ORIGINAL ARTICLE

Drowning in submerged cars caused by traffic accidents

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ABSTRACT

BACKGROUND: Traffic accidents are among the most common causes of death. A small proportion of drownings are associated with traffic accidents. The roads in the Eastern Black Sea Region, where the study was conducted are fairly close to the seas, rivers, and ponds. This study aims to evaluate the cases who underwent autopsies after the traffic accident between 2009 and 2016 and who were found to have died as a result of drowning.

METHODS: A retrospective examination was made of the autopsy reports in the period 2009–2016.

RESULTS: As a result of the examination of forensic reports, from a total of 7124 autopsies performed in our center between 2009 and 2016, 41 (0.57%) were seen to be due to death in a traffic accident that resulted in drowning. Of the vehicles involved in the accidents, 30 (73.2%) were retrieved from a river/stream, 7 (17.1%) from a lake, and 4 (9.7%) from the sea. In all 39 cases, the primary cause of death was determined as asphyxia related to drowning. Other reasons affecting death were traumatic intracranial bleeding in 7 (17.1%) cases, medulla spinalis injury in 4 (9.7%), and pulmonary injury in 2 (4.9%).

CONCLUSION: It was determined in the study that the typical autopsy results of trauma and drowning after a traffic accident could coexist. Drowning alone could be the cause of death, even though there was a traumatic origin such as a traffic accident in such cases. It was revealed that chemical and microscopic examinations should be handled together with crime scene results and eyewitness statements in addition to traumatic results during the examination phase.

Keywords: Autopsy; drowning; traffic accident.

INTRODUCTION

According to the World Health Organization (WHO), throughout the world, a person dies associated with a traffic accident every 23 s. It has been reported that in 2016, 1.35 million people passed away in traffic accidents and almost 50 million individuals were injured.[1,2] In 2018, 6675 deaths were reported in more than 1.2 million traffic accidents in Turkey.[3,4] Furthermore, there are an estimated 320,000 annual drowning deaths worldwide, while 600 people death in Turkey.[3,5]

Traffic accidents resulting in drowning are not common and there is very little information about drowning in water associated with traffic accidents on roads. Of all drowning cases, 3–11% occur together with a motor vehicle accident. Drowning associated with a road motor vehicle has been reported as 1.5% of all traffic accident deaths and as 3.3% of accidents involving a single vehicle.[6]

Death origin detection can be difficult in such deaths due to a lack of witnesses and late access to the scene. Therefore, medical and crime scene investigation reports must be obtained before the autopsy. The findings obtained from a well-organized crime scene investigation team will be highly determinant in the autopsy procedures to be applied by the experienced forensic pathologists when there is an overlap of traumatic agents with asphyctic results such as drowning.

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This study aimed to evaluate the scene of crime findings and autopsy reports of bodies retrieved from the water following traffic accidents which finished in the sea, rivers, or lakes and, thereby, contribute to the relevant specialists for the determination of traumatic injuries and asphyxia states. In our country, which is not rich in terms of water resources, it is to give information about road traffic accidents that submerged vehicles, and corpses removed from the water.

MATERIALS AND METHODS

A retrospective examination was made of the autopsy reports made by the The Council of Forensic Medicine – Trabzon Forensic Medicine Group Directorate in the period 2009–2016. The study only included traffic accidents involving road motor vehicles and maritime accidents were excluded from the study. A total of 41 deaths following road traffic accidents were evaluated with respect to the autopsy findings and scene of crime reports. A record was made of the demographic data of the cases, the location of the accident, the cause of the accident, and the cause of death. Data obtained in the study were analyzed statistically using SPSS vn. 24 Software (Statistical Package for the Social Sciences).

RESULTS

As a result of the examination of forensic reports, from a total of 7124 autopsies performed in our center between 2009 and 2016, 41 (0.57%) were seen to be due to death in a traffic accident that resulted in drowning. The 41 cases comprised 36 (87.8%) males and 5 (12.2%) females with a mean age of 46.46±16.19 years (range, 12–82 years). Most of the accidents (n=13) occurred in 2013 in the months of June and August. In 40 accidents, a single vehicle was involved, in 39 (95.1%) the vehicle was a car and in two accidents, a lorry. It was recorded that four vehicles were overturned in the water.

Of the vehicles involved in the accidents, 30 (73.2%) were retrieved from a river/stream, seven cases (17.1%) from a lake, and four cases (9.7%) from the sea. The distribution of the months of the accidents is shown in Figure 1 and the time at which the accidents happened in Figure 2.

Of the 27 bodies found within the vehicles, 16 were the drivers. Four of the 11 bodies found outside the vehicle were at a distance of 1–16 km from the site of the accident. Rescue teams were at the site of the incident within the 1st h in 12 cases and bodies were retrieved between 3 and 312 h in 23 cases. This information was not available in five cases. From the records, it was determined that only two cases (3.2%) were wearing a seatbelt before the accident. The positions of the bodies in the vehicle before and after the accident according to the crime scene reports are shown in Figure 3.

In the examination of the bodies removed from the water, grazes and lacerations were determined in 78% (n=32), washer-woman hand in 58.5% (n=24), mud stains on the skin in 48.8% (n=20), cutis anserina in 4.9% (n=2), and decomposition in 4.9% (n=2). In the respiratory system examination, the mushroom-like foam was determined in 24.4% (n=10), bleeding, froth, and edema in pulmonary sections in 96% (n=39), and pleural transudate in 4.9% (n=2) (Figs. 4 and 5).

Bone fractures were determined in 61.1% of the cases. Three of the six cases with cervical vertebrae fractures and one with thoracolumbar vertebra fracture were determined with medulla spinalis damage. The scene of crime photographs of one of the current cases is shown below (Figs. 6 and 7).

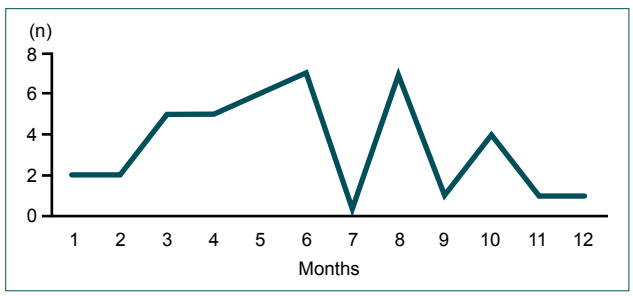

Figure 1. Distribution of the accidents according to months.

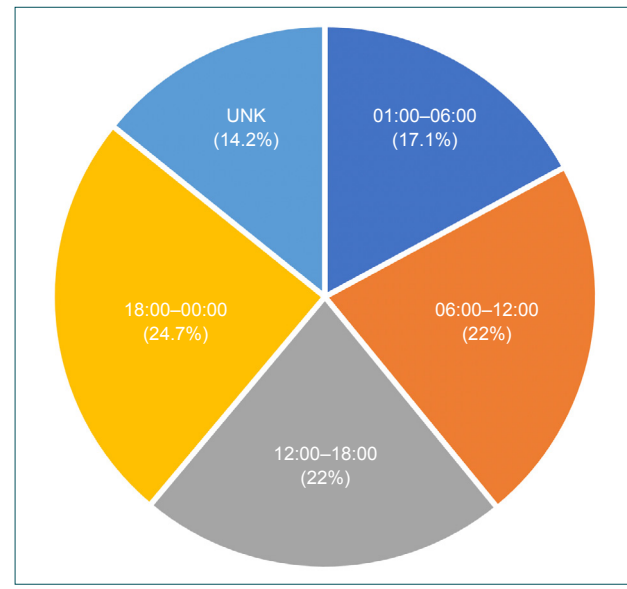

Figure 2. Distribution of the accidents according to the time at which they happened.

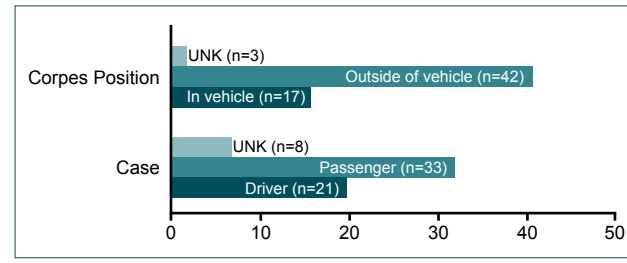

Figure 3. Positions of the individuals before and after the accident.

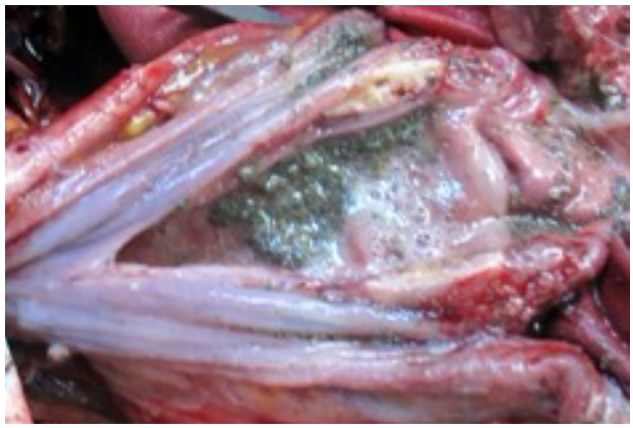

Figure 4. Sand aspirated together with water in the trachea.

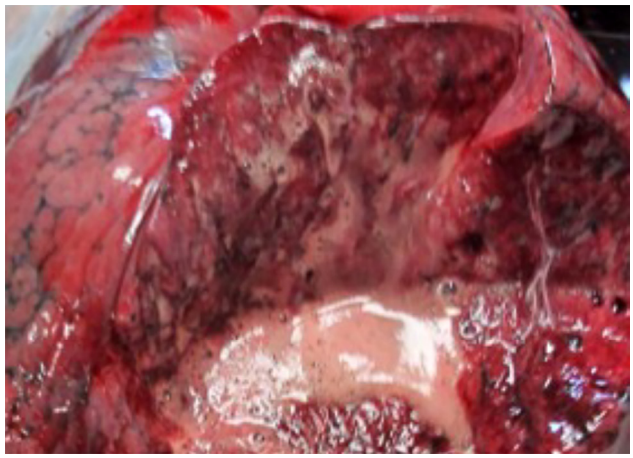

Figure 5. Spontaneous frothing fluid output in slices taken from edematous lungs which were increased in weight.

In the toxicology examination, blood ethyl alcohol levels were mean 189.50±77.1 mg/dL (range, 93–306 mg/dL) in 14 cases. SSRI group antidepressant substance was determined in one case, Δ9-tetrahydrocannabinol (THC) in one and benzodiazepine metabolites in one case.

In the histopathological examination, a fibrotic appearance consistent with myocardial infarction was determined in seven (17.1%) cases, and atherosclerotic changes causing >50% obstruction in at least one of the coronary vascular lumen in seven (17.1%) cases.

In 39 (95.1%) cases, abundant froth and edema fluid were determined in the lungs and respiratory pathways, and in 19 (46.3%) cases, mud and sand were determined in the stomach. Fluid content was detected in the stomach of 46.3% (n=19) of the cases. About 68.4% (n=13) of these cases with fluid in their stomachs were removed from a stream. The right lung was weighed as mean 786.1±250.3 g (range, 395–1500 g) and the left lung as 705.90±225.20 g (range; 303–1200 g). In two cases (4.9%), the respiratory and gastrointestinal systems could not be fully evaluated due to findings of decomposition. These two decomposed bodies were retrieved 288 and 312 days after the accidents, one from inside the vehicle and the other from 2500 m distant from the location of the accident. In all 39 cases, the primary cause of death was determined as asphyxia related to drowning. Other reasons affecting death were traumatic intracranial bleeding in 7 (17.1%) cases, medulla spinalis injury in 4 (9.7%), and pulmonary injury in 2 (4.9%).

Figure 6. A crime scene photograph.

Figure 7. An overturned vehicle in a stream.

DISCUSSION

The eastern Black Sea Region of Turkey has a rugged geographical nature with a long coastline and many rivers and streams and reservoirs. The Black Sea Coast road runs along the coast parallel to the sea and the inland roads are generally parallel to rivers. Therefore, vehicles in traffic accidents can roll into these areas of water. The cause of death in traffic accidents is generally musculoskeletal system or organ damage, severe bleeding, or asphyxia in the early period. However, in the later period, mortality may develop due to secondary bleeding, hypotension, and/or kidney failure associated with widespread muscle damage, fat embolism, local and systemic infections, and myocardial or cerebral infarctus.[2]

The origin of death in traffic accidents and drowning cases is usually an accident.[2,7] It can be difficult to clarify the cause of death when these two events overlap. Autopsy studies of bodies removed from water which has presented difficulties

due to the continuously changing characteristics of lakes, rivers, and seas.[6–8] To determine the cause of death in a body removed from the water, an autopsy has to be conducted and must be excluded from other causes than drowning.[9] In Turkey, unlike some countries, forensic pathologists do not specify the origin of death in their reports. Autopsy reports only have the causes of death. According to the judicial structuring, the origin of death is determined after the result of the crime scene investigation, autopsy, inquiry, and trial by the judicial authorities. In this retrospective study, the cases whose cases have been concluded were evaluated.

There are a few scientific articles in the literature related to motor vehicle accidents that result in drowning. In these accidents, the vehicle leaves the road and enters the water or falls from a bridge[6,10] (Figs. 6 and 7). The cause of death may be traumatic due in part to drowning or maybe drowning alone.

Especially in bodies that have remained in shallow water, there may be extensive wearing away of the skin due to friction from stones or pebbles.[2] In 78% (n=32) of the current cases, there were grazes and lacerations, the majority of which were determined to have occurred antemortem or in the early postmortem period. Deaths occurring through the mechanism that triggered the traffic accident explain the reason for bone fractures determined mostly in the neck and chest.

Asphyxia may be caused by not being able to undo the seatbelt and not being able to get out of the vehicle due to the physical injuries or the water pressure created in the vehicle. The deaths of four cases where the vehicle was found to be overturned could have happened for this reason. When there is a loss of consciousness or restricted movement due to trauma, it is possible for a person in a prone position to drown in shallow water.[7] Of the current cases, 70.7% (n=29) were found within the vehicle, and in 95.1% (n=39), bleeding, froth, and edema fluid were determined in the lungs and respiratory tract, and in 4.9% (n=2), pleural transudate. These findings demonstrate that the deceased was severely or slightly injured due to the accident, could not get out of the vehicle, and aspirated water.

In traffic accidents within the vehicle, musculoskeletal system and visceral injuries may occur, which are defined as "seatbelt syndrome".[11,12] The wearing of seatbelts reduces injuries and deaths by 45–50% for those in front seats and by 25–75% for those in back seats.[1,13] In our study, it was detected that only two cases (3.2%) have been wearing a seatbelt while an accident. In the others, no findings could be determined suggestive of seatbelt syndrome. Except for the victims (34.3%; n=14) who had skull and spine fractures that could impede mobility and it was found that the cases (70.7%; n=29) could not get out of the vehicle.

Washerwoman's skin was determined in 58.5% (n=24) of the current cases and mushroom-like foam in 24.4% (n=10). In the study of Türkoğlu et al.,[14] it is stated that the most common finding in corpses taken out of water is washerwoman's skin and mushroom-like foam. The Washerwoman's hand appearance occurs when a body has remained in the water for more than 1–2 h.[15] There may also be soil, sand, and seaweed stains from the environment, in which it is found. Experimental studies have reported that the washerwoman's hands appearance is formed in the fingerprints when the body remains in the water of 10–18°C for 20–30 min (max 100 min), and for this to form in the whole finger, it must remain in the water for 50–60 min (max 150 min).[9,15] The more frequent occurrence of the accidents in May, June, and August is directly relating to the increasing agricultural, commercial, and tourist traffic in the region. Furthermore, on secondary roads, protective mechanisms that can tolerate personal mistakes are less than on highways.

Of the 18 cases in the current study removed from the water within the first 3 h, the washerwoman's hand finding was determined in only four cases, whereas it was present in all 18 bodies retrieved between 4 and 312 h after the accident. Of the five cases, where there was no information about the time of the accident, the washerwoman's hand finding was present in two cases. Irrespective of the time spent in the water, the mushroom-like foam finding, was negative in 75.6% of the whole sample, including the cases where the time of the accident was not known. Washerwoman's skin and cutis anserina show that the body has been in water but does not show whether the body was alive or dead when it entered the water.[15] However, the findings of mushroom-like foam, bleeding in the inner ear (petrous bone), and the presence of foreign bodies in the sinuses indicate respiration difficulties and are evidence of live drowning.

Drowning increases the weight of the lungs by mean 100 g and it has been stated that the lungs can reach 600–700 g in weight.[2,16] Weight is related to the process of asphyxia, and it has been reported that in suffocation, the weight of the lungs is <1000 g, whereas the mean weight in drowning cases is 1411–1484 g.[17,18]

There was plenty of fluid in the lungs of our 39 cases and mud/sand in the stomachs of 19 patients (46.3%). Dirlik and Bostancıoğlu[19] stated in their research, they stated that they detected fluid in the stomach and duodenum in 79.4% of the children who were removed from the water. A similar situation in our study and in Dirlik's[19] study was that the bodies removed from the river and irrigation channels had more fluid in the respiratory and gastrointestinal tract than those removed from the lake or sea. This situation is thought to be due to stream pressure. In the autopsy, aspirated fluids may be encountered in the airways and lung sections (Fig. 5).

However, this is only valid when the body has been in the water for <24 h, and after this time, the weight of the lungs decreases, but the amount of pleural transudate increases.

It has been reported that in more than 75% of bodies that have remained in the water for longer than 30 days, the total amount of transudate and pulmonary weight is 1000–2200 g.[2,17] In the present study cases, the mean weight of both lungs was 1492.1 g (right: 786.1±250.3 g, left: 705.9±225.2 g). In 35 cases, where the time of the accident was not known, pleural free fluid (transudate) was not determined. Based on the information above, it can be concluded that these cases remained in the water for <24 h. In cases with no increase in lung weight, rarely seen "dry drowning" is seen in 2% of all drowning cases.[20] Due to vasovagal inhibition, there may be sudden and severe stimulation of the parasympathetic system with severe stimulation of the sensitive nerve endings, and bradycardia and cardiac arrest may be triggered through the 10th cranial nerve nucleus and vagal stimulus. Water entering the trachea in the form of a bolus can cause reflex cardiac arrest before the fluid enters the lower respiratory tract.[2] As findings were determined to support the diagnosis of drowning in all the current study cases, there were no cases that were thought to have been caused by vasovagal inhibition.

Decomposition occurs in 3 days postmortem in moderate climates and within the first 24 h in subtropical climates.[2] While organic content in the water accelerates decomposition, saltiness slows it down. In tropical regions, bodies in water come to the surface in 24 h, and in moderate climates, they come to the surface in 1 week in summer and in 2 weeks in winter.[21] In laboratory conditions, the mean body temperature of an adult falls to 35°C in 1 h in the water of 5°C, and in 3–6 h in the water of 15°C. The water temperature of the Black Sea varies between 7.9°C and 15.1°C between November and April, reaching the lowest temperatures in February.[22] In two of the present study cases, internal organ evaluation could not be made due to decomposition. These two cases were retrieved 288 and 312 days after the accident, one from within the vehicle and the other at a distance of 2500 m from the location of the accident.

There may be pathologies such as cardiac or neurological disorders (cardiac, aortic, cerebrovascular disease, stroke, and epilepsy) which may have caused the accident, and these may be found incidentally in the histopathological examination.[7,23] As a result of our autopsies, a fibrotic appearance consistent with chronic myocardial infarction was determined in 17.1% of cases, but these pathologies were not evaluated as causing the accidents. As a result of the trials made after the crime scene investigation, witness statements, and autopsy, it was concluded that all traffic incidents subject to our study were not murder or suicide, but accidents due to human error.

Diatoms, which are microscopic single-cell algae found in freshwater, saltwater, soil, and air, enter the systemic circulation when water is aspirated.[2,7] Due to the high possibility of contamination, this is not sufficiently specific or sensitive for a diagnosis of live drowning.[18,20,24–26] However, the determination of diatoms in bone marrow (healthy femur, sternum, and vertebrae) is valuable.[24,27] As it is not part of the routine work discipline of our center, no investigation was made related to the determination of diatoms.

It has been reported that the majority of drowning cases are male and 60.7% test positive for alcohol and 26.2% for psychotropic substances.[28,29] When blood ethyl alcohol concentration (BAC) is ≥0.04 g/dL, the risk of a traffic accident when driving is significantly increased. The risk of traffic accidents when drugs have been taken shows variations depending on the psychoactive drug used. The risk of a fatal traffic accident of those using amphetamines has been reported to be increased by approximately 5-fold.[1] In Turkey, the BAC limit is 0.5 mg/dL in traffic. Positive BAC was determined in 34.1% of our cases (mean 189.5±77.1 mg/dL). The reason for the lower BAC rate can be attributed to cultural and regional differences.

In three of the present study cases, SSRI, THC, and benzodiazepine metabolites, respectively, were determined at non-lethal levels. Compared to other anti-depressants, SSRI is safer, and the lethal dose is extremely high (LD50). No anticholinergic, cardiac, or sedative side-effects are seen associated with these drugs, and epileptic seizures do not occur during SSRI use. The drug agent substances determined in the toxicology examination in our study were not at a toxic level, and it was concluded that they had not had an effect on the occurrence of the accidents.

Conclusion

When the cases in this study were examined, bone fractures in the cervical region were predominant among the trauma findings. As expected, alcohol consumption was an important risk factor in these cases. Typical autopsy findings related to both trauma and drowning were seen together in these cases. In complicated cases such as these, which can become extremely confusing, the determination of pathologies which can cause death together or alone is important.

It should be kept in mind that sudden illness onset while driving may cause an accident.[23] All drivers, especially commercial drivers (bus, taxi, and truck drivers), should be regularly checked for their health and should not be allowed to drive when a disturbance is detected. As in our research, it was determined that the most important cause of the traffic accidents occurring in the regions with steep slopes human errors. It was concluded that the most important protective factor in vehicles that especially roll-over before submerged, the water is the seat belt.

In cases where the seat belt is not fitted, it will be difficult to distinguish between the driver and the passenger in the vehicle that rolls over and moreover somersaults into the water. Therefore, it would be appropriate to perform an autopsy in all cases in such cases. Besides, we think that it would be

beneficial to share the judgment results with the physician performing an autopsy in forensic death cases.

Highlights

- Traffic accidents resulting in drowning are not common and there is very little information about drowning in water associated with traffic accidents on roads.
- To determine the cause of death in a body removed from water, an autopsy must be conducted and causes of death other than drowning must be excluded.
- Bone fractures in the cervical region were predominant among the trauma findings.

Ethics Committee Approval: This study was approved by the Ministry of Justice, Forensic Medicine Institute Ethics Committee (Date: 12.12.2017, Decision No: 21589509/2017/587).

Peer-review: Internally peer-reviewed.

Authorship Contributions: Concept: H.Ç.K.; Design: H.Ç.K.; Supervision: S.Ö., H.İ.A.; Resource: H.Ç.K., M.A.; Materials: H.Ç.K.; Data: H.Ç.K., H.İ.A.; Analysis: H.Ç.K., H.İ.A., S.Ö.; Literature search: H.Ç.K., H.İ.A., S.Ö., M.A.; Writing: H.Ç.K., H.İ.A., S.Ö., M.A.; Critical revision: H.İ.A., S.Ö., M.A.

Conflict of Interest: None declared.

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REFERENCES

1. World Health Organization. Global status report on road safety. Geneva: World Health Organization; 2018.
2. Saukko P, Knight B. Knight's forensic pathology. 4th ed. United States: CRC Press; 2015. [CrossRef]
3. Turkish Statistical Institute. Available from: https://www.tuik.gov.tr/PreTablo.do?alt_id=1051. Accessed Jun 06, 2020.
4. Traffic accident statistics in Turkey. Available from: https://www.trafik.gov.tr Accessed Jun 01, 2020.
5. World Health Organization. Drowning. Geneva: World Health Organization; Available from: https://www.who.int/news-room/fact-sheets/detail/drowning. Accessed Jun 06, 2020.
6. Stjernbrandt A, Öström M, Eriksson A, Björnstig U. Land motor vehicle-related drownings in Sweden. Traffic Inj Prev 2008;9:539–43. [CrossRef]
7. Shkrum MJ, Ramsay DA. forensic pathology of trauma common problems for the pathologist. Totowa, NJ: Humana Press Inc; 2007. [CrossRef]
8. Baker SP, O'Neill B, Ginsburg MJ, Li G. The Injury fact book. 2nd ed. New York: Oxford University Press; 1992.
9. Kadı G, Günay Y, Seçkin C. The evaluation of the corpses pulled out of water in province of Muğla. Turk Klin J Foren Sci Leg Med 2017;14:27–33. [CrossRef]
10. Hammet M, Watts D, Hooper T, Pearse L, Naito N. Drowning deaths of U.S. Service personnel associated with motor vehicle accidents occurring in operation Iraqi freedom and operation enduring freedom, 2003-2005. Mil Med 2007;172:875–8. [CrossRef]
11. Huecker MR, Chapman J. "Seat Belt Injuries". Treasure Island, FL: StatPearls Publishing; 2019.
12. Sharma OP, Oswanski MF, Kaminski BP, Issa NM, Duffy B, Stringfellow K, et al. Clinical implications of the seat belt sign in blunt trauma. Am Surg 2009;75:822–7. [CrossRef]
13. Campbell BJ. Safety belt injury reduction related to crash severity and front seated position. J Trauma 1987;27:733–9. [CrossRef]
14. Türkoğlu A, Tokdemir M, Börk T, Tunçez FT, Yaprak B, Sen M. Retrospective assessment of drowning cases occurred between 2005-2012 in Elazig. Fırat Tıp Derg 2014;19:145–50.
15. Di Maio D, Di Maio VJ. Forensic Pathology. United States: CRC Press; 2001.
16. Piette MH, De Letter EA. Drowning: Still a difficult autopsy diagnosis. Forensic Sci Int 2006;163:1–9. [CrossRef]
17. Kringsholm B, Filskov A, Kock K. Autopsied cases of drowning in Denmark 1987-1989. Forensic Sci Int 1991;52:85–92. [CrossRef]
18. Tse R, Garland J, Kesha K, Morrow P, Lam L, Elstub H, et al. The potential diagnostic accuracy of autopsy lung weights, lung-heart ratio, and lung-body ratio in drowning deaths. Am J Forensic Med Pathol 2018;39:223–8. [CrossRef]
19. Dirlik M, Bostancıoğlu B. Child drowning deaths in Aydin Province, Western Turkey, 2002-2012. Eur J Trauma Emerg Surg 2015;41:683–8.
20. Lunetta P, Penttila A, Hallfors G. Scanning and transmission electron microscopical evidence of the capacity of diatoms to penetrate the alveolo-capillary barrier in drowning. Int J Legal Med 1998;111:229–37.
21. Guharaj PV, Chandran MR. Forensic medicine. 2nd ed. Himayatnagar, India: Orient Longman Pvt. Ltd.; 2003. p. 59 73.
22. Meteoroloji Genel Müdürlüğü. MKaradeniz Deniz Suyu Sıcaklıkları. Available from: https://www.mgm.gov.tr/FILES/resmi-istatistikler/denizSuyu/Karadeniz-DenizSuyu-Sicakligi-Analizi.pdf. Accessed Jun 06, 2020.
23. Hitosugi M, Gomel S, Okubo T, Tokudome S. Sudden illness while driving a vehicle-a retrospective analysis of commercial drivers in Japan. Scand J Work, Environ Health 2012;38:84–7. [CrossRef]
24. Pollanen MS, Cheung C, Chiasson DA. The diagnostic value of the diatom test for drowning, I. Utility: A retrospective analysis of 771 cases of drowning in Ontario, Canada. J Forensic Sci 1997;42:281–5. [CrossRef]
25. Peabody AJ. Diatoms and drowning--a review. Med Sci Law 1980;20:254–61. [CrossRef]
26. Auer A. Qualitative diatom analysis as a tool to diagnose drowning. Am J Forensic Med Pathol 1991;12:213–8. [CrossRef]
27. Foged N. Diatoms and drowning--once more. Forensic Sci Int 1983;21:153–9. [CrossRef]
28. Pajunen T, Vuori E, Vincenzi FF, Lillsunde P, Smith G, Lunetta P. Unintentional drowning: Role of medicinal drugs and alcohol. BMC Public Health 2017;17:388. [CrossRef]
29. Driscoll TR, Harrison JA, Steenkamp M. Review of the role of alcohol in drowning associated with recreational aquatic activity. Inj Prev 2004;10:107–13. [CrossRef]

ORİJİNAL ÇALIŞMA - *ÖZ*

Suda boğulma ile sonuçlanan trafik kazaları

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AMAÇ: Trafik kazaları en sık ölüm nedenleri arasındadır. Suda boğulmaların ise küçük bir kısmının trafik kazaları ile ilişki bulunmaktadır. Çalışmanın yapıldığı Doğu Karadeniz Bölgesi'ndeki karayolları deniz, akarsu ve göletlere oldukça yakın mesafededir. Çalışmada; 2009–2016 yılları arasında trafik kazası sonrasında otopsileri yapılan ve suda boğulma sonucu öldüğü tespit edilen olguların değerlendirilmesi amaçlanmıştır.

GEREÇ VE YÖNTEM: 2009–2016 yılları arasında yapılmış otopsilerin raporları geriye dönük olarak incelendi.

BULGULAR: Adli kayıtların incelenmesi sonucunda 2009–2016 yılları arasında merkezimizde otopsisi yapılan 7124 olgudan 41'inin (%0.57) ölümünün suda boğulma ile sonuçlanan trafik kazası sebebiyle gerçekleştiği görüldü. Kazaya karışan araçların %73.2'si (n=30) akarsudan, %17.1'i gölden (n=7) ve %9.7'si denizden (n=4) çıkartıldı. Otuz dokuz olgunun tamamında primer ölüm sebebinin "suda boğulmaya bağlı asfiksi" olduğu tespit edildi. Yedi olguda (%17.1) ölüme etki eden diğer sebepler travmatik intrakraniyal kanamalar, dört olguda (%9.7) medulla spinalis hasarı, iki olguda (%4.9) akciğer yaralanmasıydı.

TARTIŞMA: Çalışmada trafik kazası sonrasında travma ile suda boğulmanın tipik otopsi bulgularının bir arada bulunabildiği tespit edildi. Bu tip olaylarda, trafik kazası gibi travmatik bir köken olsa da; suda boğulmaların tek başına ölüm nedeni olabileceği görüldü. İnceleme aşamasında travmatik bulguların yanında kimyasal ve mikroskobik incelemelerin, olay yeri bulguları ve tanık ifadeleri ile birlikte ele alınmasının gerekliliği ortaya konuldu.

Anahtar sözcükler: Boğulma; otopsi; trafik kazası.

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