

Characteristics of Pediatric and Adolescent Trauma-Database Review of Single Level Trauma Center in Gangwon Province

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Purpose: Although trauma is the most common cause of death under age 18, Korean national pediatric trauma data has lack of clinical data. This study is to prepare manpower resources, equipment, and make a correct policy decision on pediatric trauma victims

Methods: The study enrolled 528 patients under age 16 with traumatic injury visited Wonju Severance Christian Hospital Trauma Center, from February 12, 2015 to December 31, 2016. We analyzed the distribution of gender, age, place and time of the accident, injury mechanism, injury severity, and injured organ by medical record.

Results: The major injury mechanisms were blunt injury in 485 (91.90%), penetrating injury in 27 (5.10%), burn in 13 (2.50%), near drowning in 2 (0.40%), and foreign body ingestion in 1 (0.20%). Ninety-seven (18.4%) patients were injured at home and 67 (12.7%) patients were injured at school. The overall mortality rate was 1.13% (n=6). 5 mortalities were related to automobile accident and one was fall down. Mean Injury Severity Score (ISS) was 4 (2, 8). No statistical significance was observed in the mean ISS between each age group. The peak time of accident occurrence was between 16 and 17 o'clock. The mean ISS was higher in blunt injury group than penetrating injury with statistical significance (6.50 ± 7.60 vs. 3.00 ± 8.10 ; $p < 0.05$). The most common injury site was upper extremity. Mean ISS was highest in thorax injury. However, mean ISS of thorax injury was higher with statistical significance only compared with face, neck and upper extremity injury.

Conclusions: We reported our pediatric trauma patients data of our hospital level I trauma center, which is the only one level I trauma center of Gangwon Province. These data is useful to prevent and prepare for pediatric trauma.

Keywords: Injury; Pediatric emergency medicine

INTRODUCTION

Trauma is the most common cause of death under aged 18 [1]. More than half of these pediatric and adolescent mortalities are caused by trauma [2]. In addition, the impact on physical and mental disabilities is larger than that of adult victims. The death rate related to trauma per 100,000 people under aged 14 was 3.15 in Korea [3]. Although the mortality cases were decreased significantly from the last ten years, trauma is the important cause of pediatric and adolescent mortalities in Korea.

Pediatric and adolescent trauma data, reported by The Statistics Korea, the national statistical office of Korea, is lack of clinical data. We assumed that the clinical data related to pediatric and adolescent trauma of the only one level I trauma center in Gangwon Province, Wonju Severance Christian Hospital Trauma Center represent that of Gangwon Province. These data may be helpful to prepare the manpower resources, equipment, and make a correct policy decision. We analyzed our pediatric and adolescent trauma data based on our hospital database for the Korea Trauma Data Bank.

METHODS

We analyzed Wonju Severance Christian Hospital Trauma Center data from February 12, 2015 to December 31, 2016. Our trauma center is the only one level I trauma center of Gangwon Province. We opened our level I trauma center at February 12, 2015. Since opening the trauma center, 528 pediatric and adolescent patients under the age of 16 were visited our trauma center. We analyzed the distribution of gender, age, place and time of the accident, injury mechanism, injury severity, and injured organ.

Statistics

The one-way analysis of variance (ANOVA) was used for multiple comparison of Injury Severity Score (ISS) means for each age group, trauma mechanism. The ANOVA test was also used for multiple comparisons of abbreviated injury scale (AIS) means for each location of injury group. The student *t*-test was performed to compare the

ISS mean of penetrating and blunt injury group.

RESULTS

Male patients were 345 and female patients were 183. Mean age was 9.3 ± 4.6 years old (range 2 months-16 years old). The proportion of men to women was 1.90:1. The injury mechanisms were blunt injury in 485 (91.90%), penetrating injury in 27 (5.10%), burn in 13 (2.50%), near drowning in 2 (0.40%), and foreign body ingestion in 1 (0.20%). To list the place of injury in order of frequency, 117 (22.2%) patients were injured at public road, 97 (18.4%) patients were injured at home, 67 (12.7%) patients were injured at school, 64 (12.1%) patients were injured at residential area, and 56 (10.6%) patients were injured at public place. The overall mortality rate was 1.13% ($n=6$). Five mortalities were related to automobile accident and one was fall down. Three of the mortality patients were aged under 12 years old and injury mechanism was automobile accident, they all did not have pediatric car seats. Mean ISS was 4 (2, 8). There were 54 (10.20%) patients with ISS score not less than 16. The mean ISS score of these 54 severe injured patients was 25.10 ± 10.90 . The mean ISS score of patients with ISS score less than 16 was 4.26 ± 2.90 . No statistical significance was observed in the mean ISS between each age group (Fig. 1).

The peak time of accident occurrence was between 16 and 17 o'clock (Fig. 2). The mean ISS was higher in blunt injury group than penetrating injury with statistical sig-

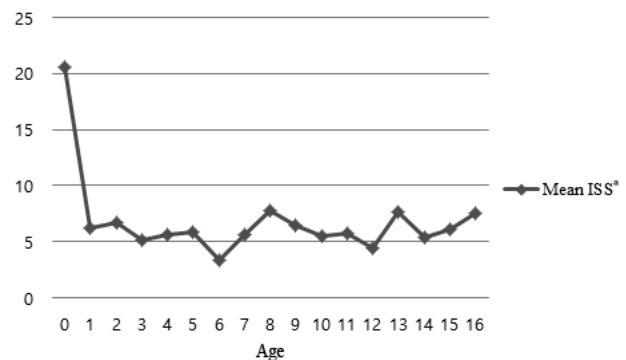


Fig. 1. Mean ISS. ISS: Injury Severity Score. *Statistics were analyzed using one-way ANOVA method. There was no statistical significance in the mean ISS of each age group.

nificance (6.50 ± 7.60 vs. 3.00 ± 8.10 ; $p < 0.05$). The causes of blunt injuries are detailed in (Table 1). The inter-group difference of mean ISS was analyzed using one-way ANOVA method, excluding 'Others accident group' because the total number is so small. The injury was most severe in 'Motorcycle accident group'. The inter-group difference of mean ISS showed statistical significance of the comparison between 'Contusion or pinching by environmental objects accident group' and all other groups and between 'Slip down accident group' and all other groups. Although 'Motorcycle accident group' showed the highest ISS, there was no statistical significant difference between 'Motorcycle accident group', 'Automobile injury accident group', 'bicycle accident group', and 'Fall down accident group'.

Total of 1,191 injuries were coded by abbreviated injury scale 2005 coding system in 528 patients [4]. We categorized these 1,191 injuries according to location of body by abbreviated injury scale 2005 coding system; the first left digit of AIS code means where the injury located in one of

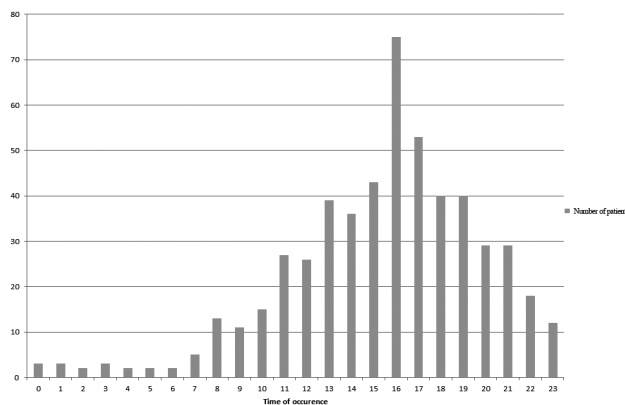


Fig. 2. Time of occurrence.

Table 1. The cause of blunt trauma

Mechanism of blunt injury	Contusion or pinching by environmental objects ^a	Slip down ^b	Fall down	Bicycle	Automobile injury	Motorcycle	Others ^c
Total (n=485)	122	111	96	47	86	18	5
Mean ISS	3.06	4.32	7.16	8.38	10.95	14.61	6.541

ISS: Injury Severity Score.

^aThere was significant statistical difference from other groups ($p < 0.05$).

^bThere was significant statistical difference from other groups ($p < 0.05$).

^cUnknown cause in 2, fracture during arm wrestling in 1, injury by rotary machine for earthenware in 1, arm injury during boat upset accident in 1.

the body locations among head, face, neck, thorax, abdomen, spine, upper extremity, lower extremity, and external and other. The frequency of injury location and mean AIS score, reflecting the injury severity, according to injury locations are detailed in Table 2. The most common injury site was upper extremity. Mean AIS was highest in thorax injury. However, mean AIS of thorax injury was higher with statistical significance only compared with face, neck and upper extremity injury.

DISCUSSION

The understanding of national or local statistical property is important to the preparedness of certain issues. To save trauma victim needs very high cost burden from pre-hospital transportation to rehabilitation. Social and medical resources should be properly allocated to reduce this high cost burden. In recent years, Korean government developed national government designated regional level I trauma centers. Wonju Severance Christian Hospital Trauma Center is one of them. As these level I trauma centers are tertiary referral center of severely injured patients, so the clinical data of trauma victims who visit or refer to these level I trauma centers represent that of corresponding area in which each level I trauma center is located.

The injury mechanism was blunt injury in 91.9% pediatric trauma patients. In our data, blunt injury includes fall down, slip down, automobile, bicycle and motor cycle injury. National Emergency Medical Center reported that the injury mechanism of all age group was traffic accident in 18.6%, fall down in 6.2%, slip down in 17.8%, and blunt injury in 19.4% patients. These data was collect-

Table 2. The frequency of injury location and mean AIS score

Location of injury	Mean AIS	Value
Head	2.26±1.00	223 (18.70)
Face	1.14±0.34	173 (14.50)
Neck	1.00±0.00	2 (0.20)
Thorax	2.28±1.15	88 (7.40)
Abdomen	2.07±0.85	95 (8.00)
Spine	1.71±0.66	28 (2.40)
Upper extremity	1.67±0.47	366 (30.70)
Lower extremity	1.88±0.81	199 (16.70)
External and other	2.18±1.24	17 (1.40)
Total		1,191

Values are presented as number (%).

AIS: abbreviated injury scale.

ed from National Emergency Department Information System (NEDIS) registered emergency medical center at 2015 [5]. By categorizing these injury mechanisms as our trauma center data, including traffic accident, fall down, and slip down to blunt injury, the blunt injury forms 62% in injury mechanisms of all age trauma patients. Blunt injury mechanism was more common to pediatric and adolescent trauma patients of our trauma center than all aged patients in Korea (91.9% vs. 62%). In addition, the proportion of traffic accident was 28.6% in our data, including automobile, motor cycle and bicycle accident. As we could not find reports that shows the national statistics about injury mechanism of pediatric and adolescent patients, so we assumed that the difference between our data and NEDIS data is originated from the difference between pediatric and adolescent and adult patients or the specific reason results from the feature of Gangwon province. This issue may need further investigation.

Blunt trauma showed more injury severity than penetrating trauma. Motorcycle accident was the most severe injury cause among blunt injury mechanisms. In Korea, motorcycle driving license is issued aged 16 and over. 18 patients were injured by motorcycle accident in our data. Six of 18 patients were aged under 16. Two of them were driver and four were passenger. Only one of the four passengers wore helmet for bike. Fortunately, there were no severe disability cases or mortality cases. However, it implicates the risk of serious accident that there is illegal

motorcycle driver and victims who did not wear helmet for bike.

The most common injury site identified by AIS code was upper extremity, but the most severely injured site was thorax. In the order of injury severity, head is the second severely injured site and abdomen is the third injured site in the present study. Overall, head and torso injury showed the more severe injury than other site. Although we could not find out the relation between these injuries and automobile accidents, these injuries may have close relationship with automobile accidents, especially in the case of severe injury. We analyzed our pediatric patient, aged under 6 years old, data who visited our emergency department by automobile accident from January 12, 2010 to December 31, 2015. Only 15% of pediatric patients wore car seat (unpublished data). Pediatric passenger aged under 8 years old should wear car seat by law in Korea. However, no patients, aged from 6 year old to 14 years old, wore car seat at the time of accident (unpublished data). In the present study, automobile passenger accident occurred in 41 patients. Although 20 of them were aged under 8, only 3 (15%) wore car seat. The remainder 21 patients, aged 8 and over, only 7 (33.3%) wore seat belt. In addition, 35 pediatric passengers aged under 14 years old sat in the passenger seat. Pediatric and adolescent passenger aged under 14 years old should not sit in the passenger seat by law in Korea. However, 6 (17.1%) broke this law. As all we know, to prevent fatal head and torso injuries, to wear car seat or seat belt appropriate to age and not to sit in passenger seat aged under 14 years old is the most important rules. As our unpublished data and result from the present study show, these important rules are not followed, so more publicity campaign and rigid enforcement of regulations are needed.

This study has some limitations. The first, this study did not show detailed clinical results. Although database analysis usually has this defect, this limitation may be surmounted by well-designed prospective data collection. The second, the study period is short and the data is limited to single center. Multicenter data analysis may be needed to make more reliable and meaningful nationwide data.

CONCLUSION

We reported our pediatric and adolescent trauma patients data of our hospital level I trauma center, which is the only one level I trauma center of Gangwon Province. These data is useful to prevent and prepare for pediatric and adolescent trauma.

REFERENCES

1. Sminkey L. World report on child injury prevention. *Inj Prev* 2008;14:69.
2. Hackam DJ, Newman K, Ford HR. Trauma in children. In: Brunnicardi FC, Andersen DK, Billiar TR, Dunn DL, Hunter JG, Pollock RE, eds. *Schwartz's Principles of Surgery* 8th ed. New York:McGraw-Hill; 2005:1512-4
3. The Stastics Korea. National pediatric safety accident status [Internet]. Daejeon: The Stastics Korea 2016 [cited 2016 Sep 29]. Available from: http://www.index.go.kr/potal/main/EachDtl-PageDetail.do?idx_cd=2711.
4. Thomas A, Gennarelli, Elaine Wodzin. *Abbreviated Injury Scale 2005 - Update 2008*. Des Plaines:American Association for Automotive Medicine (AAAM);2008.
5. National Emergency Medical Center. *NEDIS annual report 2015* [Internet]. Seoul: National Emergency Medical Center 2016 [cited 2016 Aug 31]. Available from: http://www.e-gen.or.kr/nemc/statistics_annual_report.do?brdclscd=02.