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PAGES: 1267-1271

ORIGINAL PDF URL: <https://dergipark.org.tr/tr/download/article-file/2424818>

Is it as harmless as it appears? Thoracic traumas caused by Pat-Pat accidents

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Cite this article as: Hekimoğlu B, Beyoğlu MA. Is it as harmless as it appears? Thoracic traumas caused by Pat-Pat accidents. J Health Sci Med 2022; 5(5): 1267-1271.

ABSTRACT

Aim: This study examines the morbidity and mortality of chest traumas due to Pat-Pat accidents, which is one of the most frequently used motor vehicles in agriculture, especially in mountainous regions in developing countries.

Material and Method: This retrospective study included 57 patients who were followed up in a single center between November 2018 and 2021 for thoracic trauma due to a Pat-Pat accident. Patients' age, gender, position in the vehicle, trauma mechanism, trauma location and time, trauma-related pathologies, treatments, and length of stay in hospital and intensive care unit were examined.

Results: The cases included 44 (77.2%) men and 13 (22.8%) women with a mean age of 49.93 ± 20.9 years. Of the accidents, 54 (94.7%) occurred on rural roads, 35 (61.4%) occurred on weekdays, 29 (50.9%) occurred in spring, and 20 (35.1%) occurred in summer. The cases consisted of 37 (64.9%) drivers and 20 (35.1%) passengers, of which 31 (54.4%) were injured due to collision and 26 (45.6%) were injured due to vehicle overturning and being ejected from the vehicle. All cases had rib fractures, 8 (14%) had sternum fracture, 25 (43.9%) had pneumothorax, 36 (63.2%) had hemothorax, 22 (38.6%) had pulmonary contusion, and 2 (3.5%) had cardiac contusion. While 19 (33.3%) of the cases were discharged after evaluation and treatment in the emergency department, 30 (52.6%) were treated in the ward, and 8 (14%) were treated in the intensive care unit (ICU). Thirty-three patients underwent a surgical procedure. The mean hospital stay was 7.8 days, and the mean ICU stay was 5.47 days. Mortality developed in 3 (5.3%) cases. The rates of ICU admission and mortality were found to be higher in injuries caused by being ejected from the vehicle compared to injuries caused by impact ($p < 0.05$).

Conclusion: Pat-Pat accidents cause severe thoracic trauma. In these vehicle accidents with no significant safety precautions, morbidity and mortality are quite high, especially in thoracic trauma caused by ejection from a vehicle.

Keywords: Agriculture vehicles, Pat-Pat, thoracic surgery, trauma

INTRODUCTION

Agricultural vehicle accidents are one of the leading causes of accident-related morbidity and mortality in developing countries such as Turkey (1,2). Simple agricultural tools, which provide great convenience with their use in agricultural production, also cause severe trauma due to the easy access of untrained careless people (3). Accidents involving a vehicle called "Pat-Pat", which is used both in agricultural production and worker transportation, are increasingly observed in harsh natural conditions, especially in rural hilly areas such as the Eastern Black Sea Region of Turkey (4,5).

The Pat-Pat vehicle gets its name from the loud running noise of its engine. In fact, the 2-wheeled front part that houses the engine is a simple digging-riding tool used in

gardening (**Figure 1a**). Adding a simple chassis to this engine part, placing a driver's seat, and adding a 2-wheel trailer or chassis to the rear create a simple 4-wheel tractor (**Figure 1b**). There is no surrounding hull or roof structure for safety (4,6). Pat-Pat is difficult to use due to low vehicle stability and handling ability, weak braking system, and simple steering system. There is no active or passive safety equipment to protect passengers against accidents. There is no driver's license requirement for its use, nor is a vehicle license required. In essence, the Pat-Pat is similar to the all-terrain vehicles (ATVs) in the world that were originally designed for agricultural use. ATVs are 4-wheel drive, and vehicle stability is much more advanced than Pat-Pats. In addition, unlike ATVs, Pat-Pats consist of two parts; the 2-wheel engine at the front and the trailer structure at the rear create a high

level of instability and frequently cause accidents (7). These vehicles cost much less than ATVs, and they can be used for transporting workers or digging, planting, and spraying by attaching different apparatus (4). It is used especially in the Black Sea region as well as in rural areas in other parts of Turkey. Apart from Turkey, it is also used as an agricultural tool in Russia, Pakistan, Afghanistan, and Macedonia (8). Accidents involving this vehicle do not usually occur during its use as an agricultural tool in the garden. Pat-Pat, which is forbidden for travel on the highway, is used intensively in the transportation of workers and cargo, especially during hazelnut cultivation. Lack of safety measures and roof structure, being thrown from the vehicle during the accident, being under the overturned vehicle, and collisions are the most critical injury mechanisms in Pat-Pat accidents. These accident mechanisms cause chest trauma, which causes significant morbidity and mortality. There are few studies on pat-pat accidents in the literature. While some of these studies describe trauma mechanisms, some describe orthopedic injuries. There is no study in the literature on isolated chest trauma, which is a significant cause of morbidity and mortality in pat-pat accidents. This study investigates the morbidity and mortality rates of thoracic injuries in Pat-Pat accidents.



Figure 1. The design of the Pat-Pat vehicle (a) The two-wheeled Pat-Pat, which is designed as simple gardening digging-riding equipment. (b) A simple chassis, seats, and a 2-wheel trailer are added to the back to obtain a simple four-wheel drive Pat-Pat vehicle. (The vehicle in the photos belongs to the author's father and the author took these photographs himself. The author has the right to use the photographs.)

MATERIAL AND METHOD

This study was approved by the Ordu University Clinical Research Ethics Committee (Date: 05.11.2021, Decision No: 229). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

This study was designed in a tertiary hospital in the Black Sea region of Turkey, where the Pat-pat vehicle is widely used. Approximately 600 traffic accident patients are followed and treated annually in this center, especially during the intense agricultural and tourism months.

All patients with chest trauma brought to the emergency department after a traffic accident between November 2018 and November 2021 were reviewed retrospectively. Cases were reported as pat-pat accidents in epicrisis, thoracic surgery consultation notes, and forensic reports were recorded. The study did not include patients whose required data could not be obtained. The study included 57 patients with thoracic trauma. Cases with extra-thoracic injuries were excluded from the study. Cases were examined in terms of age, gender, whether the accident occurred on weekdays or weekends, seasonal distribution, whether the accident occurred in a rural or central location, the mechanism of injury, whether the injured was a driver or passenger, Revised Trauma Score (RTS) at the time of admission to the emergency department, the rate of continuation of treatment after discharge in the ward or the intensive care unit (ICU), presence of rib and sternum fracture, presence of pneumothorax hemothorax and pulmonary-cardiac contusion, type of treatment and type of surgical intervention, length of hospital stay, duration of work power loss, and mortality rate. The RTS used in the study is a combined scoring system created by adding the systolic blood pressure and respiratory rate parameters to the Glasgow Coma Scale and is frequently used today (9).

Statistical Analysis

Statistical analysis was performed using the "IBM SPSS Statistics for Windows Version 22.0 (Statistical Package for the Social Sciences, IBM Corp., Armonk, NY, USA)" program. Descriptive statistics were presented with frequency and percentage for categorical variables and mean and standard deviations for numerical variables. Independent group analyses were performed using Mann-Whitney U and Student's T-test, and a $p < 0.05$ value was considered significant.

RESULTS

Baseline patients' characteristics are given in **Table 1**. Forty-four male and 13 female patients with thoracic trauma after a Pat-Pat accident were included in the study. The mean age of the patients was 49.93 ± 20.9 (minimum-maximum: 18-86). Of the accidents, 35 (61.4%) occurred on weekdays, and 22 (38.6%) occurred on weekends. The distribution of accidents by season was as follows: 29 (50.9%) in spring, 20 (35.1%) in summer, and 8 (14%) in autumn. There was no thoracic trauma due to a Pat-Pat accident in the winter season.

Fifty-four (94.7%) accidents occurred on rural roads, and only 3 (5.3%) happened in the city center. Of the cases, 32 (56.1%) were brought to the emergency department by personal vehicle and 25 (43.9%) by ambulance. 37 (64.9%) drivers and 20 (35.1%) passengers had thoracic injuries due to the accident.

Table 1. Baseline patients' characteristics and Pat-Pat accident distribution due to season, location, and trauma mechanism		
Variables	n	% Mean±SD
Age		49.93±20.9
Gender		
Female	13	22.8
Male	44	77.2
Incident location		
Urban	3	5.3
Rural	54	94.7
Season of the incident		
Spring	29	50.9
Summer	20	35.1
Autumn	8	14.0
Day of the week		
Weekday	35	61.4
Weekend	22	38.6
Trauma mechanism		
Collision	31	54.4
Ejection	26	45.6
Location of the injured		
Driver	37	64.9
Passenger	20	35.1
Revised trauma score		
5	5	8.8
6	3	5.3
7	8	14.0
8	41	71.9

Analysis of the mechanism of accidental thoracic injuries revealed that in 31 (54.4%) cases, injuries occurred due to the collision of the Pat-Pat vehicle with another vehicle or object (tree, wall, stone, etc.), and in 26 (45.6%) cases, injuries occurred due to being under the vehicle or being ejected directly from the vehicle due to vehicle overturning.

In terms of RTS, 41 (71.9%) cases scored 8 points, 8 (14%) cases scored 7 points, 5 (8.8%) cases scored 5 points, and 3 (5.3%) cases scored 6 points. After being evaluated in the emergency department, 30 (52.6%) cases were treated in the ward, 8 (14%) cases were admitted to the ICU 19 (33.3%) cases were discharged after evaluation and treatment in the emergency department (**Table 1**).

All cases had rib fractures; there were multiple rib fractures in 51 (89.5%) cases and single rib fractures in only 6 (10.5%) cases. Sternal fractures were detected in 8 (14%) cases. Pneumothorax was detected in 25 (43.9%) and hemothorax in 36 (63.2%) cases. Pulmonary contusion was detected in 22 (38.6%) cases, and cardiac contusion was detected in only 2 (3.5%) cases (**Table 2**).

A total of 24 (42.1%) cases received conservative treatment. A total of 33 (57.9%) patients underwent surgical treatment, 29 (50.9%) received tube thoracostomy, 3 (5.3%) received bleeding control intervention and lung parenchyma repair by thoracotomy, and only 1 (1.8%) received bleeding control intervention by videothoracoscopy (**Table 2**).

Table 2. Distribution of trauma-related injuries and treatments according to patients		
	n	%
Rib fracture	57	100
Rib fracture number		
Single	6	10.5
Multiple	51	89.5
Sternum fracture	8	14
Pneumothorax	25	43.9
Hemothorax	36	63.2
Pulmonary contusion	22	38.6
Cardiac contusion	2	3.5
Follow-up		
Ambulatory	19	33.3
Inpatient service	30	52.6
Intensive care unit	8	14.0
Treatment		
Conservative	24	42.1
Surgical	33	57.9
Surgical intervention		
Tube thoracostomy	29	50.9
Thoracotomy	3	5.3
VATS	1	1.8

The average length of stay of the patients in the ICU was 5.47±5.0, and the mean total treatment time was 7.8±4.26 (minimum-maximum: 2-21). Labor force loss due to thoracic injuries as a result of the Pat-Pat accident was 24.21±10.3 days on average. When examined according to the trauma mechanism, the hospitalization duration was 2.55±0.546 and 8.96±9.42 days for injuries caused by impact and being ejected from the vehicle, respectively. The loss of workdays according to injuries due to impact and ejection from the vehicle was 19.68±1.33 and 29.62±2.12 days, respectively. Hospitalization and lost workdays differed significantly according to the trauma mechanism ($p<0.05$).

Mortality was seen in a total of 3 (5.3%) patients. Cases with mortality were male Pat-Pat drivers treated in the ICU, had a first admission RTS of 5, and were traumatized due to being ejected from the vehicle. Injuries caused by ejection from the vehicle resulted in significantly different ICU admission rate ($p=0.001$) and mortality ($p<0.05$).

DISCUSSION

Studies in the literature indicate that the mortality rate of injuries related to tractor and Pat-Pat accidents is high, especially during agricultural activities (1,4,10-12). The Pat-Pat vehicle is used as a simple tractor suitable for narrow and steep terrain conditions in the eastern Black Sea region where the study is carried out. In our study, the mortality rate due to thoracic traumas after the Pat-Pat accident was observed as high as 5.3%. We can attribute this high rate to the vehicle's serious stability problems, insufficient brake system, especially in rural areas such as the mountainous regions of the

eastern Black Sea region with many sharp bends and high slopes, drivers not wearing protective equipment, and the vehicle overload during worker transportation.

Traumas resulting from falling under the vehicle or being thrown from the vehicle in traffic accidents involving agricultural vehicles cause severe injuries and even death (3,4,10,13). Our study determined that injuries in 54.4% of the cases were caused by the Pat-Pat vehicle colliding with another vehicle or object (tree, wall, stone, etc.), and in 45.6%, the injuries resulted from the vehicle overturning or being ejected directly from the vehicle. Three patients with mortality had suffered chest trauma due to accidents involving ejection from the vehicle. In terms of mortality, accidents involving ejection from the vehicle were statistically significantly different from crashes ($p < 0.05$). Among the causes of severe trauma are the increase in vehicle power with home-made modifications, the ease of overturning on high-speed winding roads due to its high structure, the absence of safety equipment such as seat belts and airbags, the drivers not wearing personal protective equipment, and the absence of chassis parts on the roof and top protection in the vehicle cabin structure.

The RTS score of 3 cases with mortality was 5, and the RTS score of all 19 cases discharged after the emergency department evaluation was 8. We think that obtaining the correct RTS score is crucial in determining the severity of the patient in the first evaluation made in the emergency department in such accidents, and the correct triage approach contributes to the functioning of the emergency department in cases where trauma patients come in groups.

It has been reported that men (approximately 75%) are mostly affected by traumas caused by tractors and similar vehicles used in agricultural activities (4,12,14). In our study, 77.2% of the patients with thoracic trauma after a Pat-Pat accident were men. Karapolat et al. (4) reported that cases aged 20-40 constituted the majority, while our study had a relatively older population with a mean age of 49.9 years. We think that the higher prevalence of such traumas in middle-aged men is due to the migration of young male adults from rural areas to city centers and shifting from agricultural activities to business lines in city centers.

Some studies reported that Pat-Pat accidents occur very little in winter and frequently in summer and autumn, especially in the months of July, August, and September during intensive hazelnut cultivation (3,4). Karapolat et al. (4) reported that those accidents mostly occur during summer. In our study, the examination of the seasonal distribution of accidents revealed that 29 (50.9%) accidents occurred in spring, 20 (35.1%) in summer, and 8 (14%) in autumn. It is observed that thoracic traumas due to the Pat-Pat accident occurred in parallel with the hazelnut and other agricultural activities that started in the post-winter

period, especially in the Eastern Black Sea region where our study was conducted, increased in spring and summer, and ended in September during hazelnut harvest.

Existing literature indicates that the majority of Pat-Pat accidents occur on highways in rural areas and to a lesser extent in agricultural areas (3-5). Researchers have attributed the increasing rate of these accidents to the speeds of Pat-Pats and other vehicles on the highways being different and to the increased traffic density (4). Our study found that accidents occurred on highways in rural areas with a high rate of 94%. The Pat-Pat vehicle was designed for activities such as carrying goods in the agricultural field, tilling the garden, and application of agricultural medicine. Yet, their use for transporting workers and goods on highways in rural areas paves the way for accidents. Those who use these vehicles, which require no license plates and drivers' licenses, drive quickly and hastily not to be caught by the security guards because driving these vehicles on the highway is illegal. This results in accidents and serious injuries, and even deaths.

In our study, the average hospital stay of the cases after the Pat-Pat accident was 7.8 days, and the mean duration of disability after trauma was 24.2 days. Pat-Pat accidents were associated with severe traumatic pathologies and mortality. The patients were separated from working life for a long time due to pneumothorax, hemothorax, rib and sternum fractures that developed as a result of thoracic trauma. Previous studies have reported serious economic damage due to the decrease in the workforce in agricultural production as a result of similar accidents (15,16). These accidents can be prevented with necessary legal regulations and serious controls to be applied in the field. The use of Pat-Pat vehicles in traffic is already prohibited by law, but in daily practice, it is clear from the number of accidents that people cannot be prevented from entering the traffic. We think that these accidents and thus injuries and loss of life can be prevented by the strict controls of law enforcement officers on rural roads, especially during hazelnut cultivation.

The limitations of our study are its retrospective design, the low number of cases, the coverage of accidents that took place in a relatively short period of time, the inclusion of only the cases that came to or were brought to the hospital due to the Pat-Pat accident, and not including mortality at the scene of the accident.

CONCLUSION

Pat-Pat accidents cause severe thoracic trauma that results in significant morbidity and mortality. These vehicles, manufactured only for agricultural use and without adequate safety precautions, cause serious injuries when used on highways.

Abbreviations

ATV: All-terrain vehicles, **RTS:** Revised trauma score, **ICU:** Intensive care unit

ETHICAL DECLARATIONS

Ethics Committee Approval: This study was approved by the Ordu University Clinical Research Ethics Committee (Date: 05.11.2021, Decision No: 229).

Informed Consent: Because the study was designed retrospectively, no written informed con-sent form was obtained from patients.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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