of the fracture will provide some regarding the force applied. [28]

Conclusions

The study within its limitation concludes that the fracture of the hyoid bone in hanging was 10.11% and in garroting cases, all 100% were found to have hyoid bone fractures along with thyroid cartilage fractures. The fractures of hyoid bone were found with higher frequency in patients with age > 50 years. Multiple factors which influence the fractures of hyoid bone are the amount of force applied to the neck, the age of the victim, the rigidity of the hyoid, and the shape of the hyoid bone. Additionally, not the hyoid bone but the surrounding soft tissues must be carefully examined for extravasation, because extravasation in soft tissues around the fracture reveals a true fracture.This can help differentiate perimortem injury or postmortem artifact.

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