JTI
JOURNAL OF
TRAUMA AND INJURY

ORIGINAL ARTICLE
J Trauma Inj 2017;30(3):80-86
http://doi.org/10.20408/jti.2017.30.3.80

Analysis of Cultivator-related Trauma Cases in a Regional Trauma Center in the Rural Area of Gyeongbuk Province

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Received: May 10, 2017
Revised: July 4, 2017
Accepted: July 8, 2017

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Purpose: To analyze the data of patients who suffered trauma in a cultivator accident and visited the trauma center in rural Gyeongbuk Province.
Methods: We retrospectively reviewed the medical records and Korean Trauma Data Bank data of 120 patients who suffered cultivator-related traumas and visited the rural regional trauma center in Gyeongbuk Province from January to December 2015.
Results: The age of the patients ranged from 35 to 96 years (mean, 70 years). Ninety-one (75.8%) patients were men, and twenty-nine (24.2%) were women. Most of the patients were in their 70s (46 men [50.5%] and 13 women [44.8%]). In total, 113 patients (94.1%) arrived at the regional trauma center by ground transport and 7 (5.9%) arrived by air transport. Ninety-eight patients (81.7%) were transported to the regional trauma center directly from the scene of the accident, and twenty-two (18.3%) were transferred from another medical institute. The mean time from the accident to arrival at the emergency department was 139 minutes, and only 46 patients (38.3%) arrived within 1 hour. Twelve (10.0%) patients died, including two deaths on arrival and two post- cardiopulmonary resuscitation deaths in the emergency department. All deaths were of male cultivator operators. The causes of death were shock (hypovolemic, traumatic, or septic), subdural hematoma (open), hemothorax, rhabdomyolysis, and pneumonia.
Conclusions: As the government - led regional trauma center project is on process, it would be clinically important to summarize the initial outcome of cultivator injuries, which are characteristically found more in regional trauma centers in the rural area, and have high mortality. Based on this study, in the future, it will be necessary to follow up and analyze more number of patients and to construct accurate database about trauma cases related to cultivator in Gyeongbuk region.

Keywords: Trauma; Agriculture; Transportation; Treatment

http://www.jtraumainj.org
eISSN 2287-1683
pISSN 1738-8767

INTRODUCTION

In the 1970s, the Korean government expanded its distribution of agricultural machinery, including cultivators, across the nation to accelerate economic growth and promote their food policy [1]. According to the National Statistical Office, 1,089,000 farm households existed in South Korea as of December 1, 2015. Gyeongbuk had 185,000 farm households (17.0%), which is the most in the country [2]. Cultivator accidents are generally severe and can lead to substantial physical damage and economic losses. Although there have been cultivator accidents in Gyeongbuk, systematic data and reports are lacking. The regional trauma center project implemented by the government has made it possible to construct a more accurate trauma database. The purpose of this study was to analyze the data of patients who suffered cultivator trauma and visited the trauma center in the rural area of Gyeongbuk Province.

METHODS

We retrospectively reviewed the parameters(clinical characteristics, pre-hospital arrival patient information, trauma center medical information, treatment and outcomes) based on the medical records and Korean Trauma Data Bank data of 120 patients who suffered cultivator trauma and visited the regional trauma center in Gyeongbuk Province from January to December 2015. Statistical analysis was done by frequency analysis using Microsoft Excel pivot table.

RESULTS

Clinical characteristics (Table 1)

The age of the patients was 35–96 years (mean, 70 years). Ninety-one (75.8%) patients were men and twenty-nine (24.2%) were women. Most of the patients were in their 70s (46 men and 13 women). In addition, there were 14 men and 1 woman >80 years of age (Fig. 1). There were 73 patients (60.8%) with comorbidities, including hypertension (35 patients), diabetes (23 patients), and cancer (11 patients). Patients who suffered from cultivator trauma presented to the emergency department most often in spring (47 cases [39.2%]), followed by summer (41 cases [34.2%]), autumn (29 cases [24.2%]), and winter (3 cases [2.5%]). Regarding the injury mechanism (in order of prevalence), the cultivator overturned in 41 (34.2%) cases, followed by fall in 37 (30.8%), collision in 32 (26.7%) and unknown in 10 (8.3%). In order of frequency, the injured persons were as follows: cultivator operator, 92 cases (76.7%); cultivator passenger, 20 cases (16.7%); pedestrian, 5 cases (4.1%); and unknown, three cases (2.5%). The accidents occurred on a public road in 56 cases (46.7%) cases, on farmland in 26 cases (21.7%), on a farm road in 18 cases (15.0%), in a residential area in 14 cases (11.6%), and in another or unknown location in six cases (5.0%).

Status on arrival in the emergency department (Table 2)

In total, 113 patients (94.1%) arrived at the regional trauma center by ground transport and seven arrived (5.9%) by air transport. Ninety-eight patients (81.7%) were transported to the center directly from the scene of the accident, and twenty-two (18.3%) were transferred from another medical institute. The mean time from accident to arrival at the emergency department was 139 min, and only 46 patients (38.3%) arrived within 1 hour. According to the Abbreviated Injury Scale, the injured body area were the head in 29 cases (13.8%), the face in 9 (4.3%), the neck in 0 cases, the thorax in 40 cases (19.0%), the abdomen in 14 cases (6.7%), the spine in 44 cases (20.9%), the upper extremities in 31 cases (14.8%), the pelvis and lower extremities in 34 cases (16.2%), and external, thermal, and other trauma in 9 cases (4.3%). There were 20 major trauma patients (16.7%) with an Injury Severity Score (ISS) $\geq$16, 98 (81.6%) with an ISS <16, and 2 (1.7%) in whom the ISS was unknown. The mean value of the ISS was 8.538 and the median was 5. There were 108 patients (90.0%) with a Revised Trauma Score (RTS) $\geq$7.0, 8 (6.7%) with a score <7.0, and 4 (3.3%) in whom the RTS was unknown. The mean value of RTS was 7.7668 and the median was 7.8408. Twenty-four patients (20.0%) were transported to the trauma center from Andong city and 90 (75%) were transported from six counties adjacent to Andong city (Bonghwa, Yeongyang, Cheongsong, Uiseong, Yecheon, and Yeongju). Six patients (5.0%) visited

Table 1. Clinical characteristics of the cultivator-related trauma cases

Variable	Value
Age (year)	
<60	20 (16.7)
60–79	85 (70.8)
≥80	15 (12.5)
Gender	
Male	91 (75.8)
Female	29 (24.2)
Comorbidities	
Yes	73 (60.8)
Season	
Spring	47 (39.2)
Summer	41 (34.1)
Autumn	29 (24.2)
Winter	3 (2.5)
Injury mechanism	
Cultivator overturned	41 (34.2)
Fall	37 (30.8)
Struck by cultivator	32 (26.7)
Other or unknown	10 (8.3)
Person injured	
Operator	92 (76.7)
Passenger	20 (16.7)
Pedestrian	5 (4.1)
Unknown	3 (2.5)
Accident location	
Public road	56 (46.7)
Farmland	26 (21.7)
Farm road	18 (15.0)
Residential area	14 (11.6)
Other or unknown	6 (5.0)

Values are presented as number (%).

the other three counties (Uljin, Gunwi, and Mungyeong). No patients visited any of the other 13 cities and counties (Fig. 2).

Treatment and outcomes (Table 3 and 4)

Twenty-one patients (17.5%) were admitted to the intensive care unit (ICU), and their average ICU stay was 5.7 days. Fourteen patients were admitted to the ICU for 1–5 days, three for 6–10 days, and four for >10 days. Trauma and Injury Severity Scores (TRISS) (probability of survival [Ps]) ranged from 11.3% to 99.7% (mean, 94.1%). The mean value of TRISS was 0.9408 and the median was 0.9765. There were 12 (10.0%) mortalities, including 2 deaths on arrival and 2 post- cardiopulmonary resuscitation (CPR) deaths in the emergency department. All deaths were of male cultivator operators. The causes of death were shock (hypovolemic, traumatic, or septic), subdural hematoma (open), hemothorax, rhabdomyolysis, and pneumonia.

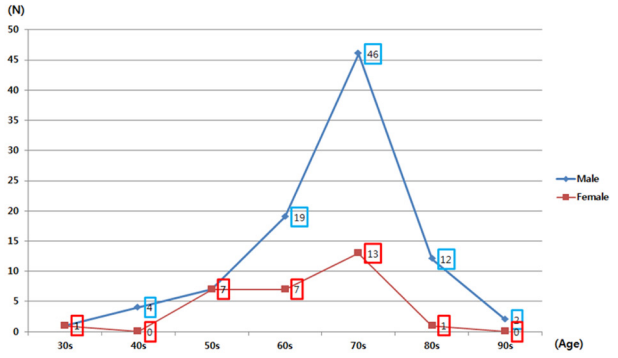

Fig. 1. Comparison of the number of male and female cultivator-related trauma patients according to age.

DISCUSSION

In South Korea, the proportion of people aged ≥65 years is increasing steadily, such that its aging society is rapidly transitioning into an aged society; this creates the most serious problems in rural areas. According to the National Statistical Office, 1,089,000 farm households existed in South Korea as of December 1, 2015, with the largest proportion being in Gyeongbuk Province (185,000 households [17.0%]). The total population of the farm households was about 2,569,000, and Gyeongbuk had the largest farm household population (410,000; 16.0%). Most of the farm householders in Gyeongbuk Province are in their 70s (29.5%), followed in terms of prevalence by those in their 60s and 50s. In addition, 42.0% of the

http://doi.org/10.20408/jti.2017.30.3.80

Table 2. Patient status on arrival at the regional trauma center

Variable	Value
Transportation route	
Ambulance	
Direct	73 (60.8)
Transferred	15 (12.5)
Other road vehicle	
Direct	20 (16.6)
Transferred	5 (4.2)
Air transport	
Direct	5 (4.2)
Transferred	2 (1.7)
Time to emergency department (hour)	
≤1	46 (38.3)
1–2	39 (32.5)
2–3	21 (17.5)
>3	14 (11.7)
Injury site (total = 210)	
Head	29 (13.8)
Face	9 (4.3)
Neck	0
Thorax	40 (19.0)
Abdomen	14 (6.7)
Spine	44 (20.9)
Upper extremities	31 (14.8)
Pelvis and lower extremities	34 (16.2)
External, thermal and other trauma	9 (4.3)
Injury Severity Score	
<16	98 (81.6)
≥16	20 (16.7)
Unknown	2 (1.7)
Revised Trauma Score	
≥7.0	108 (90.0)
<7.0	8 (6.7)
Unknown	4 (3.3)

Values are presented as number (%).

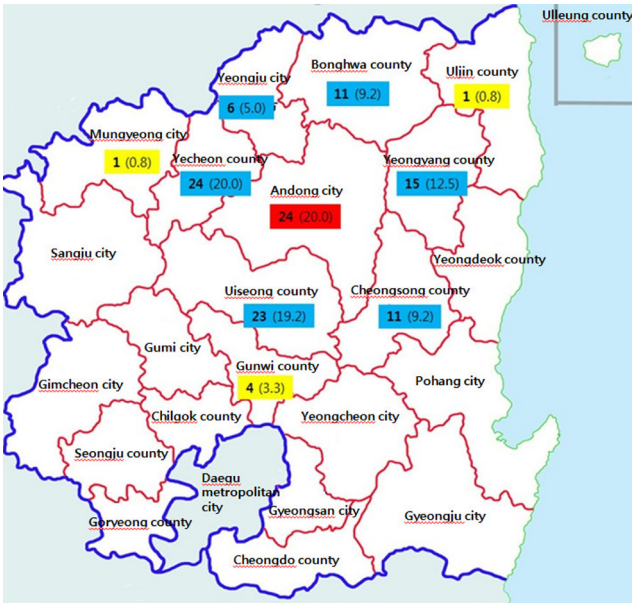

Fig. 2. Distribution of cultivator-related trauma patient visits to the regional trauma center in Gyeongbuk Province (red, regional trauma center; blue, close by to regional trauma center; yellow, remote from regional trauma center; no color, no patients)

householders are >65 years old [2]. Park and Kim [3] reported cases of abdominal trauma caused by cultivator accidents in 1984. In that study, the majority (69%) of the patients were in their 20s and 30s. Korea was an aging society at that time, and young people in rural areas were actively engaged in farming activities. In an article on abdominal trauma caused by cultivator accidents in 2015, most of the patients were in their 60s (56.6%), followed in terms of prevalence by those in their 70s (20.8%) [4]. In a 2011 report, Oh et al. [5] reported that 59.3% of cultivator-related trauma patients were >65 years. In that study, 35.9% of the patients had comorbidities. In our study, the mean age of the patients (n=120) who suffered cultivator accidents was 70 years, and the most common decade of age was the 70s (49.1%). Only 20 patients (16.7%) were <60 years of age, and 15 (12.5%) were >80 years of age. In the present study, 73 (60.8%) patients had comorbidities. These data demonstrate that the age of patients suffering from these types of accidents is increasing. Older patients often develop hearing loss, visual impairment, and loss of balance, and are more limited in their movements. In addition, they may suffer from physiological defects, such as chronic and cardiovascular diseases. Therefore, older people have a greater chance of being exposed to trauma compared to younger people, and there is a greater risk of injury in older people even at the same level of trauma to that of younger age groups. In addition, older patients are less likely to recover from trauma and have a higher

Table 3. Treatment and outcomes of the cultivator-related trauma patients

Variable	Value
ICU stay (days)	
0	99 (82.5)
1–5	14 (11.7)
6–10	3 (2.5)
>10	4 (3.3)
TRISS (Ps, %)	
≥75	111 (92.5)
50–75	1 (0.8)
25–50	3 (2.5)
<25	1 (0.8)
Unknown	4 (3.3)
Mortality	12 (10.0)
Dead on arrival	4

Values are presented as number (%).
ICU: intensive care unit, TRISS: Trauma and Injury Severity Score, Ps: probability of survival.

trauma-related mortality rate than younger patients, even with less severe injuries [6-8]. Older patients have a two-fold higher mortality rate after trauma than their younger counterparts with the same ISS, except in cases of death caused by underlying diseases [9]. According to Jung et al. [6] older cultivator-related trauma patients have a higher mortality rate than patients <65 years of age, even for those with a low ISS. Therefore, careful attention should be paid during physical examinations and more active treatment is required for older versus younger patients who have the same ISS at the time of admission to the emergency room.

Park and Kim [3] reported that the most common type of cultivator-related trauma was that involving the handles (45.2%). Yeo et al. [4] reported that 14 cultivator operators (77.4%), 11 cultivator passengers (20.8%), and 1 passerby (1.9%) suffered from trauma caused by cultivators in their study of 53 abdomino-perineal organ injuries. Park and Kim [3] also reported that cultivator operators (66.7%), followed in terms of prevalence by passer-byers (23.8%), and cultivator passengers (9.5%) all sustained injuries in cultivator accidents. In the current study, cultivator operators were the most frequently injured group of all those involved in cultivator accidents (76.7%).

The mean time from injury to arrival at the emergency department was 139 minutes. Voaklander et al. [7] reported that older farmers are less likely to survive traumatic injury for various reasons, such as working in isolation (which contributes to a longer time to discovery, longer transport times to the hospital, and less opportunity for resuscitation and recovery). Considering that older cultivator-related trauma patients tend to die within 24 hours after accidents, Jung et al. [6] claimed that it is critical to pursue aggressive care for such patients, not only on their arrival at the emergency room but also during emergency transport, and that preventive measures need to be taken to reduce the mortality rate for cultivator-related trauma, such as providing safety education and cultivator maintenance, and improving the structure and material of cultivator handlebars.

In the current study, bodily injuries (to the thorax, abdomen, spine, and pelvis; n=103, 49.1%) were also more frequent than head (n=29; 13.8%) and limb injuries (upper and lower extremities; n=60, 28.6%). Park and Kim [3] reported that the most common injury site was the spleen (n=15, 29.4%), followed by the small intestines (n=12, 23.5%), mesentery (n=8, 15.7%), and liver (n=7, 13.7%) in their study on abdominal trauma caused by cultivators. In the present study, the abdominal injury sites were the mesentery (n=4), liver, small intestine, large intestine, abdominal wall (n=3), spleen, retroperitoneal area, bladder (n=2), adrenal glands, and urethra (n=1). According to the Road Traffic Authority's traffic accident analysis system, agricultural machinery-related traffic accidents accounted for 0.3% of total traffic accidents in 2015, but the death rate from those accidents was 2.8%, showing that agricultural machinery-related accidents can be lethal [10].

In the current study of 120 patients with cultivator-related injuries, 108 (90.0%) survived and 12 (10.0%) died. All deaths were of male cultivator operators. Of the 12 deceased cases, 8 were ≥65 years of age, while two patients were dead on arrival and two other died post-CPR. Five of these eight patients died despite a TRISS ≥0.75. According to Oh et al. [5], when the ISS or RTS, which are applied to all age groups except children, are used in older patients, injuries tend to be judged as relatively mild such that it is possible that proper intensive care will be

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Table 4. Detailed analysis of mortality cases

No.	Age/ sex	ISS	RTS	TRISS	Main injury	Person injured	Injury mechanism	Accident location	Cause of death
1	86/M	10	6.90	0.928	Chest	Operator	Fall	Unknown	Pneumonia
2	69/M	34	6.17	0.489	Abdomen	Operator	Cultivator overturned	General road	Hypovolemic shock
3	82/M	25	4.09	0.275	Head	Operator	Cultivator overturned	General road	Subdural hematoma (open)
4	84/M	17	7.84	0.939	Chest	Operator	Struck by cultivator	Farm road	Traumatic shock
5	66/M	21	7.84	0.916	Chest	Operator	Cultivator overturned	Farm land	Hemothorax
6	70/M	22	7.11	0.848	Abdomen	Operator	Struck by cultivator	General road	Septic shock
7	75/M	21	7.84	0.916	Lower extremity	Operator	Cultivator overturned	Unknown	Rhabdomyolysis
8	79/M	38	4.09	0.113	Head	Operator	Struck by cultivator	General road	Subdural hematoma (open)
9	74/M				Unknown (CPR)	Operator	Cultivator overturned	General road	Unknown
10	72/M				Unknown (CPR)	Operator	Cultivator overturned	Farm road	Hypovolemic shock
11	60/M				Unknown (DOA)	Operator	Struck by cultivator	General road	Hypovolemic shock
12	73/M				Unknown (DOA)	Operator	Cultivator overturned	General road	Unknown

ISS: Injury Severity Score, RTS: Revised Trauma Score, TRISS: Trauma and Injury Severity Score, M: male, CPR: cardiopulmonary resuscitation, DOA: dead on arrival.

omitted at an early stage. Therefore, older patients require more attention, even when injury severity is low, due to a depleted physiological reservoir and high incidence of underlying diseases, as any injury may lead to a poor outcome.

CONCLUSION

As the government - led regional trauma center project is on process, it would be clinically important to summarize the initial outcome of cultivator injuries, which are characteristically found more in regional trauma centers in the rural area, and have high mortality. Based on this study, in the future, it will be necessary to follow up and analyze more number of patients and to construct accurate database about trauma cases related to cultivator in Gyeongbuk region.

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