

ORIGINAL ARTICLE

Amussat's Sign in Hanging – A Morphological and Histopathological Study

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Abstract:

Amussat's sign is typically a transverse laceration of the intimal layer of carotid arteries described in cases of hanging. Subtotal laceration of the carotid artery is not strictly specific for hanging and can be also caused by blunt neck trauma, extreme overstretching, or whiplash-injuries. The aim of this study is to find out the occurrence of Amussat's sign on morphological and on histopathological examination in cases of hanging. This is an observational cross-sectional study conducted in Tertiary care hospital during time period of January 2021 – June 2022 which consisted of 115 cases of hanging. Out of 115 cases of hanging, 93 (80.9%) cases were complete hanging. Males (n-78) were affected more than females (n-37). The most affected age group was 21-30 years contributing to 39.1%. Most common ligature material used was odhni (31.3%). Most common position of knot was at occipital region in 62.6% cases. Tear in carotid artery was seen in 14 (15.05%) cases on naked eye examination and all 14 cases were of complete hanging. On histopathological examination carotid intimal tear was seen in 73.3% (n-84) cases. Amussat's sign was mostly seen in anterior hanging cases on both gross (28.6%) and histopathological examination (85.7%). In present study Amussat's sign was present in 73.3% cases and most of them were identified by histopathological examination rather than naked eye examination and results shows incidence of carotid tear more in complete hanging.

Keywords: Hanging; Asphyxia; Carotid intimal tear; Amussat's sign.

Introduction:

Hanging has been the most common form of violent asphyxial death, be it suicidal, homicidal, or accidental. Hanging remains one of the most common methods of committing suicide. In India, suicide by hanging was the second most adopted means of committing suicide, i.e., 57.0% in the year 2021. In Maharashtra, hanging is the most popular method of suicide, followed by poison consumption.¹ Hanging is a form of violent asphyxial death produced by suspending the body with a ligature around the neck, the constricting force being the weight of the body or a part of the body's weight.² Apart from various common external and internal post-mortem findings, in cases of hanging carotid arteries, changes in the carotid arteries are also inevitable.

The most important signs in the diagnostics of hanging are internal neck injuries. Such vital findings are evidence of a pre-mortem origin of hanging and injury to carotid arteries as a result of hanging is one such basic diagnostic sign. The best known is the so-called Amussat's sign i.e., transverse laceration in the intimal layer of the carotid artery.³ It must be emphasized that carotid tears are not specific for hanging only, but can also be caused by blunt neck trauma, extreme overstretching of neck or whiplash-injuries too.⁴ Nonetheless, this sign has only been reported macroscopically, and only a few studies have been published to assess its true occurrence and any possible

relationship with the position of the hanging mark.⁵⁻⁷

The present study, "Amussat's sign in compression of neck," makes a detailed autopsy examination and tries to compare and correlate established findings by previous authors, and an attempt is made to establish newer trends from the earlier studies. And a newer dimension, like the position of the knot and histopathological examination of the carotid artery, which corresponds to the ligature mark, has been added to this present study and highlights microscopic events. The objective of this paper is an attempt to find the morphological and histopathological changes in carotid artery in hanging cases. This study is also an attempt to find the changes in carotid artery in cases of faint ligature mark or partial hanging cases or where the ligature mark is barely visible and doubtful regarding hanging cases. In such cases, histopathological findings can help to strengthen the cause of death.

Material and method:

This is an observational cross-sectional study conducted in a tertiary care hospital, during the period of January 2021–June 2022. Sample size was taken by the total enumeration method, which consisted of 115 cases of hanging deaths out of 1247 autopsies. The decomposed and burned bodies, which allegedly died due to fatal neck compression, were excluded from the study. Detailed information regarding the demographic profile of the deceased, circumstances of death, type of ligature material, and whether it is a complete or partial hanging was collected from the inquest and relatives. This information was accompanied in some cases by a visit to the scene of the occurrence or by photographs taken at the scene of the occurrence. The standard autopsy protocol was followed, beginning with general and local external examination, and ending with general and local internal

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Article History

DOR : 10.05.2023; DOA : 21.10.2023

examination.

Based on the position of the knot, all cases were divided into four categories according to the position of the knot on the neck (I–IV) (Fig. 1). In cases of anterior hanging (I), the ligature knot was situated in the anterior midline, and the limit was the inner side of the sternocleidomastoid muscle. In cases of posterior hanging (II), the ligature knot was situated in the posterior midline, and the limit was the posterior aspect of the mastoid process. When the ligature knot was placed on the sides of the neck or head between the mentioned limits (on the right or on the left), then the category was right hanging (III) or left hanging (IV). Furthermore, individual cases were divided according to the completeness of the victim's suspension into two main subcategories: free body suspension and incomplete body suspension.

Ethical clearance was obtained from the institutional clinical ethics committee.

Dissection of neck: For a bloodless dissection of the neck, the thoraco-abdominal contents and the brain were removed before proceeding to the neck dissection. A block 12–20 cm high was placed under the shoulders to allow for minimal extension of the neck to aid dissection. After the evisceration, neck dissection was undertaken following the protocol of Prinsloo and Gordon. The neck is dissected layer by layer and carotid sheath was opened anteriorly to expose the internal jugular vein and carotid artery.

Table 1. Type of hanging depending upon degree of suspension.

Type of suspension	Frequency	Percent
Complete	93	80.9 %
Partial	22	19.1 %
Total	115	100 %

Table 2. Incidence of Amussat's sign on gross and histopathological examination in complete and partial hanging.

Amussat's sign	Gross examination		Histopathology examination	
	Complete (n=93)	Partial (n=22)	Complete (n=93)	Partial (n=22)
Present	14 (15.05%)	0	71 (76.3%)	8 (36.4%)
Absent	79 (84.95%)	22 (100%)	22 (23.7%)	14 (63.6%)

Table 3. Incidence of amussat's sign on gross and histopathological examination in complete and partial hanging according to different position of knot.

Position of knot	Carotid intimal tear on gross examination		Carotid intimal tear on histopathological examination.	
	Complete	Partial	Complete	Partial
Anterior (n=7)	2 (28.6%)	0 (0%)	5 (71.4%)	1 (14.3%)
Left lateral (n=25)	5 (20%)	0 (0%)	14 (56%)	3 (12%)
Right lateral (n=11)	3 (27.3%)	0 (0%)	9 (81.8%)	0 (0%)
Posterior (n=72)	4 (5.5%)	0 (0%)	43 (59.7%)	4 (5.6%)

The carotid artery was resected lower down at its origin and the internal and external carotid arteries were cut as distally as possible. Carotid arteries were opened longitudinally on the anterior surface for inspection of any intimal injuries or tears. Blunt forceps was used to handle the artery during dissection and care was taken to use as minimal handling as possible to avoid artefactual injuries. Appropriate tissue section of carotid arteries from neck beneath the ligature mark were dissected and preserved in 10% formalin solution for histopathological examination. Routine hematoxylin and eosin stain was used. Tissue samples were taken from 5 normal cases for comparison as control.

Results:

- The analyzed group consisted of 115 cases of deaths due to fatal compression of neck and out of that 115 cases were of hanging; Out of 115 cases of hanging, there were 67.8% males (n=78) and 32.2% females (n=37).
- The major age group affected in both the sexes in cases of hanging was in the range of 21-30 years contributing 39.2% (n=45) followed by 31-40 years contributing 23.4% (n=27) as shown in table no. 2. The least affected age group was 61- 70 years.
- The commonest ligature material of choice was odhni (n=43, 37.4%) followed by nylon rope (n=36, 31.3%), followed by saree (n=20, 17.4%).
- Out of 115 cases of hanging, Amussat's sign was seen in 79 (69.5%) cases in which 14 (12.17%) cases were identified by naked eye examination.
- In 25 cases of left lateral hanging 17 cases had carotid tears in which 14 cases were complete hanging and three cases were partial hanging and, in most cases, tear restricts to left side only.
- In 11 cases of right lateral hanging nine cases had carotid tears in which all cases were of complete hanging and in most cases, tear restricts to right carotid only.
- In 72 cases of posterior hanging 47 cases had carotid tears in which 43 cases were complete hanging and four cases were partial hanging.

Discussion:

The present observational cross-sectional study was conducted between January 2021 to June 2022. A total of 1247 autopsies were conducted of which deaths due to hanging comprised 115 cases. In that males were more affected than females contributing to 67.8% (n=78) and 32.2% (n=37) respectively and most of the cases were within the age group of 21-30 years. The present study was conducted during the COVID-19 pandemic period, during which most of the people got stuck inside their houses, confined to closed spaces for indefinite periods of time, with fear, mental stress, anxiety, uncertainty, job loss, financial problems, family problems, intramarital problems, illnesses etc. which had a huge negative impact on mental health of public.

In present study the commonest choice of ligature material used was odhni due to its easy availability in the houses. The present study also indicated the fact that 80.9% of the hangings were complete. The present study showed 79 cases of carotid tear amongst 115 cases of hanging and most of them were identified by histological examination rather than by naked eye examination. Results shows incidence of carotid tear more common in complete hanging.

Amussat's sign was not seen on gross in cases of partial hanging. It is possible that in such cases the ligature does not produce intense pressure upon the area of the arteries of the neck. Intimal tears of the carotid artery were seen in more cases of lateral hanging on the same side of the suspension point. Factors like long drop and convulsive phase during the process of asphyxia on the ligature also contribute to this process.

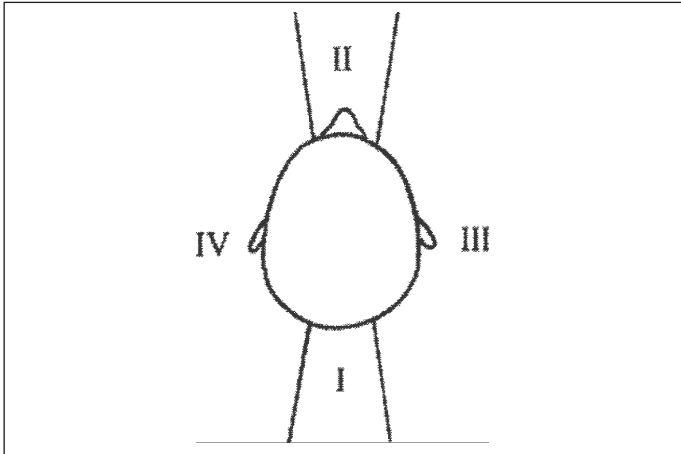


Figure 1. Subcategorization of cases according to the location of the knot into four groups.¹⁴

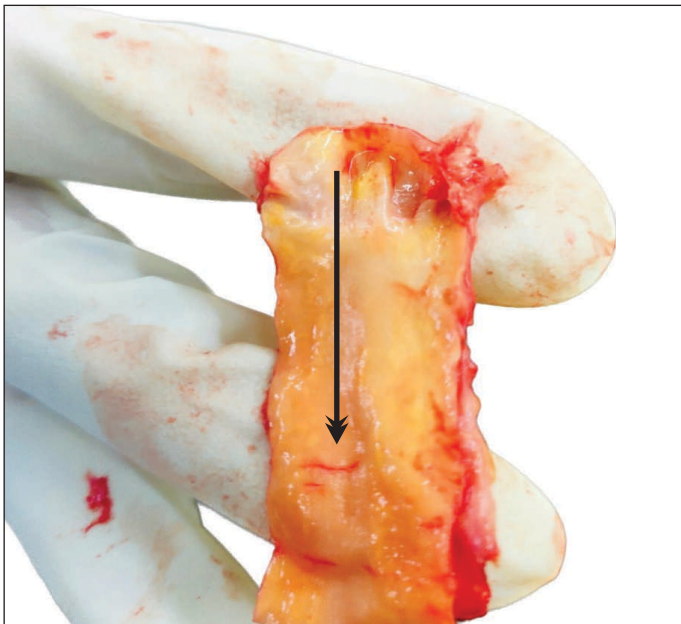


Figure 2. Amussat's sign on gross examination.

It is reasonable to speculate that the incidence of intimal tears in the carotid artery is associated not only to traction but also to direct pressure exerted by knot compression on the neck tissues. The section of the artery below the ligature is very likely to deform and become fixed to the deeper tissue structures of the neck as a result of the acting pressure of the ligature. The proximal section of the artery below the point of its fixation is then exposed to traction forces that lead to a forced, downward stretching of this part of the artery.⁸ The most prevalent mechanism causing ruptures in the intimal layer of carotid arteries in hanging may involve a combination of forceful compression of the artery and its longitudinal stretching. The bilateral occurrence of intimal tears in the carotid arteries in anterior hanging instances, where a combination of the intense radial pressure of the tightening rope and powerful axial traction is invariably present, lends weight to this theory.^{9,10}

Most of the autopsy studies published so far showed a state of relatively low frequency of occurrence of intimal ruptures in the

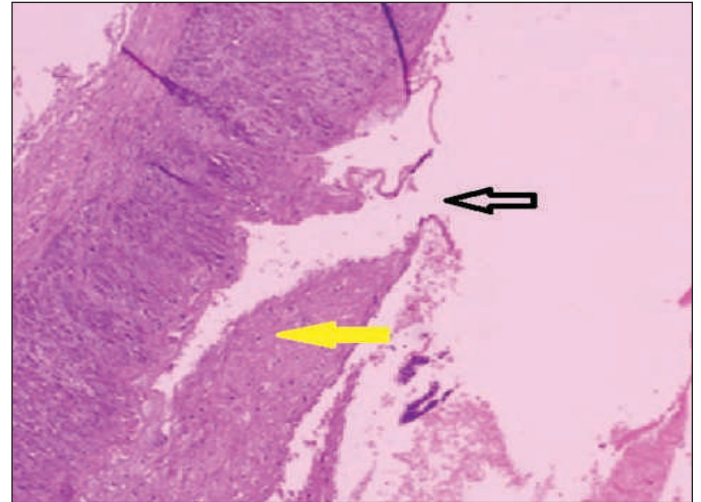


Figure 3. Photomicrograph showing carotid artery with tear in intima (black arrow) and media (yellow arrow) layers, H & E, 100X.

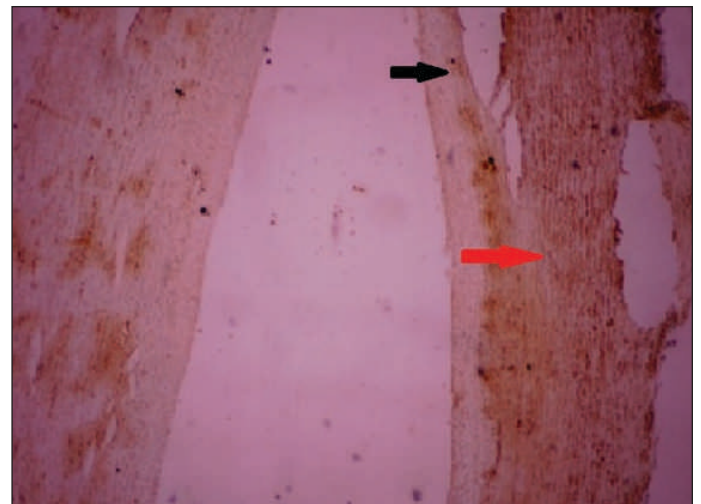


Figure 4. Photomicrograph showing tear in media layer (black arrow) and compression of muscle fibers of carotid artery (red arrow), IHC for smooth muscle actin, 40X.

walls of carotid arteries. In a study conducted by Jani and Gupta,¹¹ they found carotid tears in 47.8% cases. Nikolic et al.⁵ documented injuries of the carotid arteries on the left side of the neck in 7.4 % of the cases and on the right side in 10.9 % of the cases in a retrospective study of 175 cases of hanging. Suarez-Penaranda et al.⁶ found Amussat's sign in 9.1% of 228 cases of hanging, Jayprakash et al.⁷ et al reported Amussat's sign in 1.1% out of 189 cases of hanging. Rao D¹² observed transverse tear in internal carotid artery in 52.27% cases out of 264 cases. Meera and Singh¹³ observed in 23.81% cases of hanging and Hejna¹⁴ in 16.1% cases of hanging.

In present study Amussat's sign was seen in 15.05% cases on gross in complete hanging which was quite similar to studies done by Petr Hejna¹⁴ and S. Balusubramanian et al.¹⁵ which showed incidence of Amussat's sign as 17.90% and 16.50% respectively. Whereas in partial hanging carotid tear was not seen in present study but it was seen in 13.7% cases and 6.69% cases in studies of Petr Hejna¹⁴ and S. Balasubramanian et al.,¹⁵

respectively.

On histopathology examination Amussat's sign was seen in 76.34% (n=71) cases of complete hanging and in 36.40% (n=8) cases of partial hanging which was different from the findings of study conducted by S. Balasubramanian et al.¹⁵ and D. Ghodake et al.¹⁶ which showed 42.40% and 25.00% in complete hanging and 11.50% and 6.66% in partial hanging. However, in our study a statistically significant association was noted and it has been supported by similar studies conducted by Petr Hejna¹⁴ and S. Balasubramanian et al.¹⁵

In present study Amussat's sign on gross examination was seen mostly in anterior hanging (28.6%) cases, followed by right lateral hanging (27.3%) cases, followed by left lateral hanging (20%) and least seen in posterior hanging (5.5%) cases. It was different from the study conducted by Petr Hejna¹⁴ which showed Amussat's sign mostly present in right lateral hanging cases (28.57%) and it was not seen in anterior hanging cases.

In present study, Amussat's sign on histopathological examination was mostly seen in anterior hanging (85.7%) cases, followed by right lateral hanging (81.8%) cases, followed by left lateral hanging (68%) and least seen in posterior hanging (65.3%) cases. It was different from the studies conducted by S. Balasubramanian et al.¹⁵ and D. Ghodake et al.¹⁶ which showed Amussat's sign mostly in left lateral hanging (80.76%) cases and right lateral hanging (68.18%), respectively.

Conclusion:

1. Tear in carotid arteries is caused due to direct and indirect trauma in the form of crushing and gravitational pull.
2. Amussat's sign was more visible on histopathological examination (69.5%) as compared to gross examination (12.17%).
3. Amussat's sign was seen more in complete hanging (76.30%) as compared to partial hanging (36.4%).
4. Amussat's sign was most commonly seen in anterior hanging cases (85.7%) as compared to any other position of knot.

Acknowledgement: Nil.

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