

Original Research Paper

Pattern of Internal Neck Injuries in Strangulation Deaths With special reference to Laryngeal Fractures

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Abstract

One of the important finding in strangulation death is injury to laryngeal appendages. A cross sectional study was done to know the incidence of injury to laryngeal cartilages in strangulation deaths autopsied at our department from year 2010 to 2012.

A total of 31 cases studied in which ligature strangulation accounted for 18 cases (12 male, 06 female) and manual strangulation 13 cases (7 male and 6 female). Fractures of the hyoid and/or thyroid cartilage were present in 23 cases. Out of 23 cases, hyoid bone fractures noted in 9 cases (23%) and thyroid cartilage fractures found in 17 cases (54%). In ligature strangulation cases hyoid bone fracture present in 5 cases (28%) and thyroid cartilage fracture present in 9 cases (50%). In manual strangulation cases hyoid bone fracture noted in 4 cases (31%) and thyroid cartilage fracture were seen in 8 cases (62%). Cricoid cartilage fracture was not found in our study. Among external features sub-conjunctival hemorrhage was seen in 19 cases and nasal bleeding in 10 cases. Hemorrhage in strap muscles seen in all cases. Thyroid cartilage fracture is more common than hyoid bone fracture in both Ligature and Manual strangulation deaths.

Key Words: Strangulation, Laryngeal fractures, Hyoid and thyroid cartilage

Introduction:

Gonzalez's scientific research paper, relying on European references from the 19th century about examination of strangulation victims is considered as best till date. [1] Pattern of neck injuries distinguishes strangulation from other types of blunt injuries including hanging, traumatic blow to the neck, and artifacts of decomposition. [2-8]

Abrasions and contusions of the skin of the anterior neck are typical of strangulations cases. In some cases, external injury may not be evident or seen especially in cases of manual strangulation.

In some cases of manual strangulation where extensive force is applied by the assailant, classical fingernail marks are seen which are superficial, curvilinear abrasions occurring singly or in sets.

In addition to the blunt force injuries of the neck, strangulation produce the signs of asphyxiation, such as pinpoint hemorrhages (petechiae) in the skin, conjunctiva of the eyes, and visceral pleura of deep internal organs. [9, 10] Petechiae are non-specific findings that can develop from any cause of asphyxia including strangulation, hanging, drowning, and some natural diseases.

The presence of petechiae does not prove strangulation, and the absence of petechiae does not disprove strangulation. [11]

Pollanen studied histopathology of larynx in eight manual strangulation cases, in all cases; he found intra-cartilaginous laryngeal hemorrhages associated with sub-epithelial laryngeal hemorrhages, and intra-laryngeal muscular hemorrhages forming a "triad of hemorrhages."

Triad of hemorrhages has diagnostic value as an independent morphological criterion for the postmortem diagnosis of strangulation.

Mechanism of laryngeal, epithelial, subconjunctival and petechial hemorrhage over face is due to increased venous pressure

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draining the territory of the jugular venous system which is compressed in strangulation. [12] A common cited injury is fracture of the hyoid bone, actually only found in a minority (no more than one third) of all fatal strangulations. [13-18] Hyoid bone fracture is considered as a pathognomic feature of strangulation according to most of the literatures.

Aims and Objectives:

- To study the pattern of internal neck injuries with special reference to laryngeal cartilage fractures.

Material and Methods:

A cross sectional study was undertaken at our mortuary during period from 2010 to 2012. Out of 1450 autopsied cases, 31 cases of Strangulation were selected for study. All ligature and manual strangulation deaths were included in the study. Advanced decomposed bodies, deep burns and charred bodies were excluded from study.

Results:

In our study total 31 cases of strangulation deaths were studied which included 18 cases of ligature strangulation and 13 cases of manual strangulation.

Male accounted for 19 cases (61%) and female 12 cases (38%). Most common age group involved is 21-30 (32 %) followed by 31-40 (22%) in this study. (Table1)

General pathological signs of asphyxia observed most commonly were bluish discoloration of lips and petechial hemorrhage over heart and lungs which were found in all 31 cases, followed by bluish discoloration of nails 28 cases (67%) and Subconjunctival hemorrhages in 19 cases (61.2%).

Most common General body injuries present were abrasions and contusions. Injuries were absent in 10 cases. In manual strangulation cases, head injury was present in five cases, smothering in two cases and sexual assault in one case. In ligature strangulation cases head injury was present in four cases and smothering with head injury in one case.

Most common motive for murder in our study was revenge in nine cases, followed by five cases each accounted for property disputes and dowry harassment. In seven cases motive was not known.

In Manual strangulation (13 cases) local external neck injuries were scratch abrasions present in 10 cases and contusions in 9 cases. In all Manual strangulation cases external injuries were present except in one post-mortem burn case where external injuries were not made out due to superficial burns.

Most consistent internal neck injuries in Manual strangulation cases was contusion of strap muscles present in all 13 cases followed by laryngeal mucosal hemorrhagic spots in five cases and hemorrhage into sternocleidomastoid muscle in 4 cases. (Table 2)

Ligature mark was complete in 15 cases and incomplete in three cases. Course of ligature mark was transverse in 16 cases one sided transverse and other side oblique in one case and bilateral oblique in one case.

Ligature Mark was situated above thyroid cartilage in 9 cases, over thyroid cartilage in seven cases and below thyroid cartilage in two cases. Ligature material was found in 15 cases and not found in three cases.

In ligature strangulation cases internal neck injury most commonly encountered was contusion of strap muscles which was noted in all 18 cases followed laryngeal mucosa hemorrhagic spots in 6 cases. (Table 2)

Out of 13 manual strangulation cases hyoid bone fractures were present in four cases (31%) and thyroid cartilage fractures were seen in eight cases (62%). In ligature strangulation cases hyoid bone fractures were present in five cases (28%) and thyroid cartilage fractures were present in nine cases (50%).

Inward fractures were seen in all 5 cases of hyoid fractures. Bilateral superior horn thyroid fractures were most commonly found (6 cases) in our study. (Table 3)

In age group less than 40 years (20 cases) laryngeal fractures were present in 12 cases and absent in eight cases and in age group more than 40 years (11 cases) laryngeal fractures were present in eight cases and absent in three cases. (Table 4) In our study cricoid cartilage fractures were not found.

Discussion:

Though the hyoid bone has received most attention in publication as being the marker of violence to the larynx, in fact the thyroid horns are far more vulnerable. Simpson found that, in 25 successive deaths from manual strangulation, there were 22 fractures of thyroid horns but only one hyoid bone fracture. Although fractures of the horns are more common with advancing age, they can on rare occasions be found even in teenagers. [19]

In ligature strangulation, injuries to deeper tissues of neck are more common than in cases of hanging, as considerable force is used to constrict the neck in cases of strangulation. The superior horns of the thyroid cartilage being slender and is present below the hyoid bone are prone for fracture. Also the

indirect force exerted by the thyro-hyoid membrane causes the fracture of thyroid cartilage. [20]

According to Polson, thyroid cartilage fracture more than hyoid in cases of hanging. In strangulation injury to the hyoid bone is uncommon since the level of constriction is relatively low and well below the bone. [21]

Our study findings were consistent with these studies. 48 deaths by ligature strangulation (21 male, 27 female) and 41 deaths by manual strangulation (27 female, 14 male) studied by Di Maio VJ. [22]

In ligature strangulation cases, petechiae were present in the conjunctivae and/or sclera in 86% of the cases; fractures of the hyoid and/or thyroid cartilage were present in 12.5%. In manual strangulation cases petechiae were present in 89% of the cases.

In cases of manual strangulation, fractures of the hyoid, thyroid, or cricoid cartilage were found in all the male victims and slightly more than one half of the female victims. Rape was the motive in 66% of the female victims of ligature strangulation and 52% of those due to manual strangulation. [22]

The hyoid is the U-shaped bone of the neck that is fractured in one-third of all homicides by strangulation. The reasons why some hyoid fracture and others do not may relate to the nature and magnitude of force applied to the neck, age of the victim, nature of the instrument (ligature or hands) used to strangle, and intrinsic anatomic features of the hyoid bone.

In Xeroradiographic study by Pollanen it was found that fracture of hyoid occur commonly in older victims of strangulation (39 +/- 14 years) than when compared to the victims with unfractured hyoids (30 +/- 10 years). The age-dependency of hyoid fracture correlated with the degree of ossification or fusion of the hyoid synchondroses. The hyoid was fused in older victims of strangulation (41 +/- 12 years) whereas the unfused hyoids were found in the younger victims (28 +/- 10 years).

In addition, the hyoid bone was ossified or fused in 70% of all fractured hyoids, but, only 30% of the unfractured hyoid was fused. The shape of the hyoid bone was also found to differentiate fractured and unfractured hyoid. Fractured hyoids were longer in the anterior-posterior plane and were more steeply sloping when compared with unfractured hyoids. [18]

In our study age group less than 40 years (20 cases) laryngeal fractures were present in 12 cases and absent in 8 cases and in age group more than 40 years (11 cases)

laryngeal fractures were present in eight cases and absent in three cases.

Cricoid cartilage fractures were not found in our study. In cases of death by ligature strangulation thyroid cartilage fracture was present in seven (35%) cases, fracture of the hyoid bone in three cases (15%), fracture both of the thyroid cartilage and hyoid bone in one case (5%), only ecchymosis in soft tissues in seven cases (35%). [23] The fracture was noted in cases when the victims were strangled by using a thick, broad material.

In a recent study, Ubelaker reported that only 34% of all cases of manual strangulation have a fractured hyoid bone. It is likely that many variables like magnitude and precise position of the force applied to the neck; rigidity of the hyoid bone; age of the victim; nature of the instrument used to strangle (for example, hands or ligature) and possibly the shape of the hyoid determine whether hyoid bone will fracture during strangulation or not. [24]

However in recent study by Lebreton chakour and his fellow researchers found no significant association between gender and type of fracture, or between fusion or non-fusion of the horn ($p>0.05$). Fused bones were not more susceptible to fracture than non-fused bones. [25]

Conclusion:

Thyroid cartilage fracture is more common than hyoid bone fracture in both types of strangulation deaths. Though age of ossification of hyoid bone influences to some extent its situation in upper neck makes it less likely to involve whereas thyroid cartilage being slender easily fracture.

In cases of strangulation deaths importance should be given to fractures along with the extravasations of blood into the surrounding tissues which can gauge the amount of pressure applied to the neck structures.

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Table 1: Age and Sex wise Distribution

Age Grp (Yrs)	Cases (%)	Male (%)	Female (%)
1-10	2(6.4)	1(3.2)	1(3.2)
11-20	2(6.4)	1(3.2)	1(3.2)
21-30	10(32.2)	5(16.1)	5(16.1)
31-40	7(22.5)	5(16.1)	2(6.4)
41-50	6(19.3)	5(16.1)	1(3.2)
51-60	2(6.4)	1(3.2)	1(3.2)
61-70	3(9.6)	1(3.2)	1(3.2)
Total	31(100)	19(61.3)	12(38.7)

Table 2: Internal Neck injuries

Hemorrhage in Neck Structures	Strangulation		Total
	Manual	Ligature	
Platysma	2	1	3(9.67)
Contusion of strap muscles	13	18	31(100)
Sternocleidomastoid	4	2	6(19.35)
Retrolaryngeal hemorrhage	3	3	6(19.35)
Retrotracheal hemorrhage	3	2	5 (16.12)
Scalenie muscle	1	2	3(9.67)
Laryngeal Mucosa hemorrhage	5	6	11(35.48)
Base of tongue hemorrhage	2	1	3(9.67)

Table 4: Relation between Age and Laryngeal Fractures

Fracture Cartilages	Laryngeal	Age		Total (%)
		<40 yrs	>=40yrs	
Present		12	8	20(64.5)
Absent		8	3	11(35.4)
Both hyoid and thyroid cartilage fracture		2	4	6 (19.3)

**Table 3
Laryngeal Fractures in Strangulation Cases**

Laryngeal Cartilage	Fracture Site	Ligature Strangulation	Manual Strangulation	Total Cases
Hyoid bone fracture	Greater cornu Unilateral	2	3	5
	Greater cornu Bilateral	3	0	3
	Greater Cornu Unilateral and body	0	1	1
	Inward fracture	5	3	8
	outward fracture	0	1	1
Total		05	04	9(29.03%)
Thyroid cartilage fracture	Superior horn Unilateral	2	4	06
	Superior horn Bilateral	6	4	10
	Superior horn Bilateral with Body	1	0	01
Total		09	08	17 (54.83%)