

## **Deaths as a result of hanging.**

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### **Abstract**

**Background:** Death by hanging occurs as a result of the tightening of a cord around the neck with the effect of body weight. Although generally seen, it is not always necessary for hanging to be in a completely perpendicular position with the feet off the ground. With the exception of judicial cases, most hangings are suicides and in some cases may be the result of accident or murder.

**Material and method:** In this study an evaluation was made of the autopsies of 48 cases of death by hanging in the province of Tokat, Turkey between 2009 and 2013. Through a retrospective evaluation of autopsy data, the cases were examined in respect of age, gender, location, type of hanging, instrument of hanging, fractures of the hyoid bone and thyroid cartilage and level of alcohol and other substances in the blood. In the evaluation of the data, the SPSS 11.0 software was used.

**Results:** The cases were 35 (73%) males and 13 (27%) females with a mean age of 34.56 years; males, mean 35.37 years and females, mean 32.38 years. Typical hanging was determined in 42 (87.5%) cases. Fracture of the hyoid bone was seen in 14 (29.2%) cases and fracture of the thyroid cartilage in 13 (27%) cases. With the exception of 2 cases, ecchymosis was found in the fracture region of all the other cases. Ethanol was determined in the blood of 8 (16.6%) cases and other substances in the blood of 2 (6.2%) cases.

**Conclusions:** In every case of hanging, the autopsy and toxicology and histopathology examinations made following autopsy are extremely important in respect of differential diagnosis and determining whether or not it is a case of suicide or whether the hanging occurred after death.

**Keywords:** Autopsy, Capital punishment, Suicide.

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### **Introduction**

Hanging is defined as an event in which a cord is attached at one end to a fixed point and the other end is passed around the neck in the form of a noose or wrapped several times around the neck and with the full or partial weight of the body, the neck is restricted, causing pressure on the respiratory tract, vessels and nerves, thereby preventing vital functions and which generally results in death [1-5].

In most cases, death by hanging is caused by brain ischaemia which develops because of compression on the airways and blood vessels of the neck and sometimes reflex cardiac arrest occurs due to vagal inhibition created by pressure on the carotid sinus. Occasionally, death may occur as a result of mechanical asphyxia due to obstruction of the airways with the swallowing of the glottis and tongue directly into the pharynx caused by restriction of the neck. However, these mechanisms

of hanging should not be considered separately from each other as it is thought that the inhibition of respiratory and circulatory functions together result in acute brain ischemia leading to death [1,6]. Research into determination of the origin of death as a result of hanging, which is a frequently seen method of suicide, is of great importance. In addition to death by hanging generally being suicide, cases of accident and murder have also been reported [7-9].

The relationship between the use of alcohol, narcotics, sedatives and similar substances in hanging by suicide cases is a known fact [2]. The determination of substance and metabolites in bodily fluids such as blood and urine are the most important criteria in the diagnosis of substances used. However, in the postmortem examination, as the time that the substance was taken cannot be accurately established, it is not possible to know exactly the amount of substance used [10].

The aim of this study was to evaluate the autopsy reports of cases of death by hanging in the 5-year period of 2009-2013 in the province of Tokat and to discuss the results obtained in the light of the relevant literature.

## Material and Method

An evaluation was made of cases of deaths by hanging in the province of Tokat in the 5-year period of 2009-2013. The autopsy data of cases in this time period were examined in respect of age, gender, location, type of hanging, instrument of hanging, fractures of the hyoid bone and thyroid cartilage, the level of alcohol and other substances in the blood and the origin of the incident. The data obtained were evaluated using SPSS 11.0 software. The Chi-square test was used as a statistical test and a value of  $p < 0.05$  was accepted as statistically significant.

## Results

A total of 484 autopsies were conducted in the province of Tokat between 2009 and 2013, of which 48 (9.9%) were determined as cases of death as a result of hanging. The 48 cases of death by hanging were 35 (73%) males and 13 (27%) females with a mean age of 34.56 years; males, mean 35.37 years and females, mean 32.38 years.

The location of the incident was reported to be the home in 29 (60.4%) cases, in an open area in 9 (18.75%) cases, the workplace in 5 (10.4%) cases, in prison in 3 (6.25%) cases, in hospital in 1 (2%) case and in a hotel in 1 (2%) case. Of the 29 cases where the hanging occurred at home, 19 were male and 10 were female, of the 9 cases where the hanging was in an open area, 6 were male and 3 were female and all the other cases were male (Table 1).

**Table 1.** The location of hanging.

	Male	Female
Home	39.5% (n=19)	20.8% (n=10)
Outside	12.5% (n=6)	6.25% (n=3)
Office	10.41% (n=5)	none
Prison	6.25% (n=3)	none
Hospital	2.08% (n=1)	none
Hotel	2.08% (n=1)	none
Total	n=35	n=13

When the genders were compared in terms of location, no statistically significant difference was determined between the genders in respect of the incidence of hanging at home (Chi-square statistic: 2.0312,  $p: 0.154099$ ).

No statistically significant difference was determined between the genders in respect of the incidence of hanging in an open area (Chi-square statistic: 0.2191,  $p: 0.639723$ ).

As there were no females in the group of hangings in other locations, statistical evaluation could not be applied.

The instrument of hanging was reported as nylon cord in 30 cases, muslin fabric in 5, bedsheets in 6, and electric cable in 4 and a belt in 3 cases. In respect of the materials used, of the 30 cases who used nylon rope, 24 were male and 6 were female, of the 6 who used sheets, 3 were male and 3 were female, of the 5 who used muslin curtains, 1 was male and 4 were female and all the cases who used electric cable or a belt were male (Table 2).

**Table 2.** The material used for hanging.

	Male	Female
Nylon Line	50% (n=24)	%12.5 (n=6)
Bed Sheet	6.25% (n=3)	%6.25 (n=3)
Cheesecloth	2.08% (n=1)	%8.33 (n=4)
Electric Cable	8.33% (n=4)	none
Belt	6.25% (n=3)	none
Total	35	13

When the types of methods and materials used for hanging were compared, the rate of females using muslin curtains was seen to be statistically significantly higher than males (Chi-square statistic: 7.9141,  $p: 0.004905$ ). No statistically significant difference was determined between the genders in respect of other materials used. No females used electric cable or a belt so statistical evaluation could not be made.

In all 48 (100%) cases the noose used in the hanging was described as raised with a shallow drop. In the postmortem examination reports, typical hanging was reported in 42 (87.5%) cases, atypical hanging in 6 (12.5%) cases and in 1 case, incomplete hanging was determined. In the 6 cases of atypical hanging, the knot was on the left side in 3, on the right side in 2 and at the front of the neck in 1 case. In the autopsy, ecchymosis was determined in the soft tissue in the area under the noose in all the cases and in 6 cases ecchymosis was determined in the muscle. In the 6 cases where intramuscular ecchymosis was determined, all were male, 4 had used an electric cable, 2 had used nylon rope and 1 had used a belt. When the relationship was determined between the material used and the cases where intramuscular ecchymosis was determined, the ratio of cases where electric cable was used was determined to be statistically significantly high (Chi-square statistic: 30.5455,  $p: 0.0001$ ).

In the examination of the hyoid bone and thyroid cartilage, fracture was determined in the left horn of the hyoid bone in 8 cases, in the right horn in 8 cases, in both the left and right horns in 2 cases and no fracture of the hyoid bone was determined in 14 cases. Fracture in the left side of the thyroid cartilage was determined in 10 cases, in the right side in 9 cases, and in both left and right sides in 3 cases. With the exception of 2 cases, ecchymosis was determined in the fracture area of all the other cases (Table 3).

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No statistically significant difference was determined between the genders in respect of fracture of the hyoid bone during hanging (Chi-square statistic: 0.4024, p:0.525865). No statistically significant difference was determined between the genders in respect of fracture of the thyroid cartilage during hanging (Chi-square statistic: 0.844, p:0.358268) (Table 4).

**Table 3.** The distribution of fractures occurring during hanging according to gender.

	Hyoid Fracture	Thyroid Cartilage Fracture	No Fracture
Male	20.83% (n=10)	27.08% (n=13)	25% (n=12)
Female	8.33% (n=4)	6.25% (n=3)	12.5% (n=6)

**Table 4.** The relationship of fractures and the materials used.

	Hyoid Frac.	Thyroid Car. Frac.	No Frac.
Nylon Line	12	10	8
Bed Sheet	none	none	6
Cheesecloth	none	1	4
Electric Cable	1	3	none
Belt	1	2	none
Total	14	16	18

When the relationship was examined between fractures of the thyroid cartilage and hyoid bone and the material used for hanging, it was determined that materials with a narrow surface area and less flexibility such as electric cable and belt had caused statistically significantly more fractures (Chi-square statistic: 4.9171, p:0.026593).

While no ethanol was determined in the blood of 40 cases, it was present in 8 (16.6%) cases. Benzodiazepine derivative was determined in 1 case and opiate derivative substance in 1 case. A separated vertebral fracture was determined in 1 case and a fracture in the vertebral body in 1 case. The origin of the incident was concluded from the evidence to be suicide in all 48 (100%) cases.

## Discussion

Of the total 484 autopsies conducted in the province of Tokat in the period 2009 -2013, 48 were determined as cases of death as a result of hanging. This was a rate of 9.9% of the total autopsies. In studies in Turkey, a study in Izmir which examined autopsies over a 5-year period determined that 56% of cases were forced deaths and of all the cases, 12% were mechanical asphyxiation. A study in Ankara examined 1169 autopsies over 4 years and reported that 50 (4.3%) were cases of death by hanging [6,11]. In a 10-year period in Izmir, 14.2% of autopsy cases comprised 473 cases of suicide of which 137 (29%) were death by hanging as the second most common means of suicide. Of a total of 62 suicide cases in Sivas, 41.9% were by hanging and hanging was reported as the leading method of suicide in males at 43.8% [12-15]. In a study

conducted in Istanbul between 1980-1983, of 5262 autopsies, 159 (3.0%) were cases of death by hanging and of 5207 autopsies between 1986-1989, 200 (3.8%) were cases of death by hanging [16,17]. In studies conducted in different cities, hanging cases have been reported to comprise 3%-5% of the total autopsies. Although various studies have determined hanging as a suicide method at different rates, it is seen to be at a significant level among suicide methods [6,15]. As the material required for hanging is cheap, available and easily accessible, this has been reported to be one of the reasons that hanging is an often preferred method of suicide. In the current study, the cases of death by hanging were seen to comprise 9.9% of all the autopsies performed in that time period.

In the current study, the cases were 35 (73%) males and 13 (27%) females. In a study by Balci, the rate of males committing suicide by hanging was determined as 64.3% and females as 35.7%. In a study in Izmir, 130 (72%) cases were male and 49 (28%) were female while in the previous studies in Istanbul, these rates were determined as 76.7% males and 23.3% females in 1980-1983 and 70% males and 30% females in 1986-1989. Hanging is one of the most commonly used methods of suicide throughout the world with increasing rates of incidence in the last 30 years. Hanging has been reported as the most common method of suicide in Japan, Scotland and Lithuania and the second most common method after the use of firearms in the USA and France [18-20]. In studies conducted in different regions of the world, hanging is seen to be one of the primary methods of suicide.

In the current study, the mean age of all the cases was determined as 34.56 years, with the mean age of males as 35.37 years and of females as 32.28 years. In a study by Gök, mean age was determined as 34.7 years in males and 22.2 years in females, Üner reported an overall mean of 35 years with mean 35.8 years in males and 33.3 years in females and Özer reported that 56% of cases were in the 21-40 years age group [16-18]. In another study, a mean age of 37.8 years was reported [21]. The mean age of both genders of the cases in the current study was seen to be consistent with data in literature.

In the current study, typical hanging was determined in 42 (87.5%) cases and atypical hanging in 6 (12.5%) cases. While 25.4% of cases were reported as typical hangings in a study by Gök, Inanici et al reported typical hangings at the rate of 66%, Üner at 45% and Özer at 49% (6, 16-18). A study conducted in Adana reported that of 159 cases, 121 (76%) were typical hangings and 38 (24%) atypical hangings [22]. Various studies have been seen to report the type of hanging at different rates.

A relationship has been reported between suicide cases and the use of alcohol, narcotics, sedatives and similar substances in hanging [2]. In a study by Ege et al. alcohol was determined in 37 (20%) cases and other toxic substances in 3 cases, Özer reported alcohol in 13 (8.1%) cases and other substances in 2, and Üner determined alcohol in 29 (14.5%) cases and other substances in 4 cases [15-17]. Alcohol was determined in the blood in 38% of suicides in Australia, in 37.5% of deaths by hanging in Brazil, in 16.6% in a study conducted in Istanbul and in 10.6% in a study in Adana [5,14, 22-26]. In the current

study, this rate was determined at 17% in 8 cases. While this rate was seen to be close to that of the study in Istanbul, it was found to be different from that of studies in other countries. This can be considered to be due to the sociocultural structure.

Previous studies have reported that hanging is the most widespread or second choice of suicide method [19,22-28]. In studies conducted in prisons, while hanging is the most common method of suicide, the majority of cases have been reported to have a history of alcohol or substance use [29-37]. In a study in Hungary, alcohol was found in 15% of cases committing suicide and the use of other substances was rare, whereas in Australia it has been suggested that substance use is a prominent feature in young adult males committing suicide by hanging [38-40,41]. In some studies, alcohol is the most commonly determined substance in cases of suicide by hanging and in some ethnic groups, more than half the cases have been determined to commit suicide by alcohol or other toxic substances [31,34,35]. While hanging has been reported as one of the most used methods of suicide in many studies, different results have been found on the subject of determining alcohol or substances in these cases. It is thought that these results differ according to different countries and cultures.

In the current study, the location of the incident was reported to be the home in 29 (60.4%) cases, in an open area in 9 (18.75%) cases, the workplace in 5 (10.4%) cases, in prison in 3 (6.25%) cases, in hospital in 1 (2%) case and in a hotel in 1 (2%) case. Ege et al. reported the home as the leading location of hanging at the rate of 53.6%, Balci determined the location as the home or outbuildings at the rate of 73.6% in males and 91.7% in females, Üner reported the home as the location in 62% of cases, Gök at 64.4% and Erel et al. reported the home or garden in 42.6% of cases [12,15,17,18,23]. In the current study, the home was determined as the primary location of the incident in 60.4% of all the cases. When the two genders were evaluated separately, 19 of the total 35 male cases and 10 of the total 13 female cases were seen to have committed suicide at home, but no statistically significant difference was determined between the genders in respect of the location of the hanging.

In the examination of the hyoid bone and thyroid cartilage, fracture was determined in the hyoid bone in 14 (29.2%) cases, in the thyroid cartilage in 13 (27%) cases and with the exception of 2 cases, ecchymosis was determined in the fracture area of all the other cases.

In the autopsy, ecchymosis was determined in the soft tissue in the area under the noose in all the cases and in 6 cases ecchymosis was determined in the muscle. When the relationship was examined between the material used for hanging and deep tissue ecchymosis, it was determined that the use of materials with a narrow surface area and little flexibility such as electric cable and belt, led to statistically significantly more deep tissue ecchymosis. Therefore, deep tissue ecchymosis encountered during autopsy can give information as to the nature of the material used for hanging.

In the examination of the hyoid bone and thyroid cartilage, fracture was determined in the left horn of the hyoid bone in 8 cases, in the right horn in 8 cases, in the left side of the thyroid cartilage in 10 cases and in the right side in 9 cases.

In 7 cases, evidence of hanging was concluded from bleeding in the areas under pressure and in the soft tissue only. In 11 cases, where there was no fracture of the hyoid bone or thyroid cartilage and no haemorrhage determined in the soft tissue or areas under pressure, the verdict was seen to have been given as it was necessary to accept the other data as death resulting from hanging.

This is understood to be valid for cases where the findings could not be clearly differentiated because of treatment or that ecchymosis could not be determined because of decay. It has also been reported that in some cases in the area under the noose in deaths by hanging, no findings could be determined macroscopically in the internal examination [42]. Ecchymosis in the area where the noose is applied may be determined with difficulty in some cases or cannot be found [1]. Ege et al. determined fracture in the hyoid bone in 24 cases and in both the hyoid bone and thyroid cartilage in 2 cases Gök et al. reported fracture in the hyoid bone in 23 (39%) cases. In the study by Özer, fracture in the hyoid bone was determined in 35.2%, in the thyroid cartilage in 21.4% and in both the hyoid bone and thyroid cartilage in 11.3%. Üner reported fracture in the hyoid bone at 24.5%, in the thyroid cartilage at 16% and in both at 9%. In a study by Inanici while fracture in the hyoid bone was determined in 15 (30%) cases, no fracture was seen in thyroid and cricoid cartilage and the hyoid fractures were reported as 10 males and 5 females [9,15-18]. In the majority (>60%) of cases of hanging, no hyoid bone fracture is seen and a higher rate of fracture is known to be seen in the elderly as the hyoid bone is a more rigid structure in that age group [1]. In the current study, no statistically significant difference was determined between the genders in respect of fractures of the hyoid bone and thyroid cartilage. However, when the effect of the material used on fractures was examined, materials such as electric cable or belt were seen to be effective in the formation of fractures in parallel to the effect on the formation of intramuscular ecchymosis.

In the current study, there was evidence that the origin was suicide in all 48 (100%) cases. In previous studies, the origin has been reported as suicide in 98%, 93.2% and 95.2% of cases and other studies have reported that all the cases were suicide [8,18,22,24,43-45].

## Conclusion

In the current study, the location of the hanging was reported in 61.5% of cases. That the location and instrument of hanging were stated in a small section of the reports is seen as a limitation of this study. One of the most frequently encountered problems encountered by pathologists in cases of hanging is whether death occurred before or after hanging and data is expected to be revealed to determine if the deceased was hanged by a third party. Information related to witness

statements, a suicide note or reasons for suicide, examination of the scene of crime, photographs of the location, a schematic plan, the instrument of hanging and the knot is sent together with the legal documents before the autopsy and will be decisive in finding answers to the questions asked by the prosecutor. As medications and chemical substances are at higher concentrations in the urine than in the blood, a urine sample must be taken together with a blood sample for toxicology analysis (4). Autopsy and the toxicology and histopathology examinations made after autopsy must be taken into account as the necessary procedures to be made in every case of hanging in respect of differential diagnosis and determining the origin of the incident.

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