



Evaluation of in-Vehicle Phaeton Accidents Admitted to the Emergency Department: A Retrospective Study

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Abstract

Introduction: The aim of this study is to evaluate the traumatic consequences of in-vehicle phaeton accidents.

Methods: The study is a retrospective and observational study. Patients who admitted to the emergency department due to phaeton accidents, in a period of 8 years between 2011 and 2019, in a tertiary university hospital, were included in the study. The data were scanned twice from the hospital automation system. Patients who met the inclusion criteria and did not meet the exclusion criteria were included in the study. Demographic data and injury regions of the patients were examined in the study. Statistical significance was accepted as $p < 0.05$.

Results: There were 124 patients included in this study, which 52 were women and 72 were men. Mortality was seen in 35 (28.2%) patients. In ex cases, the percentage of nasal, subdural, epidural, intraparenchymal, skull fractures, intestinal perforation, intra-abdominal free mai, pelvis, femur, pneumothorax, hemothorax, rib fracture, and soft-tissue injury was found to be higher than the survivor cases ($p < 0.05$).

Discussion and Conclusion: Phaeton accidents are serious injuries that can cause fatal consequences. Mortality rates in these accidents can be reduced through increasing the safety measures integrated into the vehicle.

Keywords: Emergency department; head trauma; phaeton; trauma.

Accidents with horses are injuries that occur with high energy and can have serious consequences^[1]. Horses generally weigh more than 500 kg and can strike with a force of more than 1 ton^[2]. When such a high force and weight are added to a height of 3 m and a speed of 65 km/h, the consequences of the trauma created by the accident can be mortal^[3]. The consequences of this situation can lead to serious extremity injuries such as brain, spinal, thoracic, abdominal injuries, and limb loss.

Phaetons have been used as a vehicle for human beings for centuries^[4]. After the discovery of the wheel in the Bronze Age, a transportation revolution occurred with the

invention of phaetons^[4]. These vehicles, which can travel long distances, were used both in the revival of trade and in wars^[4,5]. They were used as the main vehicles of transportation in many countries around the world until after the World War II^[6].

Although phaetons are generally used for touristic trips in today, they are still used as vehicles in some countries^[7]. The most important feature that distinguishes phaeton-related accidents from other motor vehicles accidents is that there are at least two living that direct the vehicle. While the vehicles are completely under the control of the drivers in motor accidents, the severity and course of the accident

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may change according to the reaction of the horse that in the panic in phaeton accidents. In this case, accidents can be caused by horses being startled, excited, or the equipment failure^[8].

There are many studies in the literature that compile horse-related accidents^[9,10]. Especially, accidents of amateur horse sports or jockeys have been reported^[9-11]. Likewise, 23% of the accidents of jockeys in straight races were reported with hospital admissions and 16.67% of resulted in operations^[11]. In addition, in horse races, a fall was reported for 1 out of every 250 runs, and injury was reported at a rate of 35% in falls^[9]. In the races with hurdles, this rate resulted in one fall in every 20 runs and 20% injury. These results reveal the seriousness of the accidents. Thus, it is a fact that in professional horse sports accidents, riders are more advantageous than phaeton accidents in terms of preventing mortality and morbidity due to factors such as having protective equipment and being constantly observe by the health team. Accidents caused by these frequently used vehicles for touristic purposes, and the evaluation of their results, can give an idea about the measures to be determined in the accident areas. Predicting the consequences of the accidents caused by these vehicles, which are still actively used in low socioeconomic regions, can contribute to the health infrastructure plan.

We did not find any study evaluating phaeton accidents in the literature. The primary aim of this study is to examine the characteristics and results of in-vehicle phaeton accidents.

Materials and Methods

Study Design and Selection of Patients

This study was programmed retrospectively and descriptively in a university hospital. The study included patients brought to the emergency department (ED) by the emergency medical service due to an in-vehicle phaeton accident in the 8 years between 2011 and 2019. The approval was obtained for the study from the local ethics committee of the university (Ethics committee ruling number: 2020/514/171/6). The cases that have the word "phaeton" in the epicrisis were scanned by the emergency service secretary, from the hospital automation system. The epicrisis of all the cases reached later was examined separately by two emergency medicine specialists. The cases that were planned to be excluded were decided in a collective meeting. From the 127 cases that have been reached, the data of three which are a non-vehicle accident (phaeton crash) were excluded, the 124 patients who had a vehicle accident were included in the study. The imaging and examination

findings of the cases were recorded in the data form. Later, the images were reexamined by a radiologist, and the findings in the epicrisis and imaging reports were confirmed. Thus, the radiological findings of all patients in the study were confirmed by two radiologists.

Descriptive characteristics of the patients such as age, sex, accident on weekdays/weekends, or day/night were evaluated.

Trauma areas in the body were examined in detail. At this stage, the conditions of following were examined for the face and head: The injuries of frontal, zygoma, mandible, maxilla, nasal bone, skull bone, and the presence bleeding of subdural, epidural, subarachnoid, and intraparenchymal. Spinal injuries were examined as cervical, thoracic, lumbar, and sacral spinal.

Statistical Analysis

R version 2.15.3 program (R Core Team, 2013) was performed for the statistical analysis. While reporting the study data, minimum, maximum, mean, standard deviation, median, first quarter, third quarter, frequency, and percentage were used. The compatibility of quantitative data to normal distribution was evaluated by Shapiro–Wilk test and graphical analysis. Mann–Whitney U-test was used for the evaluation of variables that did not show normal distribution between two groups. Pearson's Chi-squared test and Fisher's exact test were used to compare qualitative data. Statistical significance was accepted as $p < 0.05$.

Results

The study was conducted with a total of 124 patients, which 52 were female and 72 were male (Table 1). Mortality was observed in 35 of the patients, the mean age was 37 (21, 66) in the group with mortality and 32 (21, 50) in the group with no mortality ($p=0.406$) (Table 2). There was no statistically significant difference between the groups in terms of whether the accidents were day/night or weekdays/weekends ($p > 0.05$). After the accident, 22% ($n=20$) of all patients were followed up in the intensive care unit (ICU), and mortality was observed in 18 of these 20 patients.

It was found that age, sex, nationality, being on weekends/weekdays, and being day/night had no effect on mortality ($p > 0.05$). The hospitalization period of ex cases was found to be longer ($p < 0.001$). It was determined that the ex percentage was higher in cases requiring hospitalization and intensive care ($p < 0.001$ and $p < 0.001$, respectively). Injury regions and types according to total and mortality are presented in Table 3.

Table 1. Descriptive characteristics of the study subjects

Variables	Min-Max	Mean±SD
Age	1–90	37.98±24.06
Duration of the treatment	0–31	2.38±5.24
	n	%
Sex		
Female	52	41.9
Male	72	58.1
Nationality		
Foreign	10	8.1
Turkish	114	91.9
Hospitalization/discharge		
Discharge	79	63.7
Hospitalization	45	36.3
Mortality		
Survivor	89	71.8
Ex	35	28.2
Intensive care unit requirement		
No	104	83.9
Yes	20	16.1
Week day		
Weekend	39	31.5
Weekday	85	68.5
Day/night		
Night	35	28.5
Day	88	71.5

n: Number of cases; %: Percent.

In ex cases, percentages of nasal, subdural, epidural, intraparenchymal, skull fractures, intestinal perforation, intra-abdominal free mai, pelvis, femur, pneumothorax, hemothorax, AC contraction, rib fracture, and soft-tissue injury were found to be higher than the survivor cases ($p=0.030$, $p=0.019$, $p<0.001$, $p=0.001$, $p<0.001$, $p=0.021$, $p=0.001$, $p=0.006$, $p=0.011$, $p=0.006$, $p=0.006$, $p=0.005$, $p=0.001$, and $p<0.001$, respectively).

Discussion

This study is the first study in the literature to examine the demographic data of in-vehicle phaeton accidents. Our aim in the study is to determine the types and consequences of injuries in these accidents admitted to a tertiary emergency department in an 8-year period. In this way, we aim to discuss the measures that can be determined in these vehicles.

In this study, it is remarkable that both cranial, thoracic, and abdominal injuries were serious, especially in accidents that resulted in mortality. This situation can be considered as a natural consequence of the passengers and drivers in the phaeton not using any protective equipment, includ-

Table 2. Comparison of the groups with and without mortality

Variables	Survivor Median (Q1, Q3)	Ex Median (Q1, Q3)	p
Age	32 (21, 50)	37 (21, 66)	^a 0.406
Duration of the treatment	0 (0, 0)	3 (2, 5)	^a <0.001*
	n (%)	n (%)	
Sex			^b 0.279
Female	40 (76.9)	12 (23.1)	
Male	49 (68.1)	23 (31.9)	
Nationality			^c 0.280
Foreign	9 (90)	1 (10)	
Turkish	80 (70.2)	34 (29.8)	
Hospitalization/discharge			^b <0.001*
Discharge	74 (93.7)	5 (6.3)	
Hospitalization	15 (33.3)	30 (66.7)	
Intensive care unit requirement			^b <0.001*
No	87 (83.7)	17 (16.3)	
Yes	2 (10)	18 (90)	
Week day			^b 0.665
Weekend	29 (74.4)	10 (25.6)	
Weekday	60 (70.6)	25 (29.4)	
Day/night			^b 0.986
Night	25 (71.4)	10 (28.6)	
Day	64 (71.9)	25 (28.1)	

a: Mann-Whitney U-test, results are presented as median (first quarter and third quarter); b: Pearson's Chi-squared test; c: Fisher's exact test; *: $P<0.05$.

ing seat belts, while driving. Thus, protective equipment is used in almost all motorized transport vehicles. However, there is no protective method or system in these vehicles, which are used for touristic purpose and can reach a speed of approximately 65 km/h^[3]. In areas where phaetons are used for transportation or touristic purposes, this situation can be discussed and safer transportation opportunities can be provided with both legal and technical changes that can be made.

Although studies on horse-related accidents usually have upper limb, lower limb, spinal, and head trauma, it is found that the results were different in our study^[12-14]. The difference in our study is the severity of the head injury. The clinical course of 25 of 26 patients with skull bone fractures resulted in mortality ($p<0.001$). Subdural, epidural, and intraparenchymal hemorrhages have also been associated with mortality in phaeton accidents. Even though the phaetons can be as speed as an middle level urban motor vehicle, the severity of the trauma is much more than expected. Therefore, measures can be determined to reduce the severity of the head trauma in-vehicle. In fact, all these results show the necessity of integrating systems such as

Table 3. Injury distribution by body region

Variables	Total (n=124) n (%)	Survivor (n=89) n (%)	Ex (n=35) n (%)	p
Face				
Frontal	23 (18.5)	16 (18)	7 (20)	^b 0.794
Zygoma	5 (4)	4 (4.5)	1 (2.9)	^c 0.999
Mandibular	4 (3.2)	2 (2.2)	2 (5.7)	^c 0.316
Maxilla	1 (0.8)	0 (0)	1 (2.9)	^c 0.282
Nasal	10 (8.1)	4 (4.5)	6 (17.1)	^c 0.030*
Head				
Subdural	7 (5.6)	2 (2.2)	5 (14.3)	^c 0.019*
Epidural	13 (10.5)	0 (0)	13 (37.1)	^c <0.001*
Intraparenchymal	13 (10.5)	4 (4.5)	9 (25.7)	^c 0.001*
Scalp injury	14 (11.3)	8 (9)	6 (17.1)	^c 0.216
Skull bone fracture	26 (21)	1 (1.1)	25 (71.4)	^b <0.001*
Spinal				
Cervical spinal	6 (4.8)	6 (6.7)	0 (0)	^c 0.183
Torakal spinal	5 (4)	3 (3.4)	2 (5.7)	^c 0.620
Lomber spinal	5 (4)	3 (3.4)	2 (5.7)	^c 0.620
Sacral spinal	1 (0.8)	0 (0)	1 (2.9)	^c 0.282
Abdominal				
Abdominal external abrasion	6 (4.8)	3 (3.4)	3 (8.6)	^c 0.349
Liver injury	2 (1.6)	0 (0)	2 (5.7)	^c 0.078
Spleen injury	3 (2.4)	1 (1.1)	2 (5.7)	^c 0.192
Intestinal perforation	3 (2.4)	0 (0)	3 (8.6)	^c 0.021*
Intra-abdominal free mai	5 (4)	0 (0)	5 (14.3)	^c 0.001*
Pelvis	8 (6.5)	2 (2.2)	6 (17.1)	^c 0.006*
Limb				
Forearm	3 (2.4)	1 (1.1)	2 (5.7)	^c 0.192
Clavicle	5 (4)	2 (2.2)	3 (8.6)	^c 0.136
Shoulder	14 (11.3)	12 (13.5)	2 (5.7)	^c 0.346
Arm	6 (4.8)	4 (4.5)	2 (5.7)	^c 0.999
Elbow	16 (12.9)	13 (14.6)	3 (8.6)	^c 0.553
Knee	23 (18.5)	16 (18)	7 (20)	^b 0.801
Femur	11 (8.9)	4 (4.5)	7 (20)	^c 0.011*
Hip	2 (1.6)	0 (0)	2 (5.7)	^c 0.078
Leg	7 (5.6)	4 (4.5)	3 (8.6)	^c 0.402
Foot/ankle	11 (8.9)	9 (10.1)	2 (5.7)	^c 0.727
Hand/wrist	12 (9.7)	6 (6.7)	6 (17.1)	^c 0.096
Thorax				
Thoracic laceration	2 (1.6)	2 (2.2)	0 (0)	^c 0.999
Pneumothorax	8 (6.5)	2 (2.2)	6 (17.1)	^c 0.006*
Hemothorax	4 (3.2)	0 (0)	4 (11.4)	^c 0.006*
Lung contusion	10 (8.1)	3 (3.4)	7 (20)	^c 0.005*
Rip fracture	13 (10.5)	4 (4.5)	9 (25.7)	^c 0.001*
Soft-tissue injury	83 (66.9)	48 (53.9)	35 (100)	^b <0.001*
Penetrating injury	2 (1.6)	1 (1.1)	1 (2.9)	^c 0.486

b: Pearson's Chi-squared test; c: Fisher's exact test; *: P<0.05.

protective equipment against high-energy head trauma or seat belts that will secure the passenger to the vehicle while planning the precautions related to the phaeton^[14].

In our study, especially intestinal perforation and pelvic injuries were found to be associated with mortality in injuries caused by phaeton accidents ($p < 0.05$). Although these injuries are seen with a low frequency (3 [2.4%], 8 [6.5%]), it should be kept in mind that the consequences may be mortal. Another interesting result of our study is that there is a significant correlation with mortality in patients with free fluid (5 [4%]) in the abdomen ($p < 0.05$). Thus, this finding can be easily detected by ultrasonography that can be performed at bedside in ED. When emergency physicians determine intra-abdominal free fluid in such patients, it should be kept in mind that the patient's clinic may deteriorate rapidly and the prognosis may result in mortality.

Almost all types of thoracic injuries were determined to be significantly associated with mortality ($p < 0.05$). As a natural consequence of the design of the phaeton, the absence of any mechanism to prevent the casualty moving away from the vehicle may have caused this situation.

In the area where the study conducted, phaetons are used for touristic purposes. When the accidents are evaluated according to the frequency of the weekdays and weekends, it has been determined that there are more frequent accidents on the weekends ($p > 0.05$). This result may suggest that traffic density is not related to an accident.

Patients who are hospitalized due to phaeton accidents have a poor prognosis in the future. It may be characteristic of accidents that do not have a gray zone and result in either mortality or discharge. According to the results of the study, mortality was found to be high in patients who were hospitalized in the ED or ICU and/or the length of staying was higher ($p < 0.001$, $p < 0.001$, and $p < 0.001$). This result supports the severity of the injuries.

If the studies on this subject are planned prospectively and consideration of the geographical features of the location of the accident, the number of passengers in the vehicle, and the presence of security equipment, then it can contribute more to the literature.

Conclusion

In-vehicle accidents with phaeton can cause serious injuries. Safety measures such as seat belts and head protection equipment to be integrated into the vehicle can help reduce mortality rates in these accidents.

Ethics Committee Approval: The Health Sciences University Kartal Dr. Lutfi Kırdar City Hospital Clinical Research Ethics Committee granted approval for this study (date: 12.02.2020, number: 2020/514/171/6).

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