Research Square

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Comparison between operative management versus non-operative management in patients with blunt abdominal injury in National Trauma Registry of Iran

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Abstract

Background

Trauma is one of the leading causes of death worldwide. Severe abdominal injuries cause one-fifth of injury mortality. Non-operative management (NOM) or operative management (OM) is a primary challenge in abdominal injuries. In this study, we aimed to compare NOM and OM outcomes in patients with blunt abdominal injuries in the National Trauma Registry of Iran (NTRI).

Method

This cross-sectional study was conducted with data from the NTRI from July 24th, 2016, to May 21st, 2023. All patients with an abdominal injury by road traffic crash (RTC), falls, hit or bodily fore, and assault with blunt objects were admitted to trauma registry member hospitals across the country according to the NTRI criteria included in this study.

Results

Liver, spleen, and kidney single-organ injuries managed non-operative more than operative 78 (75.7%), 101 (74.3%), and 34 (89.5%) vs. 25 (24.3%), 35 (25.7%), and 4 (10.5%) (P = 0.572, 0.845, and 0.019). Among multi-organ abdomen injuries, kidney injuries alongside spleen or liver injuries are managed non-operative more than operative. In the multivariate logistic regression model after adjustment, multi-organ abdomen injuries increased the chance of OM 3.57 times compared to NOM [OR:0.28, 95% CI: 0.171 to 0.489, p < 0.001]. Multiple logistic regression after adjustment revealed NOM did not increase mortality and decreased ICU admission compared to the OM.

Conclusion

We observed that NOM had no worse outcomes than OM. The liver, spleen, and kidney are mainly managed by non-operatives.

Introduction

Trauma is one of the leading causes of death worldwide (1, 2, 3) and the leading cause of death in people under 44 years old (4, 5). According to the World Health Organization (WHO) report, in 2019, 8% of all causes of death were due to injuries that had included approximately 4.4 million deaths (6). Also, every day, 14000 deaths are recorded due to injury, which is expected to increase to 40% in 2030 (7).

Severe abdominal injuries cause one-fifth of injury mortalities (8). The most common regions of the body that suffer from trauma include the head, extremities, and abdomen, respectively (9). Across the world,

the abdominal injury mortality rate is between 1 and 20% (3). More than 75% of abdominal traumas are caused by vehicle accidents or falling from a height. The mechanism of abdominal injuries includes: 1. Crushing: direct collision of abdominal components with fixed structures of the body, such as the spine, which often damages solid visceral components. 2. Compression: a sudden increase in pressure inside the abdominal cavity, which causes rupture of the hollow viscera. 3. Slowing down: Damage to the connection points of the abdominal components using shearing forces causes damage to solid, hollow, visceral components and vessels (10). Solid organs that are damaged in the abdomen can be examined in two ways: Parenchymal injuries, which include laceration, hematoma, and contusion, and another is vascular injuries, which include Contained vascular injury, non-contained vascular injury, or active bleeding (10).

In the past, laparotomy was used for blunt abdominal injuries to diagnose the damaged organ. With the advancement of imaging methods, knowledge of injury patterns, and patient selection criteria, a new strategy is being implemented. The non-operative management (NOM) is a method for hemodynamically stable patients and can also be used in blunt abdominal injuries (11).

Initial assessment of blunt abdominal injury in line with Advanced Trauma Life Support (ATLS), which performs initial assessment and stability of the patient according to ABCDE (airway/breathing/circulation/disability/exposure), physical examination, simple radiography and focused assessment with sonography for trauma (FAST) is the primary tool to identify life-threatening injuries and determine treatment for unstable patients quickly. At the same time, more evaluations are required in stable patients (12).

The management of abdominal injury has improved with radiological interventions, including angiography, splenic artery embolization, and non-operative treatment (NOT), including follow-up of injuries without surgical intervention (2, 13). Surgery indicated in patients that hemodynamics is continuously unstable despite active resuscitation measures (13). It can be said that about 70% of injuries to the liver, spleen, and kidney can be controlled by conservative treatment. At the same time, hollow organs such as the intestine mostly require surgical intervention and laparotomy (5).

In this study, we aimed to compare non-operative management (NOM) and operative management (OM) outcomes in patients with blunt abdominal injuries in the National Trauma Registry of Iran (NTRI).

Method

Study design

This cross-sectional study was conducted using hospital-based registry data (NTRI) from July 24th, 2016, to May 21st, 2023, in six hospitals in Tehran, Saveh, Yazd, Urmia, Isfahan, and Kashan cities.

Study population

All patients with an abdominal injury by road traffic crash (RTC), fall, hit or bodily fore, and assault with blunt objects were admitted to trauma registry member hospitals across the country according to the NTRI criteria included in this study. The study population's chart is shown in Fig. 1.

Data collection

In this study, our variables included gender, age, injury severity score (ISS), hospitalization in an ICU, LOS, organ injury, systolic blood pressure (SBP), heart rate (HR), Glasgow coma scale (GCS), and death. Demographic data and outcomes, including gender, age, LOS, ICU admission, injured organs, and death in the hospital, were collected by a trained nurse through the hospital information system (HIS) and interviews with patients. Vital signs, including SBP, HR, and GCS, are measured by a physician during visits to the emergency room. Finally, a physician as a quality reviewer considered all data accuracy and calculated ISS with the sum of squared AIS for three severe injuries in each part of the body based on the ICD-10 codes (14).

This study categorized ISS as 1–8, 15 – 9, and > 16. We considered patients with SBP < 90 and/or pulse rate above 120 as a hypovolemic. The shock index is calculated by dividing heart rate by systolic blood pressure. Victims with a shock index ≥ 1 are considered a hypovolemic shock. Multi-organ abdomen injuries are defined as injuries in more than one abdomen organ. Victims with injuries in other parts of the body alongside abdomen injury are considered multiple trauma patients.

Statistical analysis

Mean and standard deviation (SD) were used to describe the quantitative variables, and percentage frequency was used to describe the qualitative variables. In this regard, t-test, and chi-square statistical tests were used to measure the relationship. This study considered a significance level of p-values less than 0.05. Statistical analysis was performed by SPSS 26 and R.

This study compares two treatment approaches (OM and NOM) for treating patients and their outcomes. Due to the type of study (cross-sectional), it is not possible to investigate the causal effect of the treatment approach and other factors on the outcomes of the study, the occurrence of death (yes/no), and hospitalization in ICU (yes/no). On the other hand, due to the nature of the disease, the answer cannot be reached by designing clinical trial studies. Therefore, in this study, the patients' essential characteristics in the two treatment approaches were compared using the propensity score method to control the confounding factors. The package (MatchIt) was used in R version 4.1.3 software to calculate propensity score, designed for this purpose. Four hundred nine patients (132 under OM and 277 under NOM) whose information was complete were included in the study, and one person was excluded from the study due to the unknown GCS before matching. The number of qualitative variables transfusion, multiple trauma, and hypovolemia, and the quantitative variables GCS, Age, and ISS with significant values less than 0.2 that had a confounding effect on the type of treatment approach adopted were considered in the calculation of propensity score with logistic regression model. At the time of matching, 132 people from the NOM group were matched with 132 people from the OM group, and the other 145 people who were not matched were excluded from the study. An analysis was performed to

find the causal effect on 264 samples. After obtaining matched treatment groups and ensuring control of confounders, simple and multiple logistic regression was used to investigate the effect of each factor on the occurrence of death (yes/no) and hospitalization in ICU (yes/no) separately.

All analyses were interpreted at a significance level of 0.05. The multiple logistic regression model included all the variables with a significant value of less than 0.2 in the simple mode.

Ethics approval

This study was performed according to the Declaration of Helsinki. The Research Ethics Committee of Tehran University of Medical Sciences approved it (Approval ID: IR.TUMS.SINAHOSPITAL.REC.1399.090). During the data collection process, informed consent was obtained from the patients.

Results

Of 410 patients with a blunt abdominal injury, 277 (67.5%) of them managed non-operative, and 133 (32.4%) managed surgically. Twenty–four (18%) patients who managed operative had hypovolemia when admitted, while 33 (11.9%) NOM patients were hypovolemic ($p = 0.096$). The mortality rate was 11 (4%) in NOM and 10 (7.5%) in the OM group without significant difference ($p = 0.12$). Patients with OM had higher blood transfusion rates than the NOM group (44 (33.1%) vs. 55 (19.1%), $p = 0.003$). Victims with multiple trauma more than solely abdomen injury underwent OM (95(71.4%) vs. 168 (60.6%), $p = 0.033$). Also, patients with abdomen multi-organ injuries had a higher rate of OM than single-organ injuries (47 (35.3%) vs. 36 (13%), $p < 0.001$). Baseline characteristics and clinical futures of the two therapeutic groups are shown in Table 1.

Table 1
Comparisons between NOM and OM in patients with blunt abdominal injury, N (%)

Variables	NOM = 277 N	OM = 133 N	P-value
Age, mean (SD)	31.5 (18.5)	29.9 (15.7)	0.35
Sex	220 (79.4)	108 (81.2)	0.67
Male	57 (20.6)	25 (18.8)	
Female			
Hypovolemia	33 (11.9)	24 (18)	0.096
Shock Index	240 (86.6)	107 (80.5)	0.104
< 1	37 (13.4)	26 (19.5)	
≥ 1			
Multiple trauma	109 (39.4)	38 (28.6)	**0.033**
Single trauma	168 (60.6)	95 (71.4)	
M.T			
Multi-organ injury	36 (13)	47 (35.3)	**< 0.001**
Single-organ injury	241 (87)	86 (64.7)	
GCS	21 (7.6)	15 (11.4)	0.13
Severe (3–8)	18 (6.5)	14 (10.6)	
Moderate (9–12)	238 (85.9)	103 (78)	
Mild (13–15)			
ISS	142 (51.3)	54 (40.6)	0.12
1–8	71 (25.6)	42 (31.6)	
9–15	64 (23.1)	37 (27.8)	
≥ 16			
Blood transfusion	55 (19.9)	44 (33.1)	**0.003**
ICU	183 (66.3)	78 (59.1)	0.15
LOS, median (IQR), hrs	159 (209)	183 (186.25)	0.19
Death	11 (4)	10 (7.5)	0.12

NOM: non-operative management; OM: operative management; GCS: Glasgow Coma Scale; ISS: Injury Severity Score, ICU: Intensive Care Unit; LOS: Length of Stay

Between single organ abdomen injuries, liver, spleen, and kidney injuries are managed non-operative with 78 (75.7%), 101 (74.3%), and 34 (89.5%) vs. 25 (24.3%), 35 (25.7%), and 4 (10.5%) OMs (P = 0.572, 0.845, and 0.019). On the other hand, the intestine and colon are managed surgically more than observation (15 (57.7%) vs. 11 (42.3%)) $p < 0.001$. Figure 2.

Among multi-organ abdomen injuries, kidney injuries alongside spleen or liver injuries are managed non-operative more than operative. In contrast, other multi-organ injuries were managed surgically more than NOM significantly ($p = 0.002$). Figure 3.

The Standardized mean difference for all variables was less than 0.1, which shows that the matching is done well. The graph below shows this.

As can be seen from the graphs below, the median and interquartile range of the tendency scores of people in different treatment approaches after matching are completely the same. Therefore, from now on, any observed effect will be the average causal effect of that factor (average treatment effect (ATE)) on the study's result.

Univariate logistic regression model revealed moderate and severe GCS compared to mild GCS, ISS 9–15, ≥ 16 compared to ISS 1–8, hypovolemia, multiple trauma, and multi-organ injuries decreased NOM probability compared to the OM. In the multivariate logistic regression model after adjustment, multi-organ abdomen injuries increased the chance of OM 3.57 times compared to NOM [OR:0.28, 95% CI: 0.171 to 0.489, $p < 0.001$]. Table 2.

Table 2
Odds Ratio (OR) and 95% Confidence Interval (CI) of NOM predictors

Variables	Uni-variate OR (95% CI)	Multi-variate OR (95% CI)	P-value
GCS	Reference	0.586 (0.257 to 1.337)	0.204
Mild (13–15)	0.556 (0.267 to 1.161)	0.971 (0.424 to 2.221)	0.944
Moderate (9–12)	0.606 (0.3 to 1.222)		
Severe (3–8)			
Single trauma	0.617 (0.394 to 0.964)	0.733 (0.4 to 1.343)	0.314
Multiple trauma			
Single-organ abdomen injury	Reference	0.289 (0.171 to 0.489)	**< 0.001**
Multi-organ abdomen injury	0.273 (0.166 to 0.45)		
ISS	Reference	0.94 (0.503 to 1.759)	0.848
1–8	0.643 (0.392 to 1.053)	1.161 (0.575 to 2.345)	0.676
9–15	0.658 (0.394 to 1.097)		
≥ 16			
Hypovolemia	0.614 (0.347 to 1.089)	0.772 (0.402 to 1.483)	0.438

NOM: Non-Operative Management; GCS: Glasgow Coma Scale; ISS: Injury Severity Score

The results of the multiple logistic regression are significant. They reveal that hypovolemia at the initial visit to the emergency increases the chance of mortality by 1.66 times, with a p-value of 0.029. Similarly, severe GCS increases mortality 2.89 times compared to mild GCS, with a p-value of 0.001. These findings are detailed in Table 3.

Multiple logistic regression showed moderate and severe GCS compared to mild GCS increased ICU admission 1.82 and 1.42 times, respectively, p = 0.021, p = 0.035. Also, ISS ≥ 16 compared to the 1–8 ISS increased ICU admission 1.06 times, p = 0.021. Another predictor was NOM, which decreased ICU admission by 0.70 times, p = 0.014. Table 4.

Table 3
Determining the effect of variables on the outcome of death

	Simple logistic regression		Multiple logistic regression	
Variable	Estimate (S.E)	P-value	Estimate (S.E)	P-value
Transfusion	-	-	-	-
No	0.213 (0.534)	0.690		
yes				
Trauma	-	-	-	-
Single	− 0.268 (0.559)	0.632		
Multiple				
Hypovolemia	-	-	-	-
No	2.284 (0.547)	< 0.001	1.663 (0.759)	**0.029**
yes				
GCS	-	0.128	-	-
Mild	1.357 (0.891)	< 0.001	0.570 (1.051)	0.588
Moderate	3.229 (0.636)		2.895 (0.903)	**0.001**
Severe				
Age	0.057 (0.015)	< 0.001	0.071 (0.020)	**< 0.001**
ISS	-	0.921	-	-
1–8	− 0.078 (0.779)	0.096	− 0.437 (0.919)	0.635
9–15	1.034 (0.620)		− 0.398 (0.855)	0.641
≥ 16				
Treatment	-	0.307	-	-
OM	− 0.543 (0.532)			
NOM				

GCS: Glasgow coma scale; ISS: injury severity score; OM: operative management; NOM: non-operative management

Table 4
Determining the effect of variables on the hospitalization in ICU

	Simple logistic regression		Multiple logistic regression	
Variable	Estimate (S.E)	P-value	Estimate (S.E)	P-value
Transfusion	-	0.004	-	-
No	0.860 (0.302)		0.433 (0.338)	0.200
yes				
Trauma	-	0.002	-	-
Single	0.898 (0.289)		− 0.154 (0.404)	0.703
Multiple				
Hypovolemia	-	0.121	-	-
No	0.580 (0.374)		0.042 (0.434)	0.924
yes				
GCS	-	0.004	-	-
Mild	2.153 (0.748)	0.003	1.822 (0.786)	**0.021**
Moderate	1.824 (0.625)		1.428 (0.676)	**0.035**
Severe				
Age	− 0.009 (0.008)	0.259	-	-
ISS	-	0.002	-	-
1–8	0.989 (0.319)	< 0.001	0.995 (0.410)	**0.015**
9–15	1.622 (0.349)		1.069 (0.462)	**0.021**
≥ 16				
Treatment	-	0.012	-	-
OM	0.665 (0.265)		0.706 (0.288)	**0.014**
NOM				

GCS: Glasgow coma scale; ISS: injury severity score; OM: operative management; NOM: non-operative management

Discussion

Our finding showed that two-thirds of blunt abdominal victims were treated with observation. Liver, spleen, and kidney injuries are managed mainly non-operative. One-fourth of spleen injuries were

concomitant with liver injury, and one-fourth of them had managed non-operative. Multi-organ abdomen injuries decreased the chance of NOM in victims. On the other hand, OM candidates had more blood transfusions, multiple trauma, and multi-organ abdomen injuries. Multi-organ abdomen injury was predictor for OM. NOM did not increase mortality probability but decreased ICU admission.

At first, the observation of abdomen injuries without more mortality and morbidity was described by shaftan (15). Observation (NOM) or OM is a primary challenge in abdominal injuries. In our study, two-thirds of blunt abdominal victims managed non-operative. We observed that NOM decreased ICU admission without raising the mortality rate. Studies mentioned blunt injuries followed NOM in hemodynamically stable patients in the first step (16, 17). At the same time, 11.9% of our patients who were treated non-operative had hypovolemia on admission. Eleven deaths were recorded in the NOM group, and six of them had hypovolemia on admission. Definitely, with a low mortality rate, we cannot conclude that hypovolemic patients could treat NOM and need a larger population. We observed 18% mortality in hypovolemic patients who managed non-operative, while this percentage was 29% in the OM group. Because hypovolemia increased mortality chance, management strategy should be selected carefully.

Intestine and colon injuries are managed OM more than NOM. In other studies, small bowl injuries were mainly managed operatively, and these patients had more unstable hemodynamics and higher ISS than the NOM group (18).

In our study, we observed that spleen and liver injuries had more NOM than OM. Studies mentioned that NOM is a prevalent strategy for splenic injuries that could be used in all patients with stable hemodynamics and without peritonitis signs because of the low mortality rate, low LOS, and low complications. However, some factors included higher ISS and AIS, and above-grade injuries increased operative probability (19, 20) (21).

In this study, kidney injuries are managed mainly non-operatively. Renal blunt injuries grade - managed non-operative, grade NOM with monitoring and angioembolization if needed, grade - with stable hemodynamic could have NOM (22).

Although multi-organ abdomen injuries were a predictor for OM, 43.3% of them had NOM. NOM had non-significantly lower mortality than OM in multi-organ injuries, similar to the single organ injuries (3 (8.3%) vs. 6 (12.8%), p = 0.725). Approximately two-thirds of multi-organ injuries with two or three solid organ damage are managed by NOM. Our results showed that none of the MT and treatment options were predictors of mortality, but we need a larger study population to make a decision about NOM in multi-organ injuries and MT patients.

Our study had limitations; our study could have some biases because this is a registry-based study, not a randomized, double-blind, controlled clinical trial. Also, the CT scan and sonography results were not registered in our data bank. Therefore, we could not investigate the sensitivity and specificity of FAST and CT scan results. Failed NOM cases that led to the operation were not recorded in our data bank.

Therefore, we could not show failed NOM case numbers and their outcomes. Our registry did not follow patients after discharge for complications, and we did not have information about their complications.

Conclusion

We conclude that NOM did not have worse outcomes compared to the operation. On the contrary, it had lower blood transfusion and ICU admission. Multi-organ abdomen injury was a main predictor for OM, although NOM in solid multi-organ injuries did not show higher mortality and worse outcomes.

Declarations

Competing interests

The authors declare that they have no competing interests.

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Author Contribution

"SM and MNHA contributed to writing the manuscript, SM and SGH contributed to analysis and interpretation, PS contributed to the conception and design and critical revision of the manuscript, VRM and MRZ contributed to the conception and design of the study, MNI, EF, SHSB, VH, AG, SP, SMP, and KN contributed to data collection and revised the manuscript, SAMY contributed to conception and design and critical revision of the manuscript."

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Data Availability

"The datasets used and analyzed during the current study are available from Dr. Payman Salamati, director of the NTRI project, on reasonable request."

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Figures

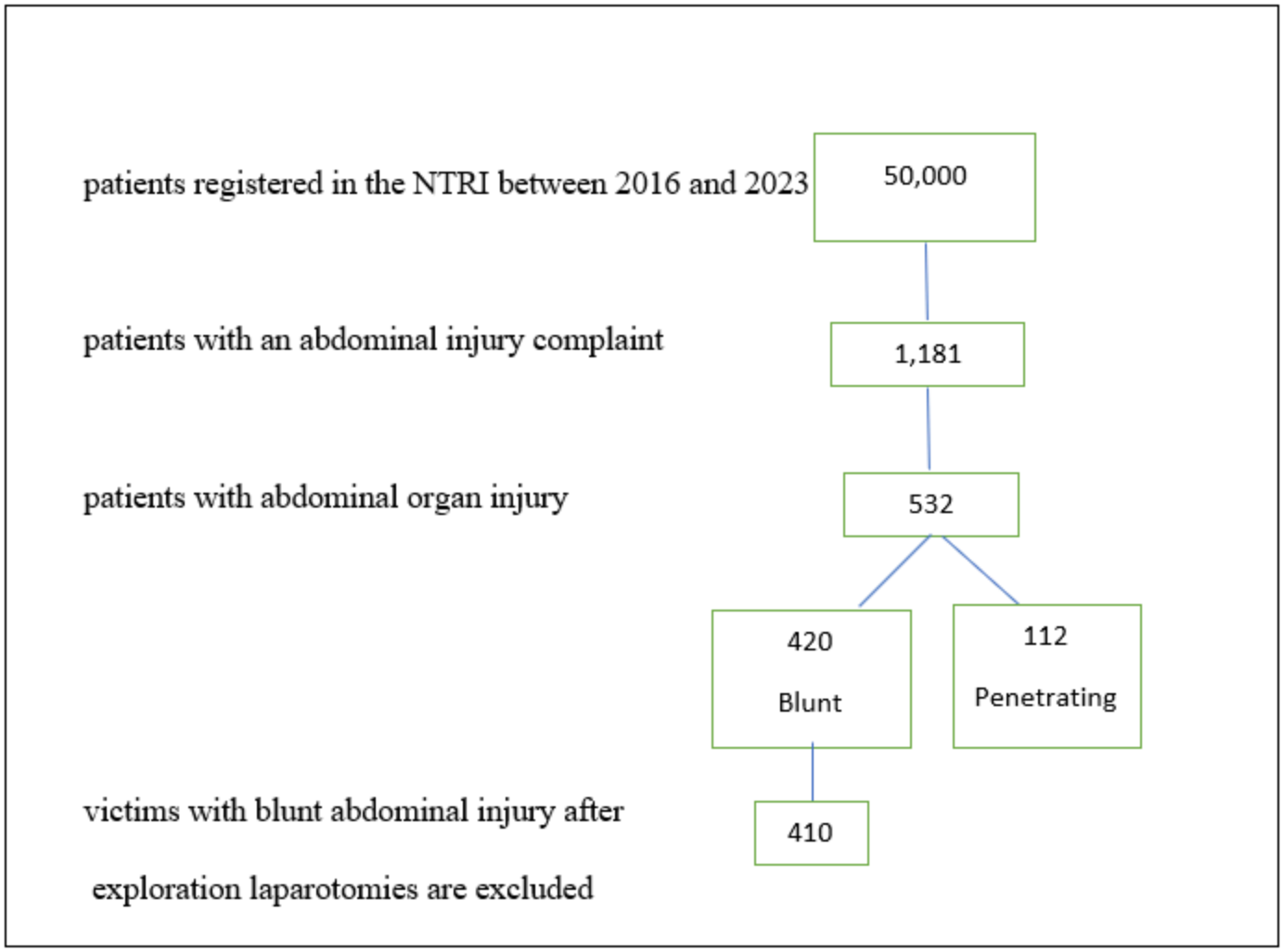

Figure 1

Study population's selection chart

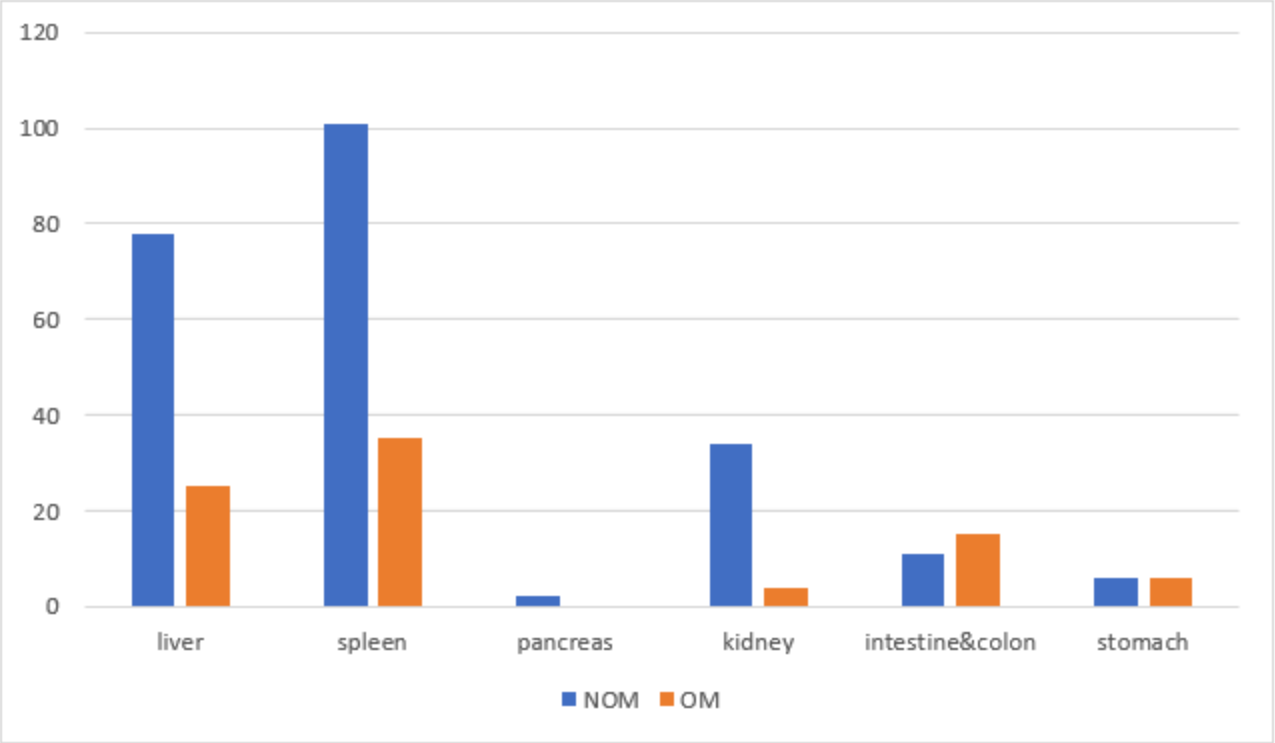

Figure 2

Comparison of managed organ damage between NOM vs. OM in single-organ injury

NOM; non-operative management; OM: operative management

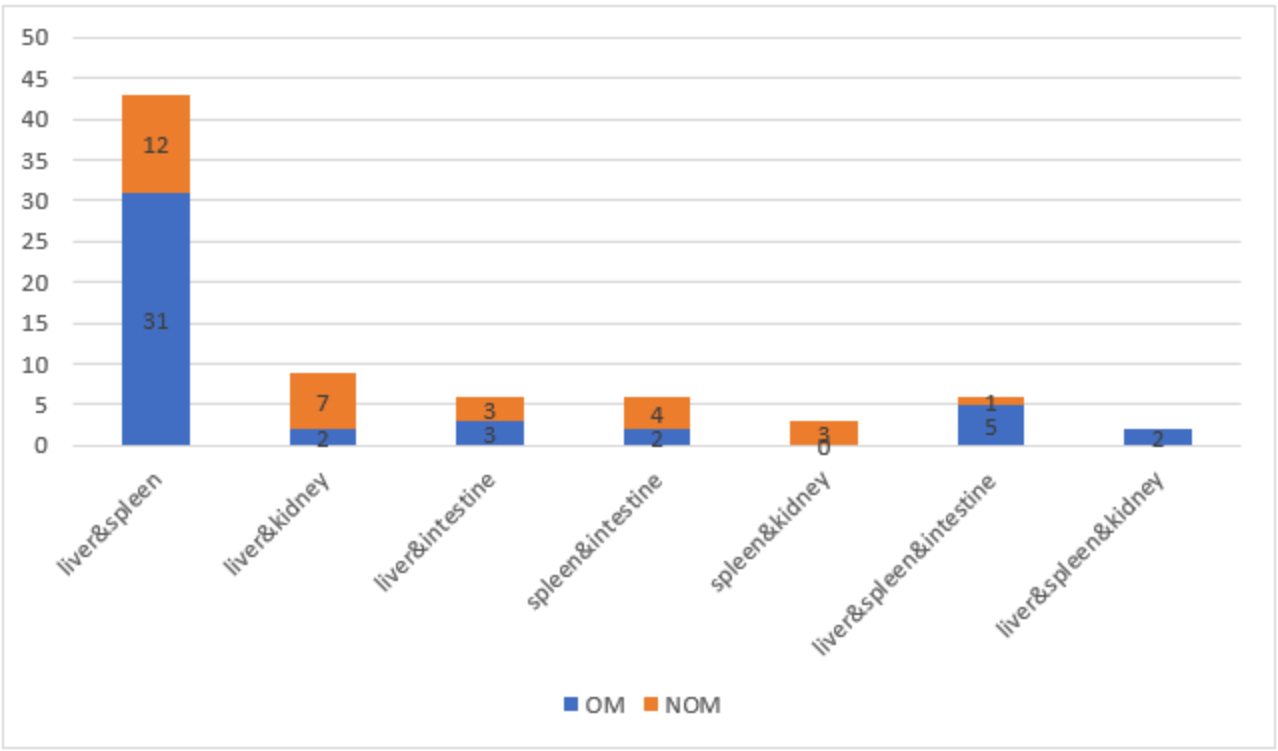

Figure 3

Comparison of managed organ damage between NOM vs. OM in multi-organ injuries

NOM; non-operative management; OM: operative management

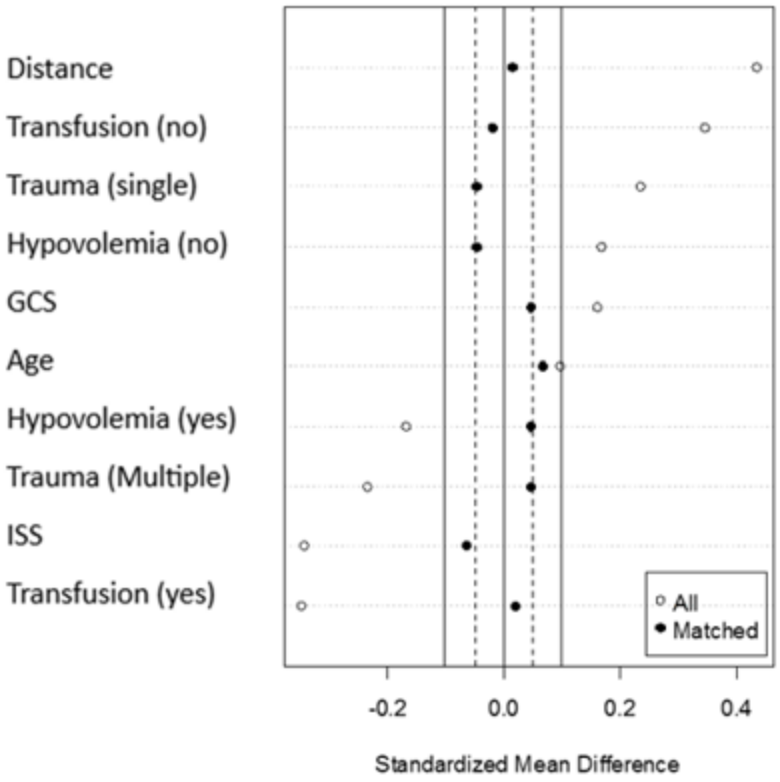

Figure 4

Standardized mean difference

GCS: Glasgow coma scale; ISS: injury severity score

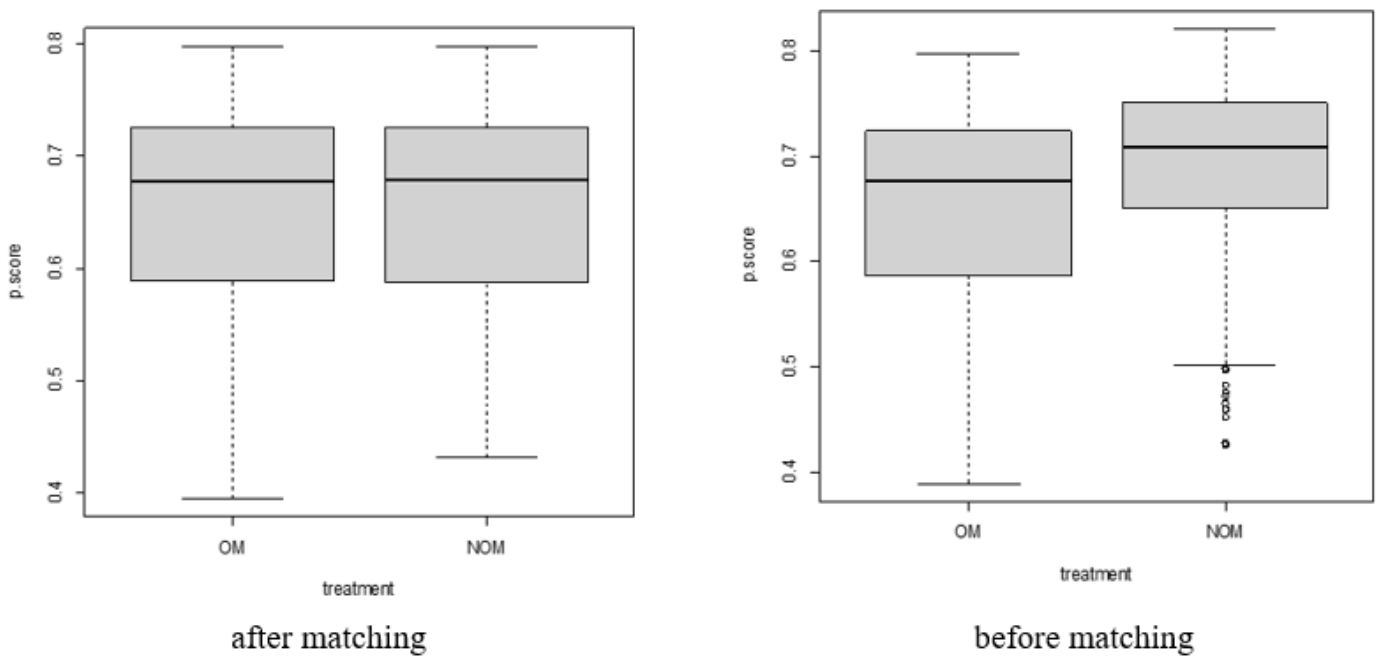

Figure 5

Boxplot diagram of propensity score before and after matching