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Original Article

Fracture of hyoid bone in association with gender, fusion, symmetry and various modes of strangulation.

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Abstract:

Introduction: U-shaped hyoid bone present in the ventral aspect of pharynx is unlikely to be fractured; therefore fracture of hyoid bone when found is a very important finding in unnatural deaths.

Objective: To determine association of the fracture of hyoid bone with different modes of strangulation.

Methodology: This descriptive study was conducted in the Department of Anatomy and Department of Forensic Medicine; Liaquat University of Medical and Health Sciences Jamshoro Sindh Pakistan from March 2016 to March 2019. During study period total of 63 hyoid bones were grouped according to age, gender, modalities of strangulation. The bones were examined for symmetry, fusion and fracture.

Results: Out of 63 bones, 55.6 % found fused and 44.5% were unfused. Among fused hyoid (n=35), 20 found in male and 15 were from female. On the other hand unfused hyoid bone is uncommon in male as compared to female (9 vs 19). The chi-square statistic is 3.9135. The p-value is .047899. Significant at $p < .05$. Fracture of hyoid bone identified in 30; among these 23 were fused and 7 were unfused.

Conclusion: When cause of death is strangulation, fused hyoid fractured more commonly as compared to unfused hyoid bone.

Keywords: Forensic Age, Fracture Hyoid, Strangulation. Fusion, of Hyoid.

Introduction:

U shaped hyoid bone is situated in the anterior midline of the neck and well protected by the mandible superiorly, the cervical spine posteriorly and thyroid cartilage anteriorly. It is the only bone in the body which do not articulate with any other bone. The function of hyoid bone is to maintain patency of the pharynx during swallowing and respiration while serving as an attachment point for the middle pharynx. The hyoid is rarely susceptible to direct trauma, with fracture rates accounting for only 0.002% to 1% of all fractures and with dislocations being even less common. However, hyoid injuries with resultant bony penetration into the pharyngeal mucosa may compromise the patency of the airway, injure the external carotid artery, or cause infection.[1]

The hyoid is fractured in one-third of all homicides by strangulation. On this basis, postmortem detection of hyoid fracture is relevant to the diagnosis of strangulation. Fracture of hyoid bone resulting from trauma other than strangulation is very rare; hyoid bone fracture associated with pan-facial trauma is even rarer. They occur more frequently in young individuals, and in men more than in women.[2, 3]

A major portion of all unnatural deaths resulting from asphyxia are due to fatal neck compression. Strangulation is constriction of neck without suspending the body. Incidence of hyoid bone fracture is highest among the victims of manual strangulation, higher in cases of ligature strangulation and least in cases of hanging. Hence hyoid bone fracture when found usually point towards homicidal death. The incidence of strangulation, all over world, differs widely due to variation in the community and geographical location. The anatomical variations of the hyoid bone have a great significance during surgical procedures of neck region, and in fo-

rensic medicine for evidence of strangulation or hanging, which causes fractures.[4-6]

Objective:

To determine the association of the fracture of hyoid bone with gender, fusion, symmetry and different modes of strangulation at LUMHS Hospital Jamshoro /Hyderabad.

Methodology:

This descriptive study was conducted in the Department of Anatomy and Department of Forensic Medicine of Liaquat University of Medical and Health Sciences Jamshoro Sindh Pakistan from March 2016 to March 2019. After excluding burns, firearm and other causes of unnatural deaths brought for postmortem examination in the Department of Forensic Medicine and from exhumation during three-year study period, 63 cases of unnatural deaths caused by strangulation were enrolled in study. After medico legal perquisite, the standardized autopsy procedure was done on every dead body. After recording all the related findings to hanging, garroting, ligature strangulation or throttling, the hyoid bone was dissected and collected for study purpose. Each bone is numbered with permanent marker with identification codes and kept in formalin for 72 hours for softening, then it is taken out washed with running tap water, dried with blower and soft tissues were removed with the help of scalpel and forceps carefully to avoid damage to the week parts of hyoid bone like lesser cornu. Then defatting of all hyoid bones was done by keeping in acetone for a period of 24 to 72 hours. Data was recorded on proforma, incorporated in tabular form and analyzed by using SPSS version 18.[7]

All the retrieved hyoid bones (n=63) from postmortem autopsy or exhumation were grouped according to age, gender, modalities of strangulation. The bones were examined for symmetry, fusion and fracture. The bone is said to be symmetric if the middle of all its transverse diameters falls on the sagittal axis; otherwise it is asymmetric, deviating to one of the sides either right or left.

Results:

During study period a total of 63 hyoid bones were studied. Among these 29 were of males and 34 were of females having age range between 15 to 75 years as shown in table no 1.

Table No 1: Age Groups and Gender.

Table No. 1. Age groups with Gender (n=63)

			Gender		
			Male	Female	Total
Age in years	15 to 30	Count	2	3	5
		Percent	40.0%	60.0%	100.0%
	31 to 45	Count	3	11	14
		Percent	21.4%	78.6%	100.0%
	46 to 60	Count	20	20	40
		Percent	50.0%	50.0%	100.0%
	61 to 75	Count	4	0	4
		Percent	100.0%	.0%	100.0%
Total		Count	29	34	63
		Percent	46.0%	54.0%	100.0%

Out of 63 bones 35 (55.6 %) of the hyoid bones were found fused, 20 (69.0%) in males and 15 (44.1%) in females; although 28 (44.4%) hyoid bones were unfused 9(31%) seen in males and 19 (55.9%) found in females with statistically significant difference (p value 0.04) as shown in table No. 2.

Table No 2: Fusion of Hyoid and Gender.

Table No. 2 Fusion of hyoid in association with gender (n=63)

			Fusion of hyoid		
			Fused	Unfused	Total
Gender	Male	Count	20	9	29
		Percent	69.0%	31.0%	100.0%
	Female	Count	15	19	34
		Percent	44.1%	55.9%	100.0%
Total		Count	35	28	63
		Percent	55.6%	44.4%	100.0%
P value 0.04 (Chi Square) df=1					

Out of 63 hyoid bones, 26 hyoid bones were found symmetrical and 37 were asymmetrical. Out of 26 symmetrical bones, 11 (42.3%) were of males and 15 (57.7%) of females with p value 0.06 as shown in table No. 3

Table No 3: Symmetry of Hyoid and Gender Distribution.

Table No. 3 Symmetry of hyoid in association with Gender (n=63)

			Gender		
			Male	Female	Total
Symmetry of hyoid Bone	Symmetrical	Count	11	15	26
		Percent	42.3%	57.7%	100.0%
	Asymmetrical	Count	18	19	37
		Percent	48.6%	51.4%	100.0%
Total		Count	29	34	63
		Percent	46.0%	54.0%	100.0%
P value 0.6 df=1					

In study population n=63, total 30 (47.65%) hyoid bones found fractured. Out of 30, 18 (62.1%) were of male and 12 (35.3%) were of females. Statistically the gender difference for fracture hyoid was significant with p value 0.03 as shown in table No. 4. Among 35 fused hyoids, 23 (65.7%) revealed fractured while fracture was not found in 12 (34.3%) hyoid bones. On the other for unfused hyoid (n=28) only 7 (25.0%) found fractured while 21 (75.0%) found unfractured. When fused and unfused hyoid bones were compared for association with fracture, the differ

Table No 4: Hyoid Fracture and Gender Distribution

Table No. 4 Association of Hyoid fracture with Gender					
			Hyoid fracture		
			Yes	No	Total
Gender	Male	Count	18	11	29
		Percent	62.1%	37.9%	100%
	Female	Count	12	22	34
		Percent	35.3%	64.7%	100%
Total		Count	30	33	63
		Percent	47.6%	52.4%	100%
P value 0.03 df 1					

Table No 5: Fusion of Hyoid and Fracture of Hyoid

Table No. 5 Association between Fusion of hyoid bone with hyoid fracture (n=63)					
			Hyoid fracture		
			Yes	No	Total
Fusion of hyoid	Fused	Count	23	12	35
		Percent	65.7%	34.3%	100.0%
	Unfused	Count	7	21	28
		Percent	25.0%	75.0%	100.0%
Total		Count	30	33	63
		Percent	47.6%	52.4%	100.0%
P value 0.01 df=1					

Table No 6: Mode of Strangulation and Hyoid Fracture

Table N0. 6 Association of Hyoid fracture with Modes of strangulation resulting in hyoid fracture (n=63)							
			Modes of strangulation				
			Hanging	Garroting	Throttling	Ligature strangulation	Total
Hyoid #	Yes	Count	8	2	9	11	30
		%	26.7%	6.7%	30.0%	36.7%	100%
	No	Count	17	6	0	10	33
		%	51.5%	18.2%	.0%	30.3%	100%
Total		Count	25	8	9	21	63
		%	39.7%	12.7%	14.3%	33.3%	100%
p-value 0.03 df=3							

ence found was statistically highly significant (p value 0.01, degree of freedom 1) as shown in table no 5. For cases having fractured hyoid bone (n=30), the cause of death was hanging in 8 (26.7%), garroting in 2 (6.7%), throttling in 9 (30.0%) and ligature strangulation in 11 (36.7%) with p- value of 0.03 at 3 df see table No.6.

Discussion:

The hyoid is the classical, mobile bone of axial skeleton, suspended from the tips of the styloid process by the stylohyoid ligament. The anatomy of the hyoid bone plays a significant role both in medicine, forensic medicine and surgery; for example sleep apnea in medicines, strangulation in forensic medicines, variation in anatomy during neck surgery. Hyoid is sexually dimorphic bone, occupy well protected position in neck by neighboring muscles and less vulnerable to injury due to its anatomical location. Therefore fracture of hyoid always points towards unnatural death especially in cases of strangulation and in others conditions where interference in functions of neck structures is suspected. The fracture of hyoid bone if occurs depends upon multiple factors; such as shape of the bone, symmetry of greater horns, age and gender of victim, degree of fusion as bone loses elasticity when completely ossified/calcified. The extrinsic factors includes mode, material and force of strangulation applied determine the occurrence of fractures.[5]

Although many morphometric studies on anatomical variations of hyoid bone was undertaken in different parts of world[7] but very few in Pakistan; however not a single study has been undertaken in Sindh province to the best of our knowledge.

Among 63 hyoid bones studied, 29 were of males and 34 were of females with age ranging between 15 to 75 years. When these 63 hyoid bone when examined for symmetry, 26 (41.26%)were found symmetrical and 37 (58.73%) were asymmetrical. This finding is in agreement with the study of Kalyan et al[8]; they examined 30 bones, 12 (40%) bones were found symmetrical and 18 (60%) were asymmetrical. During current study when symmetry assessed with respect to gender; symmetrical hyoid bone found more prevalent in female. Among 26 symmetrical hyoid bone 15 (57.7%) were from female and 11 (42.3%) were from male. Leksan et al[9] , reported incidence of symmetrical bones more in males and asymmetrical to be more in female. In Indian population incidences of symmetrical and asymmetrical hyoids were found as 93.1 % and 6.9 %respectively by Mukhopadhyay et al.[10] This difference may be attributed to the racial and geographical locales and sample size and age of victims.

Out of 63 bones 35 (55.6 %) of the hyoid bones were found fused, 20 (69.0%) in males and 15 (44.1%) in females. For unfused hyoid bone (n=28, 44.4%), 9 (31%) seen in males and 19 (55.9%) found in females. These findings are comparable with study conducted by Harjeet et al [11]that showed complete fusion in 38(23%) males while in females it was observed in 28(33%) of cases. A radiological study conducted by Bhavana et al[12] on dry hyoids, shows incidence of fusion between body and greater cornu of hyoid bones more in males (11 out of 15) when compared with females where only 06 out of 15 showed fusion; these findings are more or less consistent with this study.

The most important lesions of the hyoid apparatus are the fractures due to inward compression such as manual strangulation, sudden hyperextension of the neck seen in hanging.[13] In present

study fracture of hyoid bone was seen in 30(47.65). Out of 30, 18 (62.1%) were of male and 12 (35.3%) were of females. In study population, 33 (52.4%) hyoids were not fractured. Among 30 fractured hyoid cases, 8 (26.7%) cases were of hanging, 2 (6.7%) were of garroting, 9 (30.0%) of throttling and 11 (36.7%) of ligature strangulation. The findings of present study are more or less similar with studies conducted by other authors, Kulesh Chandekar et al[14] reported 08 cases of ligatures strangulation and 4 cases of throttling, while Sharma et al[15] observed 80.7% cases of hanging, 10.3% cases of garroting and 09.0% are of throttling. Difference in study may be attributed due to different sample size.

Conclusions:

Scarcity of national literature on hyoid bone draws our attention to carry out the present study. When cause of death is strangulation, fused hyoid bone seen fractured more commonly as compared to unfused hyoid bone.

Conflict of interest: None.

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