

## Analysis of Abdominal Trauma Patients Using National Emergency Department Information System

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**Purpose:** To develop an inclusive and sustainable trauma system as the assessment of burden of injuries is very much important. The purpose of this study was to evaluate the estimates and characteristics of abdominal traumatic injuries.

**Methods:** The data were extracted from the National Emergency Department Information System. Based on Korean Standard Classification for Disease 6th version, which is the Korean version of International Classification of Disease 10th revision, abdominal injuries were identified and abdominal surgeries were evaluated with electronic data interchange codes. Demographic factors, numbers of surgeries and clinical outcomes were also investigated.

**Results:** From 2011 to 2014, about 24,696 patients with abdominal trauma were admitted to the hospitals annually in South Korea. The number of patients who were admitted to regional and local emergency medical centers was 8,622 (34.91%) and 15,564(63.02%), respectively. Based on National Emergency Department Information System, liver was identified as the most commonly injured abdominal solid organ (39.50%, 9,754/24,696, followed by spleen (17.57%, 4,338/24,696) and kidney (12.94%, 3,195/24,696).

**Conclusion:** This study shows that the demand for abdominal trauma care is considerable in South Korea and most of the patients with abdominal trauma were admitted to regional or local emergency centers. The results of this study can be used as good source of information for staffs to ensure proper delivery of abdominal trauma care in trauma centers nationally. [ J Trauma Inj 2016; 29: 116-123 ]

**Key Words:** Trauma, Abdomen, Liver, Spleen, Kidney

### I. Introduction

Trauma is known as a major cause of death and various social problems.(1) In Korea, is prevalent in age groups under 44 years. Nevertheless, trauma system management in Korea is not well established. In 2010, preventable trauma death rate in Korea is 35.2%, which is much higher as compared to 20% rate in developed countries. To solve these problems,

the Ministry of health and welfare assigned 17 regional trauma centers and expanded specialized trauma surgeon training courses until 2016.(2) However, no research has been carried out on epidemiological characteristics of trauma patients in Korea, which has led to inhibition of trauma system growth. It is hypothesized that research on trauma epidemiology will pave way for prevention of occurrence of variety of trauma conditions and reduce trauma mortal-

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ity by establishing trauma treatment algorithm. Therefore, we analyzed abdominal trauma patients in Korea using National Emergency Department Information System (NEDIS).<sup>(3,4)</sup>

The purpose of this study is to analyze characteristics of abdominal trauma patients in Korea and we hope this study used by statistical evidence and contribute to prevention and treatment of abdominal trauma in Korea. It is conjectured that data from present study will contribute in progression of traumatology in Korea.

## II. Materials and Methods

The data was extracted from 2011 to 2014 using NEDIS, which is collected in national medical center from regional and local trauma centers in Korea. The collected data especially focused on abdominal trauma patients.

The data was classified using Korean Standard Classification for Disease 6<sup>th</sup> version (KCD), which is the Korean version of International Classification of Disease 10<sup>th</sup> revision. Abdominal injuries were identified and abdominal surgeries were evaluated based on electronic data interchange codes.

Inclusion criteria were patient would not be caused by disease, treatment result of emergency room 'admission' or 'expire' or 'hopeless discharge' with KCD 6th code S, T code which mean trauma patients code. Exclusion criteria were presence of foreign bodies, poisoning, unspecified, and transferred. Patients meeting the above criteria were sorted by age, gender, regional or local center, treatment result in emergency room, and treatment result after admission.

Patients were classified based on trauma of neck, chest, and abdomen. Abdominal trauma patients were classified based on the organ affected involving spleen,

liver, and kidney. If multiple traumas occurred in one patient, the patient was assigned to each group.

Emergency centers classified as 'regional emergency center', 'local emergency center', and 'unspecified emergency room'. 'Regional emergency center' located in hospital that has more than 500 beds. 'Local emergency center' located in hospital that has less than 500 beds, but more than 30 beds. 'Unspecified emergency room' located in hospital that has less than 30 beds, but more than 5 beds.

This study was approved by the Investigational Review Board of National Medical Center. (IRB No. H-1606-067-003)

## III. Results

### 1. Annual numbers of patients, Gender distribution, Emergency medical center

From 2011 to 2014, 692531 trauma patients were registered by NEDIS. Among them, 24696 patients were with abdominal trauma (3.57%). Analysis as per year revealed, 139134 trauma patients in 2011, 177191 patients in 2012, 182737 patients in 2013, and 193469 patients in 2014. Number of patients with abdominal trauma was 5367 (3.86%) in 2011, 6118 (3.45%) in 2012, 6525 (3.57%) in 2013, and 6686 (3.46%) in 2014 (Table 1).

The mean age of abdominal trauma patients was 41.9 years in 2011, 43.0 years in 2012, 44.1 years in 2013, and 44.7 years in 2014. Annual male to female ratio was 2.9 in 2011, 2.67 in 2012, 2.67 in 2013, and 2.81 in 2014. The prevalence of trauma in Korea was more in men as compared to women (Table 2).

Abdominal trauma patients in Korea concentrated on large sized emergency center like regional or local emergency center. In 2011, 3353 (62.5%) patients

**Table 1.** Annual numbers of patients

Year	All trauma patients	Abdominal trauma patients (%)
2011	139,134	5,367 (3.86%)
2012	177,191	6,118 (3.45%)
2013	182,737	6,525 (3.57%)
2014	193,469	6,686 (3.46%)
Total	692,531	24,696 (3.57%)

**Table 2.** Age and gender distribution of abdominal trauma patients

Year	Average age (Standard Deviation)	Male to Female ratio
2011	46.7 (22.1)	1.63
2012	48.0 (22.0)	1.55
2013	49.1 (21.9)	1.52
2014	49.7 (22.1)	1.49

**Table 3.** Distribution of therapeutic institutions for abdominal trauma patients

Year	Abdominal trauma patients	Local emergency center - large (%)	Regional emergency medical center (%)	Local emergency center - small (%)
2011	5,367	3,353 (62.47%)	1,894 (35.29%)	120 (2.24%)
2012	6,118	3,910 (63.91%)	2,091 (34.18%)	117 (1.91%)
2013	6,525	4,142 (63.48%)	2,259 (34.62%)	124 (1.90%)
2014	6,686	4,159 (62.20%)	2,378 (35.57%)	149 (2.23%)
Total	24,696	15,564 (63.02%)	8,622 (34.91%)	510 (2.07%)

**Table 4.** Mortality rate in Trauma patients

Year	Abdominal trauma patients	All death (%)	Death in emergency room (%)	Death on arrive (%)
2011	5,367	316 (5.89%)	158 (2.94%)	4 (0.07%)
2012	6,118	352 (5.75%)	156 (2.55%)	8 (0.13%)
2013	6,525	378 (5.79%)	158 (2.42%)	8 (0.12%)
2014	6,686	376 (5.62%)	164 (2.45%)	5 (0.07%)
Total	24,696	1422 (5.76%)	636 (2.58%)	25 (0.10%)

**Table 5.** Cardiopulmonary resuscitation (CPR) in emergency room

Year	Death in emergency room	Death without CPR (%)	Death after CPR (%)	Death on arrive (%)	Hopeless discharge (%)	Etc (%)
2011	158	29 (18.35%)	117 (74.05%)	4 (2.53%)	1 (0.63%)	7 (4.43%)
2012	156	26 (16.67%)	117 (75.00%)	8 (5.13%)	0	5 (3.21%)
2013	158	23 (14.56%)	114 (72.15%)	8 (5.06%)	0	12 (7.59%)
2014	164	12 ( 7.32%)	43 (26.22%)	5 (3.05%)	0	14 (8.54%)
Total	636	90 (14.15%)	391 (61.48%)	25 (3.93%)	1 (0.16%)	38 (5.97%)

were treated in local emergency center and 1894 (35.3%) patients were treated in regional emergency medical center. In contrast, only 120 (2.2%) patients were treated in unspecified emergency room. Moreover, this strategy continued in the years 2012, 2013, and 2014 (Table 3).

## 2. Mortality rate in Trauma patients

The number of deaths in patients with abdominal trauma in Korea was 316 (5.89%) in 2011, 352 (5.75%) in 2012, 378 (5.79%) in 2013, and 376 (5.62%) in 2014. Among them, the number of patient who died in emergency room was 158 (2.94%) in 2011, 156 (2.55%) in 2012, 158 (2.42%) in 2013, and 164 (2.45%) in 2014.

**Table 6.** Existence of vital sign for death after CPR

Year	Death after CPR	With vital sign (%)	Without vital sign (%)
2011	117	0	117 (100%)
2012	117	0	117 (100%)
2013	115	1 ( 0.87%)	114 (99.13%)
2014	133	90 (67.67%)	43 (32.33%)
Total	482	91 (18.88%)	391 (81.12%)

**Table 7.** Frequency of injury organ for abdominal trauma patients

Year	Abdominal trauma patients	Liver injury (%)	Spleen injury (%)	Kidney injury (%)
2011	5,367	2,025 (37.73%)	960 (17.89%)	690 (12.86%)
2012	6,118	2,443 (39.93%)	1,057 (17.28%)	828 (13.53%)
2013	6,525	2,630 (40.31%)	1,189 (18.22%)	837 (12.83%)
2014	6,686	2,656 (39.72%)	1,132 (16.93%)	840 (12.56%)
Total	24,696	9,754 (39.50%)	4,338 (17.57%)	3,195 (12.94%)

**Table 8.** Injury mechanism of liver injury

Year	Liver injury patients	Traffic accident (%)	Fall down (%)	Blunt trauma (%)	Etc (%)
2011	2,025	1,370 (67.65%)	363 (17.93%)	140 (6.91%)	152 (7.51%)
2012	2,443	1,677 (68.65%)	447 (18.30%)	157 (6.43%)	162 (6.63%)
2013	2,630	1,830 (69.58%)	452 (17.19%)	179 (6.81%)	169 (6.43%)
2014	2,656	1,821 (68.56%)	481 (18.11%)	194 (7.30%)	160 (6.02%)
Total	9,754	6,698 (68.67%)	1,743 (17.87%)	670 (6.87%)	643 (6.59%)

Additionally, the number of death on arrival (DOA) of patients was 4 (0.07%) in 2011, 8 (0.13%) in 2012, 8 (0.12%) in 2013, and 5 (0.07%) in 2014 (Table 4).

The number of patients who died in emergency room without cardiopulmonary resuscitation (CPR) was 29 (18.35%) in 2011, 26 (16.67%) in 2012, 23 (14.56%) in 2013, and 1 (7.32%) in 2014. The number of patients who died in emergency room with CPR was 117 (74.05%) in 2011, 117 (75.00%) in 2012, 115 (72.78%) in 2013, and 133 (81.10%) in 2014 (Table 5). Etc group in Table 5 is unknown group. Their death is uncertain whether or not the CPR.

The number of patients whose vital signs were measured and died after CPR was 0 in 2011 and 2012, 1 (0.87%) in 2013, and 90 (67.67%) in 2014. The number of patient whose vital signs were not measured and died after CPR was 117 (100%) in 2011, 117 (100%) in 2012, 114 (99.13%) in 2013, and 43 (32.33%) in 2014 (Table 6).

### 3. Liver Injury

Among patients with abdominal trauma, the number of patients with liver injury was 2025 (37.73%) in 2011, 2443 (39.93%) in 2012, 2630 (40.31%) in 2013, and 2656 (39.72%) in 2014 (Table 7).

The most common mechanism of liver injury is traffic accident, involving 1370 (67.65%) patients in 2011, 1677 (68.65%) patients in 2012, 1830 (69.58%) patients in 2013, and 1821 (68.56%) patients in 2014. Fall down and blunt traumas are second and third most common mechanisms of liver injury (Table 8).

Based on 2014 data, the number of liver injury patients at state of emergency room whose systolic pressure measured lower than 90 mmHg was 348 (13.10%) and higher than 90 mmHg was 2174 (81.85%), respectively. Similar tendency was recorded in previous years (Table 9).

The number of patients with liver injury who needed

**Table 9.** Systolic blood pressure of liver injury patients

Year	Liver injury patients	Lower than 90 mmHg (%)	Higher than 90 mmHg (%)	No record (%)
2011	2,025	312 (15.41%)	1,626 (80.30%)	87 (4.30%)
2012	2,443	336 (13.75%)	2,011 (82.32%)	96 (3.93%)
2013	2,630	322 (12.24%)	2,191 (83.31%)	117 (4.45%)
2014	2,656	348 (13.10%)	2,174 (81.85%)	134 (5.05%)
Total	9,754	1,318 (13.51%)	8,002 (82.04%)	434 (4.45%)

**Table 10.** Treatment for liver injury patients

Year	Liver injury patients	Operation (%)	Intervention (%)
2011	2,025	86 (4.25%)	53 (2.62%)
2012	2,443	117 (4.79%)	87 (3.56%)
2013	2,630	124 (4.71%)	90 (3.42%)
2014	2,656	99 (3.73%)	88 (3.31%)
Total	9,754	426 (4.37%)	318 (3.26%)

**Table 11.** Injury mechanism of spleen injury

Year	Spleen injury patients	Traffic accident (%)	Fall down (%)	Blunt trauma (%)	Etc (%)
2011	960	588 (61.25%)	195 (20.31%)	125 (13.02%)	177 (18.44%)
2012	1,057	648 (61.31%)	248 (23.46%)	124 (11.73%)	161 (15.23%)
2013	1,189	751 (63.16%)	265 (22.29%)	119 (10.01%)	173 (14.55%)
2014	1,132	690 (60.95%)	282 (24.91%)	114 (10.07%)	160 (14.13%)
Total	4,338	2,677 (61.71%)	990 (22.82%)	482 (11.11%)	671 (15.47%)

**Table 12.** Systolic blood pressure of spleen injury patients

Year	Spleen injury patients	Lower than 90 mmHg (%)	Higher than 90 mmHg (%)	No record (%)
2011	960	148 (15.42%)	783 (81.56%)	29 (3.02%)
2012	1,057	169 (15.99%)	848 (80.23%)	40 (3.78%)
2013	1,189	178 (14.97%)	967 (81.33%)	44 (3.70%)
2014	1,132	181 (15.99%)	902 (79.68%)	49 (4.33%)
Total	4,338	676 (15.58%)	3500 (80.68%)	162 (3.73%)

surgical treatment was 86 (4.25%) in 2011, 117 (4.79%) in 2012, 124 (4.71%) in 2013, and 99 (3.73%) in 2014. In addition, the number of patients who were treated with intervention like embolization after angiography was 53 (2.62%) in 2011, 87 (3.56%) in 2012, 90 (3.42%) in 2013, and 88 (3.31%) in 2014 (Table 10).

#### 4. Spleen Injury

Among patients with abdominal trauma, the num-

ber of patients with spleen injury was 960 (17.89%) in 2011, 1057 (17.28%) in 2012, 1189 (18.22%) in 2013, and 1132 (16.93%) in 2014 (Table 7).

The most common mechanism of spleen injury is traffic accident, and the number of patients encountering traffic accident in the years 2011, 2012, 2013, and 2014 was 588 (61.25%), 648 (61.31%), 751 (63.16%), and 690 (60.95%), respectively. Second and third most common mechanisms of spleen injury were fall down and blunt trauma (Table 11).

**Table 13.** Treatment for spleen injury patients

Year	Spleen injury patients	Operation (%)	Intervention (%)
2011	960	183 (19.06%)	35 (3.65%)
2012	1,057	194 (18.35%)	57 (5.39%)
2013	1,189	214 (18.00%)	71 (5.97%)
2014	1,132	171 (15.11%)	65 (5.74%)
Total	4,338	762 (17.57%)	228 (5.26%)

**Table 14.** Injury mechanism of kidney injury

Year	Kidney injury patients	Traffic accident (%)	Fall down (%)	Blunt trauma (%)	Etc (%)
2011	690	354 (51.30%)	202 (29.28%)	71 (10.29%)	63 (9.13%)
2012	828	455 (54.95%)	236 (28.50%)	90 (10.87%)	47 (5.68%)
2013	837	429 (51.25%)	248 (29.63%)	108 (12.90%)	52 (6.21%)
2014	840	466 (55.48%)	233 (27.74%)	103 (12.26%)	38 (4.52%)
Total	3,195	1,704 (53.33%)	919 (28.76%)	372 (11.64%)	200 (6.26%)

**Table 15.** Systolic blood pressure of kidney injury patients

Year	Kidney injury patients	Lower than 90 mmHg (%)	Higher than 90 mmHg (%)	No record (%)
2011	690	102 (14.78%)	564 (81.74%)	24 (3.48%)
2012	828	117 (14.13%)	681 (82.25%)	30 (3.62%)
2013	837	91 (10.87%)	726 (86.74%)	20 (2.39%)
2014	840	90 (10.71%)	725 (86.31%)	25 (2.98%)
Total	3,195	400 (12.52%)	2,696 (84.38%)	99 (3.10%)

Based on 2014 data, the number of patients with spleen injury at state of emergency room and whose systolic pressure measured lower than 90 mmHg was 181 (15.99%) and higher than 90 mmHg was 902 (79.68%). Similar tendency was recorded in the years 2011, 2012, and 2013 (Table 12).

The number of patients with spleen injury who needed surgical treatment was 183 (19.06%) in 2011, 194 (18.35%) in 2012, 214 (18.00%) in 2013, and 171 (15.11%) in 2014. Moreover, the number of patients who were treated with intervention was 35 (3.65%) in 2011, 57 (5.39%) in 2012, 71 (5.97%) in 2013, and 65 (5.74%) in 2014 (Table 13).

## 5. Kidney Injury

Among abdominal trauma patients, the number of patients with kidney injury was 690 (12.86%) in 2011, 828 (13.53%) in 2012, 837 (12.83%) in 2013, and 840

(12.56%) in 2014 (Table 7).

The most common mechanism of kidney injury was traffic accident, and the number of patients encountering traffic accident in the years 2011, 2012, 2013, and 2014 was 588 (61.25%), 648 (61.31%), 751 (63.16%), and 690 (60.95%), respectively. Second and third most common mechanisms of kidney injury were fall down and blunt trauma (Table 14).

Based on 2014 data, the number of kidney injury patients at state of emergency room and whose systolic pressure measured lower than 90 mmHg was 90 (10.71%) and higher than 90 mmHg was 725 (86.31%). Similar tendency was recorded in the years 2011, 2012, and 2013 (Table 15).

The number of patients with kidney injury who needed surgical treatment was 36 (5.22%) in 2011, 42 (5.07%) in 2012, 32 (3.82%) in 2013, and 30 (3.57%) in 2014. Moreover, the number of patients who were treated with intervention was 28 (4.06%) in 2011, 49

**Table 16.** Treatment for kidney injury patients

Year	Kidney injury patients	Operation (%)	Intervention (%)
2011	690	36 (5.22%)	28 (4.06%)
2012	828	42 (5.07%)	49 (5.92%)
2013	837	32 (3.82%)	41 (4.90%)
2014	840	30 (3.57%)	54 (6.43%)
Total	3,195	140 (4.38%)	172 (5.38%)

(5.92%) in 2012, 41 (4.90%) in 2013, and 54 (6.43%) in 2014 (Table 16).

#### IV. Discussion

Total number of total traumatic patients registered with NEDIS has gained a steep increase with 139,134 patients registered in 2011, 177,191 in 2012, 182,737 in 2013, and 193,469 in 2014. Among them, the number of patients with abdominal trauma was 5,367 in 2011, 6,118 in 2012, 6,525 in 2013, and 6,686 in 2014. This accounted for 3.86%, 3.45%, 3.57%, and 3.46% of total trauma patients in each year. The proportion of abdominal trauma patients in total number of trauma patients has remained relatively constant. Nevertheless, the number of abdominal trauma patients has steeply increased because of increasing number of total trauma patients. We consider that the development of faster transportation and expansion of leisure activities in Korea have led to a sharp increase in the number of trauma cases. Moreover, Korea's rapid industrialization has led to an increase in injuries caused by people falling or by objects crushing or penetrating the body at industrial sites.(5) In addition, with an increase in the number of trauma centers in Korea and development of trauma patients register system, omission of registration of traumatic patients in NEDIS has experienced a decrease. This could be another reason of increased total number of abdominal traumatic patient that registered NEDIS.

Abdominal trauma patients in Korea concentrated on large sized emergency center like regional or local emergency center, as the centers are commonly located in industrial city, where traumatic accidents occur more commonly. Moreover, unspecified emergency rooms does not have enough facilities for trauma treatment, and in case of urgent requirement of

surgery or intervention, patients are either transferred to regional or local sized emergency center.

The number of deaths in abdominal trauma patients was 316 (5.89%) in 2011, 352 (5.75%) in 2012, 378 (5.79%) in 2013, and 376 (5.62%) in 2014 stating a decline in the percentage of deaths annually. Besides, the number of deaths in abdominal trauma patients in the emergency room decreased from the year 2011 to 2014.

The number of patients who died in emergency room without CPR was 29 (18.35%) in 2011, 26 (16.67%) in 2012, 23 (14.56%) in 2013, and 12 (7.32%) in 2014, stating a decrease annually. Moreover, the number of patients who expired in emergency room with CPR was 117 (74.05%) in 2011, 117 (75.00%) in 2012, 114 (72.15%) in 2013, and 43 (26.22%) in 2014, which also represents a decrease annually. This reason was because of the development of our trauma care system and improvement in trauma call and transfer system, which also resulted in immense increase in the cases of patients with vital signs upon arrival, thus leading to decrease in total number of deaths caused due to abdominal trauma. The study by Kim et al.(6) demonstrates that after establishing plans of the Ministry of health and welfare for improvement of trauma system, preventable trauma death rate in Korea improved from 38.9% to 22.8%.

The most common mechanism of abdominal trauma is traffic accident. Second and third most common mechanisms of abdominal trauma are fall down and blunt trauma. The study by Sauasia et al.(7) showed that most of the common mechanism of abdominal trauma in United States is gunshot accidents. However, in Korea firearms trauma caused due to gunshot wounds is very rare due to restriction in the usage of firearms. Besides, other studies by Cothren et al.(8) and Ameh et al.(9) showed similar results.

The proportion of systolic blood pressure less than 90 mmHg in organ specific abdominal trauma is reported as 3.51% in liver injury, 15.58% in spleen injury, and 12.52% in kidney injury. Liver, spleen, and kidney have abundant blood flow. Spleen has higher possibility of massive bleeding than other organs and spleen injury involved more frequent cases with systolic blood pressure dropping down to less than 90 mmHg.

In abdominal trauma patients, the proportion of surgery has reduced, and the proportion of interventions like angiography has experienced an increase. Recent studies showed that interventions reducing the incidence of surgery and the results of intervention are similar to those of surgery.(10–12) Moreover, good number of equipments and specialists for intervention were provided to centers, which resulted in increase in intervention activities.

There are limitations of this study. First, as we classified the data from NEDIS from centers, we overlooked the statistical data that was classified based on region.

Second, if multiple traumas occurred in one patient, we assigned the patient to each organ trauma group, which might have caused bias due to overlapping of data from surgery and intervention. Third, collecting clinical manifestations of all patients is impossible; we have to guess specific reasons for collected data like low systolic blood pressure or intervention proportion change.

## V. Conclusion

Rapid industrialization, development and increase in traffic, and increase in economic state, has led to a constant increase in the number of abdominal trauma patients. Nevertheless, with settlement of domestic traumatic treatment system and development of relevant medicines, mortality of abdominal trauma patient is predisposed to decrease.

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## REFERENCES

- 1) Gross CP, Anderson GF, Powe NR. The relation between funding by the National Institutes of Health and the burden of disease. *New England Journal of Medicine* 1999; 340: 1881-7.
- 2) Lee KH. *J Korean Med Assoc* 2013; 56: 748-50.
- 3) Lagarde E. Road traffic injury is an escalating burden in Africa and deserves proportionate research efforts. *PLoS Med* 2007; 4: 170.
- 4) Hofman K, Primack A, Keusch G, Hrynkow S. Addressing the growing burden of trauma and injury in low-and middle-income countries. *American Journal of Public Health* 2005; 95: 13-7.
- 5) Byun CS, Park IH, Oh JH, Bae KS, Lee KH, Lee E. Epidemiology of trauma patients and analysis of 268 mortality cases: trends of a single center in Korea. *Yonsei medical journal* 2015; 56: 220-6.
- 6) Kim HW, Hong TH, Lee SH, Jung MJ, Lee JG. The Influence of How the Trauma Care System Is Applied at the Trauma Center: The Initial Experience at Single Trauma Center. *Journal of Trauma and Injury* 2015; 28: 241-7.
- 7) Sauaia A, Moore FA, Moore EE, Moser KS, Brennan R, Read RA, et al. Epidemiology of trauma deaths: a reassessment. *J Trauma* 1995; 38: 185-93.
- 8) Cothren CC, Moore EE, Hedegaard HB, Meng K. Epidemiology of urban trauma deaths: a comprehensive reassessment 10 years later. *World journal of surgery* 2007; 31: 1507-11.
- 9) Ameh E, Chirdan L, Nmadu P. Blunt abdominal trauma in children: epidemiology, management, and management problems in a developing country. *Pediatric surgery international* 2000; 16: 505-9.
- 10) Jang JY, Lee SH, Lee JG. The Choice of Management in Patients with Splenic Blunt Trauma: A Single Center Study. *Journal of Trauma and Injury* 2013; 26: 280-5.
- 11) Dondelinger R, Trotteur G, Ghaye B, Szapiro D. Traumatic injuries: radiological hemostatic intervention at admission. *European radiology* 2002; 12: 979-93.
- 12) Wei B, Hemmila MR, Arbabi S, Taheri PA, Wahl WL. Angioembolization reduces operative intervention for blunt splenic injury. *J Trauma* 2008; 64: 1472-7.