The Longer The Decision-TAE Time, The Higher The Risk of Mortality: A Retrospective Study Of Trans-Arterial Embolization In Pelvic Fracture

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Research Article

Keywords: hemostasis, transcatheter, hemorrhagic, multivariable

Posted Date: May 26th, 2021

DOI: https://doi.org/10.21203/rs.3.rs-511223/v1

Abstract

Early administration of hemostasis strategies, such as transcatheter arterial embolization (TAE), is critical in pelvic injury patients because they often experience hemorrhagic shock and other fatal injuries. We investigated the influence of delays in TAE administration on mortality. Patients admitted to the Advanced Critical Care Center at Gifu University with pelvic injury between January 2008 and December 2019 who underwent acute TAE were retrospectively enrolled. The time from when the doctor decided to administer TAE to the start of TAE (needling time) was defined as "decision-TAE time." We included 162 patients. The median decision-TAE time was 59.5 min. Twenty-five patients died. Kaplan-Meier curves for overall survival were compared, with a significant difference observed between the patients above and below the median cutoff value for decision-TAE time (p=0.02). The age and sex-adjusted multivariable Cox proportional hazards regression model revealed that the longer the decision-TAE time, the higher the risk of mortality (p=0.01). The interaction between TAE duration (procedure time) and decision-TAE time was statistically significant (p=0.044), indicating that TAE duration modified the effect of decision-TAE time on mortality. Decision-TAE time may play a key role in establishing resuscitation in pelvic fracture patients, and efforts to shorten this time should be pursued.

Introduction

Pelvic injury is often associated with hemorrhagic shock and other fatal injuries, and mortality rates remain high, particularly in patients with hemodynamic instability [1]. The unstable hemodynamics and hemorrhage-related mortality rate may be as high as 40%, and overall mortality in these patients may be over 10–32%, even if they are hospitalized in a level 1 trauma center [2–5]. Early diagnosis of the bleeding source and rapid hemostasis strategies are critical for these patients. In the emergency department (ED), the treatment options used to achieve hemodynamic stabilization in patients with pelvic injury include transcatheter arterial embolization (TAE) and pre-peritoneal packing (PPP) [1,6,7].

The literature contains many reports on the relative advantages of TAE and PPP [8–11]. As indicated in these reports, TAE is a less invasive procedure and has become widely accepted as a safe and efficacious substitute for direct surgical intervention. On the other hand, considerable delays in performing embolization and the lack of readily available experts in angiography have been highlighted [8,10]. Some researchers have reported that the mortality rates in patients treated with TAE range from 16–50% [12,13] and this represents a higher mortality rate compared to patients treated with PPP [10].

Following on from these background studies, reports suggest that earlier administration of TAE results in lower mortality rates [4,14]. In these reports, the so-called "door-to-angioembolization time" should be shorter for better outcomes. In reality, the time course of patients with pelvic injury varies according to patient status. For some patients, there may be time to perform a computed tomography (CT) scan before TAE because their vital signs are relatively stable, and for other patients, this might not be possible. The true effectiveness of shortening the delay before administration of TAE can be confirmed using “decision-TAE time,” which represents the time from the decision to administer TAE to the actual administration of TAE.

In this study, we aimed to investigate how “decision-TAE time” influences mortality in patients admitted to hospital with pelvic trauma.

Results

Patient demographics

A total of 611 patients with pelvic fractures were included in this study. A flowchart of the inclusion process is shown in Fig. 3. Table 1 summarizes the patients’ clinical characteristics. Six patients with out-of-hospital cardiac arrest (OHCA) and two patients with missing data were excluded. Acute TAE was performed in 172 patients, and 10 patients were excluded because they had undergone PPP before TAE. A total of 162 (26.5%) patients met the inclusion criteria. The median patient age was 74 (interquartile range [IQR]: 61–81) years, and 96 were male (59.3%) and 66 were female (40.7%). Eighty-three patients (51.2%) were transferred from other hospitals. The mean injury severity score (ISS) was 24.7 ± 12.4. The proportions of severe anatomic injuries indicating an Abbreviated Injury Score (AIS) of ≥ 3 were as follows: head, 44 patients (26.5%); chest, 56 patients (34.6%); abdomen, 26 patients (16.0%); and pelvis, 128 patients (79.0%). The median systolic blood pressure on arrival was 109 (IQR: 85–132) mmHg and the median Glasgow Coma Scale (GCS) score was 14 (IQR: 13–159). The Tile Orthopaedic Trauma Association (OTA) classification was A1 in six patients (3.7%); A2 in 11 patients (6.8%); A3 in three patients (1.9%); B1 in 45 patients (27.8%) (including five associated acetabular fractures); B2 in 25 patients (16.0%) (including three acetabular fractures); B3 in 16 patients (9.9%) (including one acetabular fracture); C1 in 25 patients (15.4%) (including one acetabular fracture); C2 in seven patients (4.3%); and C3 in five patients (3.1%). There was an unknown fracture type in one patient (0.6%) because of the lack of CT scan, sacral fractures in two patients (1.2%), and acetabular fractures in 15 patients (9.3%). The median decision-TAE time was 59.5 [IQR: 40–86.5] min. The DT group (door-TAE group; patients who did not undergo a CT scan before TAE) comprised 47 patients (29.0%) and the CT group comprised 115 patients (71.0%). The indication for TAE was contrast extravasation on the CT scan in 136 patient (84.0%), massive hematoma on the CT scan in 13 patients (8.0%), and unstable hemodynamics in 13 patients (8.0%).

Relationship between mortality and decision-TAE time

The median decision-TAE time was 59.5 (IQR: 40–86.5). Twenty-five patients died, and the mortality rate was 15.4%. The Kaplan-Meier curves for overall survival were compared, and a statistically significant difference was observed between the patients above and below the median cutoff value for decision-TAE time ($p = 0.02$) (Fig. 4). The multivariable Cox proportional hazards regression model adjusted for age and sex revealed that the longer the decision-TAE time, the higher the risk of mortality (hazard ratio [HR] for IQR: 40–86.5: 1.5, 95% confidence interval [CI]: 1.1–2.06, $p = 0.01$). The TAE duration (procedure time) did not show a statistically significant influence on mortality (HR for IQR: 39–75: 1.12, 95%CI: 0.67–1.89, p = 0.667) (Table 2).

The interaction between TAE duration and decision-TAE time was statistically significant (p = 0.044), indicating that TAE duration modified the effect of decision-TAE time on mortality (Fig. 5).

Patient outcomes

The total number of arteries involved during TAE was 466, with a median of three (IQR: 2–4). The locations of the arteries were investigated and the results were as follows: internal iliac artery, n = 85 (18.2%); external iliac artery, n = 55 (1.1%); superior gluteal artery, n = 57 (12.2%); inferior gluteal artery, n = 24 (5.2%); sacral arteries, including the median sacral arteries or lateral sacral arteries, n = 60 (12.9%); obturator artery, n = 59 (12.7%); iliolumbar artery, n = 53 (11.4%); lumbar artery, n = 28 (6.0%); internal pudendal artery, n = 25 (5.4%); branches of the femoral artery, n = 16 (3.4%); inferior epigastric artery, n = 13 (2.8%); deep iliac circumflex artery, n = 7 (1.5%); other arteries in the pelvis, n = 3 (0.6%); and other arteries outside the pelvis, n = 31 (6.7%). Twenty (12.3%) patients needed embolization outside the pelvis (Table 3). Gelatin, n-butyl-2-cyanoacrylate (NBCA), and coilings were used as embolic materials. The data are summarized in Table 3. Three patients (1.9%) underwent secondary TAE for hemostasis, and two patients (1.2%) underwent PPP after primary TAE (Table 4). Sixty-eight patients (42.0%) underwent surgical management for pelvic fractures, including external fixation in 16 patients (9.9%) and internal fixation in 61 patients (37.6%). The median hospital length of stay was 26 (IQR: 11–41) days. The reason for death was unstable hemodynamics in five patients (3.1%), severe head trauma in nine patients (5.6%), unstable hemodynamics and severe head trauma in three patients (1.9%), and other reasons including sepsis or respiratory failure in eight patients (4.9%). Patient outcomes are summarized in Table 5.

Age, gender, and parameters that could influence the decision-TAE time on arrival were aggregated in every IQR and statistically tested (Table 6).

Discussion

The primary finding of this research was that a longer decision-TAE time resulted in a higher risk of mortality. Moreover, although the actual TAE duration did not have a statistically significant influence on decision-TAE time, the interaction between TAE duration and decision-TAE time was statistically significant, indicating that TAE duration modified the effect of decision-TAE time on mortality.

In this study, we excluded 10 patients who underwent TAE after PPP because this may have influenced the effects of TAE on hemostasis. In contrast, we included patients who underwent TAE before PPP to reveal the effects of “primary” TAE. As a result, five patients (3.0%) needed secondary TAE or PPP for better hemostasis, three (1.9%) for secondary TAE, and two (1.2%) for PPP. In previous reports, PPP and TAE have been reported as “complementary procedures” to stop bleeding [[15, 16]]. Even if they are complementary [15,17], PPP and TAE could be effective strategies for selecting alone or combined strategy depending on the situation.

Some reports have suggested the importance of early TAE for improving mortality [4,13,14,18]. In clinical settings, there are many variations in the circumstances surrounding patient delivery to the ER and the condition of the patient upon delivery. These variables include the presence of associated injuries and the severity of said injuries and differences in vital signs. Moreover, they may or may not have been transferred from another hospital and they may have received previous treatment by prehospital medical professionals. Physicians must decide upon a treatment plan for these patients taking into consideration these factors. Based on these considerations, the true effectiveness of shortening the delay to TAE administration can be confirmed by analyzing the time from when the decision to administer TAE is made to when the TAE is performed and its effect on outcomes.

Several studies have reported that the time to angioembolization is longer than time to PPP, which may be in part due to the availability of orthopedic surgeons compared to interventional radiologists [7,10,19], and TAE may be delayed at night or on weekends based on reports on other catheter-based interventions [14,20,21]. In our institution, interventional radiologists and the equipment required for TAE are available 24 h a day, 365 days a year. Therefore, the availability of staff and/or equipment was not an issue in the present study. The overall decision-TAE time was 59.5 min, even after performing the other resuscitation procedures. Although PPP still may have advantages in terms of an earlier start time compared to TAE [7,10], most patients with pelvic fracture, even if they are unstable, can be managed with primary TAE strategies.

In our facility, we aim to finish TAE, including treatment of other bleeding injuries, within 60 min. Although we could not directly clarify the relationship between TAE duration and mortality, our intervention analysis showed that TAE duration modified the effect of decision-TAE time on mortality. From these results, the combination of a longer decision-TAE time and shorter TAE duration could have a negative impact on mortality. This indicates that when there was a delay before TAE (often due to hemodynamic instability), the interventional radiology specialists must have finished TAE in a shorter time, and this resulted in a higher risk of mortality. In these situations, physicians may decide to change to PPP for faster hemostasis.

We could not confirm the factors that influenced decision-TAE time, except for hospital transfer in the DT group (Table 6). Based on these results, the expected parameters that could influence the severity of the patient’s condition, such as ISS, vital signs, and even associated injuries, were not related to decision-TAE time. In addition, transferred patients underwent faster TAE. These results might indicate that faster CT scanning can reduce the decision-TAE time, and therefore, the development of faster imaging strategies is essential. Recently, there have been reports on the effectiveness of hybrid emergency room systems [22,23], hybrid operation rooms [24], and mobile angiography systems [25] for trauma patients. These systems consist of an angiography-computed tomography (CT) machine in a trauma resuscitation room and have the potential to provide new evidence in this field.

This study had several limitations. First, the performance of the CT scan depended on the patient’s mode of admission. This meant that we could not determine the severity of the patient's condition based on the

CT/DT stratification. Second, we could not clarify the rigid time of “decision time” which means that other definitions of decision-TAE time could be established, and the results would be changed. In fact, it is difficult to retrospectively ascertain the exact time when the decision to administer TAE is made, and we believe that the definition of decision-TAE time warrants further discussion.

In conclusion, overall survival was statistically different between the patients above and below the median cutoff value for decision-TAE time, and the longer the decision-TAE time, the higher the risk of mortality. Our results suggest that decision-TAE time may play a key role in establishing resuscitation in pelvic fracture patients, and efforts to shorten the time should be pursued.

Methods

Study design and ethics statement

This observational study used retrospectively collected data. The study adhered to the STrenghening the Reporting of Observational Studies in Epidemiology (STROBE) statement and a study protocol is available. Ethics approval was obtained from the medical ethics committee of Gifu University Graduate School of Medicine, Gifu, Japan (Institutional review board approval No. 2020-061). The need for informed consent from patients was waived by the medical ethics committee of Gifu University Graduate School of Medicine because of the retrospective nature of the study. This study adhered to the ethical guidelines for medical and health research involving human subjects established by the Japanese government.

Study setting

Gifu University Hospital (Gifu-shi, Japan) is the only advanced critical care center in this region. The region includes catchment areas populated by approximately 2 million people. Patients with pelvic injury who underwent acute TAE were included if they were admitted to the Advanced Critical Care Center (ACCC) at Gifu University between January 2008 and December 2019. The attending emergency physicians were responsible for the trauma survey and treatment of patients with pelvic injuries in the ED. Emergency physicians and interventional radiologists were involved in the decision-making process. In our institution, interventional radiologists and the equipment required for TAE are available 24 h a day, 365 days a year. Patients with OHCA without a response to resuscitation, a lack of data to calculate the time course, and those who underwent PPP were excluded.

Treatment

At the ACCC at Gifu University Hospital, we established a treatment algorithm based on the EAST recommendations [6]. Patients who could not undergo CT scan due to hemodynamic instability were directly sent for TAE. Some of these patients could not be prepared for TAE because of threatened death or PPP had just been performed, so TAE was added if needed. Other patients underwent a CT scan, and immediate TAE was initiated if necessary. If transferred patients had already undergone a CT scan and there was enough information to make a decision, additional examinations were skipped and the patient was delivered directly for TAE. The patients were treated according to the algorithm shown in Fig. 1.

Definition of parameters

Emergency physicians decided to administer TAE when: 1) the CT scan indicated massive hemorrhage from pelvic injury, or 2) the patient was hemodynamically unstable and did not undergo a CT scan, or was transferred from another hospital after the CT scan. We analyzed the time from the decision to administer TAE to the start of TAE (needling time) and called this time the "decision-TAE time." When CT scan indicated massive hemorrhage, "decision-TAE time" was defined as the time from starting the CT to TAE (CT-TAE group: CT group). When the patient did not undergo a CT scan or was transferred after the CT scan, "decision-TAE time" was defined as the time from arrival at the ED to the administration of TAE (door-TAE group: DT group) (Fig. 2). Demographic and biological data on admission were collected from medical records. The ISS and the Abbreviated Injury Score (AIS) by body area (head, chest, abdomen, pelvis, and extremities) were calculated for each patient.

Outcomes

The primary outcome of this study was the time from the end of the TAE to death. There were 10 secondary outcomes, including parameters associated with TAE (decision-TAE time, number of arteries involved in TAE, localizations, embolic materials, time of TAE administration, and number of secondary TAEs), number of patients requiring PPP after TAE, surgical management for pelvic fractures, hospital length of stay, and reasons for death.

Statistical analysis

Baseline characteristics of the patients and the outcome variables were expressed as median and interquartile range (IQR) for continuous variables, and counts and percentages for categorical variables. In the primary analysis, a Cox proportional hazards regression analysis was performed to confirm the effect of decision-TAE time on the time from the end of TAE to death. The Cox proportional hazards model was adjusted for age and sex to avoid confounding by the patients' baseline characteristics. To avoid overfitting, the number of covariates had to be limited to two [26]. Kaplan-Meier estimation was conducted to estimate the cumulative survival rate for each group divided by the median of the decision-TAE time. The difference in the cumulative survival rate between the two groups was confirmed using the log-rank test.

The effects of decision-TAE time on the time from the end of TAE to death were analyzed using a model similar to that used for the primary analysis. In addition, an interaction term (decision-TAE time * TAE duration) was incorporated into the Cox proportional hazards model to test whether the effect of decision-TAE time on mortality was modified with the inclusion of TAE duration. The hazard ratio (HR) of the 75th percentile for the 25th percentile of decision-TAE time or TAE duration with the 95% confidence interval was reported in each Cox proportional hazards analysis. The predicted HR values were obtained from the model, and interaction terms were included. Parameters that could influence the decision-TAE time on arrival were summarized for each group by dividing decision-TAE time into quartiles, and comparisons between groups were conducted using a Fisher's exact test for categorical variables and a Kruskal-Wallis test for continuous variables. Imputation was not used for missing data because no data were missing for the primary outcome. A *p*-value (two-sided) < 0.05 was considered statistically significant. There was no adjustment for multiple comparisons because all analyses were performed as exploratory. All statistical analyses were performed using R version 4.0.3 (https://www.r-project.org/).

Declarations

Funding:

None

Acknowledgments:

We would like to thank Editage (www.editage.jp/ <https://www.editage.jp/>) for English language editing of this paper.

Author Contributions:

T.M. wrote the manuscript. N.K., Y.M., M.I., T.F., T.Y., H.K., and S.Y. treated the patients. T.I. performed the statistical analysis. M.M. and S.O. supervised the study. H.O. revised and edited the manuscript. All authors read and approved the final manuscript.

Competing Interests:

The authors declare no competing interests.

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Tables

Table 1
General demographics of the pelvic fracture patients who received acute angioembolization for pelvic injury.

Factors	**No. (%) or Median(25%, 75%)** **(N = 162)**
Age(y/o)	74(61, 81)
Sex	
Male	96(59.3%)
Female	66(40.7%)
Antiplatelet drug	27(16.7%)
Anticoagulant drug	13(8.0%)
Transferred, n(%)	83(51.2%)
ISS(score)	25(16, 34)
Severe anatomic injuries, n(%)	
Head AIS ≧ 3	44(27.2%)
Chest AIS ≧ 3	56(34.6%)
Abdomen AIS ≧ 3	26(16.0%)
Pelvis AIS ≧ 3	128(79.0%)
SBP upon ED arrival(mmHg)	109(85, 132)
GCS upon ED arrival(total)	14(13, 15)
Pelvic fracture type, n(%)	
Tile OTA classification	
A1	6(3.7%)
A2	11(6.8%)
A3	3(1.9%)
B1	45(27.8%) (including associated 5 acetabular fractures)
B2	26(16.0%) (including associated 3 acetabular fractures)
B3	16(9.9%) (including associated 1 acetabular fractures)
C1	25(15.4%) (including associated 1 acetabular fractures)
C2	7(4.3%)

Factors	No. (%) or Median(25%, 75%) (N = 162)
C3	5(3.1%)
Unknown	1(0.6%)
Sacral fracture	2(1.2%)
Acetabular fracture	15(9.3%)
Indications for TAE	
1. Contrast extravasation on CT scan	136(84.0%)
2. Massive hematoma on CT scan	13(8.0%)
3. Unstable hemodynamics	13(8.0%)
DT group, n(%)	47(29.0%)
CT group, n(%)	115(71.0%)

Table 2: The multivariable Cox proportional hazards regression model adjusted for age and gender revealed that the longer the decision-TAE time, the higher the risk of mortality (HR for interquartile range (IQR, 40-86.5): 1.5, 95%CI: 1.1-2.06, p=0.01). The performed TAE time was not statistically significant (HR for IQR (39-75): 1.12, 95%CI: 0.67-1.89, p=0.667).

Multivariable Cox regression: Decision-TAE time						
	25%	**75%**	**HR**	**95%LCI**	**95%UCI**	**p**
Decision-TAE time	40	86.5	1.5	1.1	2.06	0.01
Age	61	81	1.14	0.71	1.85	0.581
Gender – female: male	2	1	0.33	0.13	0.87	0.025
Multivariable Cox regression: Performed TAE time						
Decision-TAE time	39	75	1.12	0.67	1.89	0.667
Age	61	81	1.14	0.72	1.81	0.572
Gender – female: male	2	1	0.4	0.16	1.01	0.053

Table 3

Summary of numbers of arteries performed TAE, localizations of TAE, numbers who needed embolizations out of the pelvis.

Numbers and localizations of embolizations	**N**	
Numbers of embolizations Median(25%, 75%)	162	3(2, 4)
Localizations of embolizations No. (%)	466	
Internal Iliac artery		85(18.2%)
External Iliac artery		5(1.1%)
Superior gluteal artery		57(12.2%)
Inferior gluteal artery		24(5.2%)
Sacral artery※		60(12.9%)
Obuturator artery		59(12.7%)
Iliolumbar artery		53(11.4%)
Lumbar artery		28(6.0%)
Internal pudendal artery		25(5.4%)
Branches of femoral artery		16(3.4%)
Inferior epigastric artery		13(2.8%)
Deep iliac circumflex artery		7(1.5%)
Other arteries in pelvis		3(0.6%)
Other arteries out of pelvis		31(6.7%)
Numbers who needed embolizations out of pelvis No. (%)	162	20(12.3%)
※Sacral artery includes median sacral arteries of lateral sacral arteries		

Table 4

Summary of embolic materials utilized in TAE.

Embolic Materials No.(%)			
Gelatin(G)	NBCA(N)	Coiling(C)	N = 162
+	-	-	134(82.7%)
+	+	-	3(1.9%)
+	-	+	21(13.0%)
+	+	+	1(0.6%)
-	+	-	2(1.2%)
-	-	+	1(0.6%)
NBCA: n-butyl-2-cyanoacrylate			

Table 5

Outcomes of the pelvic fracture patients who received acute angioembolization for pelvic injury (N=162).

Factors	**No. (%) or Median(25%, 75%)**
Surgical management	68(42.0%)
External fixation	16(9.9%)
Internal fixation	61(37.6%)
Mortality, n (%)	25(15.4%)
Mean hospital length of stay(day)	26(11, 41)
Reasons for death	
1)Unstable hemodynamics, n (%)	5(3.1%)
2)Severe head trauma, n (%)	9(5.6%)
3) 1) + 2), n(%)	3(1.9%)
4) Other reasons, n (%)	8(4.9%)

Table 6: Age, gender, and parameters that could influence the decision-TAE time on arrival were aggregated in every interquartile range and statistically tested**.**

Decision-TAE time	N	~ 40, N = 39[1]	40 ~ 59.5, N = 42[1]	59.5 ~ 86.5, N = 40[1]	86.5~, N = 41[1]	p-value[2]
Age(y/o)	162	73.0 (59.5, 81.0)	72.5 (59.5, 81.0)	74.0 (63.8, 83.0)	77.0 (63.0, 81.0)	0.828
gender	162					0.456
Female		12 (30.8%)	20 (47.6%)	16 (40.0%)	18 (43.9%)	
Male		27 (69.2%)	22 (52.4%)	24 (60.0%)	23 (56.1%)	
Transfer	83	30 (76.9%)	28 (66.7%)	11 (27.5%)	14 (34.1%)	< 0.001
ISS	162	21.0 (16.0, 32.0)	24.5 (13.8, 31.5)	28.0 (16.0, 34.5)	29.0 (17.0, 38.0)	0.328
GCS	162	15.0 (14.0, 15.0)	14.0 (12.0, 15.0)	14.0 (12.0, 15.0)	14.0 (13.0, 15.0)	0.051
SBP on admission	160	102.0 (80.0, 123.5)	106.0 (80.0, 120.0)	113.0 (85.0, 143.0)	114.0 (94.0, 132.2)	0.282
HR on admission	161	91.0 (75.5, 104.5)	90.5 (80.0, 105.0)	85.5 (73.5, 104.0)	89.5 (72.0, 110.0)	0.801
RR on admission	159	22.0 (18.0, 27.5)	20.0 (17.0, 24.0)	21.0 (18.0, 25.0)	22.5 (18.0, 26.5)	0.303
Antiplatelet drug	27	10 (25.6%)	9 (21.4%)	5 (12.5%)	3 (7.3%)	0.110
Anticoagulant drug	13	4 (10.3%)	4 (9.5%)	3 (7.5%)	2 (4.9%)	0.828
Indications for TAE						
Contrast extravasation	136	35 (89.7%)	32 (76.2%)	33 (82.5%)	36 (87.8%)	0.371
Massive hematoma	13	1 (2.6%)	7 (16.7%)	3 (7.5%)	2 (4.9%)	0.140
Unstable hemodynamics	13	3 (7.7%)	3 (7.1%)	4 (10.0%)	3 (7.3%)	0.959
Packing after TAE	2	1 (2.6%)	1 (2.4%)	0 (0.0%)	0 (0.0%)	0.739
Head AIS ≧ 3	43	8 (21.1%)	9 (21.4%)	11 (28.2%)	15 (36.6%)	0.368
Chest AIS ≧ 3	56	10 (25.6%)	11 (26.2%)	17 (42.5%)	18 (43.9%)	0.150
Abdomen AIS ≧ 3	26	7 (17.9%)	8 (19.0%)	6 (15.0%)	5 (12.2%)	0.830
Pelvis AIS ≧ 3	128	34 (81.0%)	31 (77.5%)	30 (73.2%)	0.640	0.186

Decision-TAE time	N	~ 40, N = 39[1]	40 ~ 59.5, N = 42[1]	59.5 ~ 86.5, N = 40[1]	86.5~, N = 41[1]	p-value[2]
[1]Statistics presented: n (%); Median (IQR)						
[2]Statistical tests performed: Fisher's exact test; Kruskal-Wallis test						
ISS: injury severity score, GCS: Glasgow coma scale, SBP: systolic blood pressure, HR: heart rate, RR: respiratory rate						

Figures

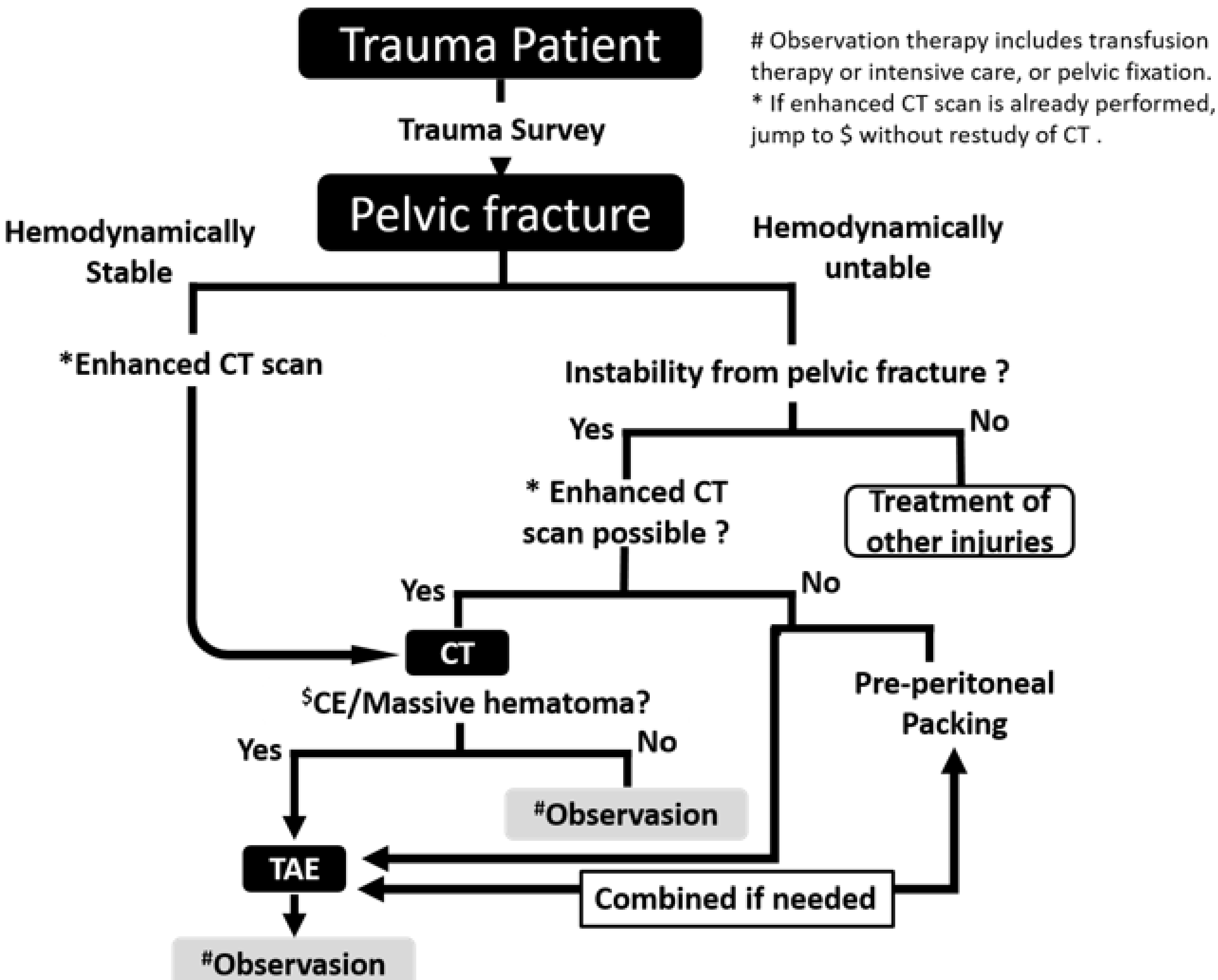

Figure 1

Treatment algorithm for pelvic injury CT, computed tomography TAE, transarterial catheter embolization

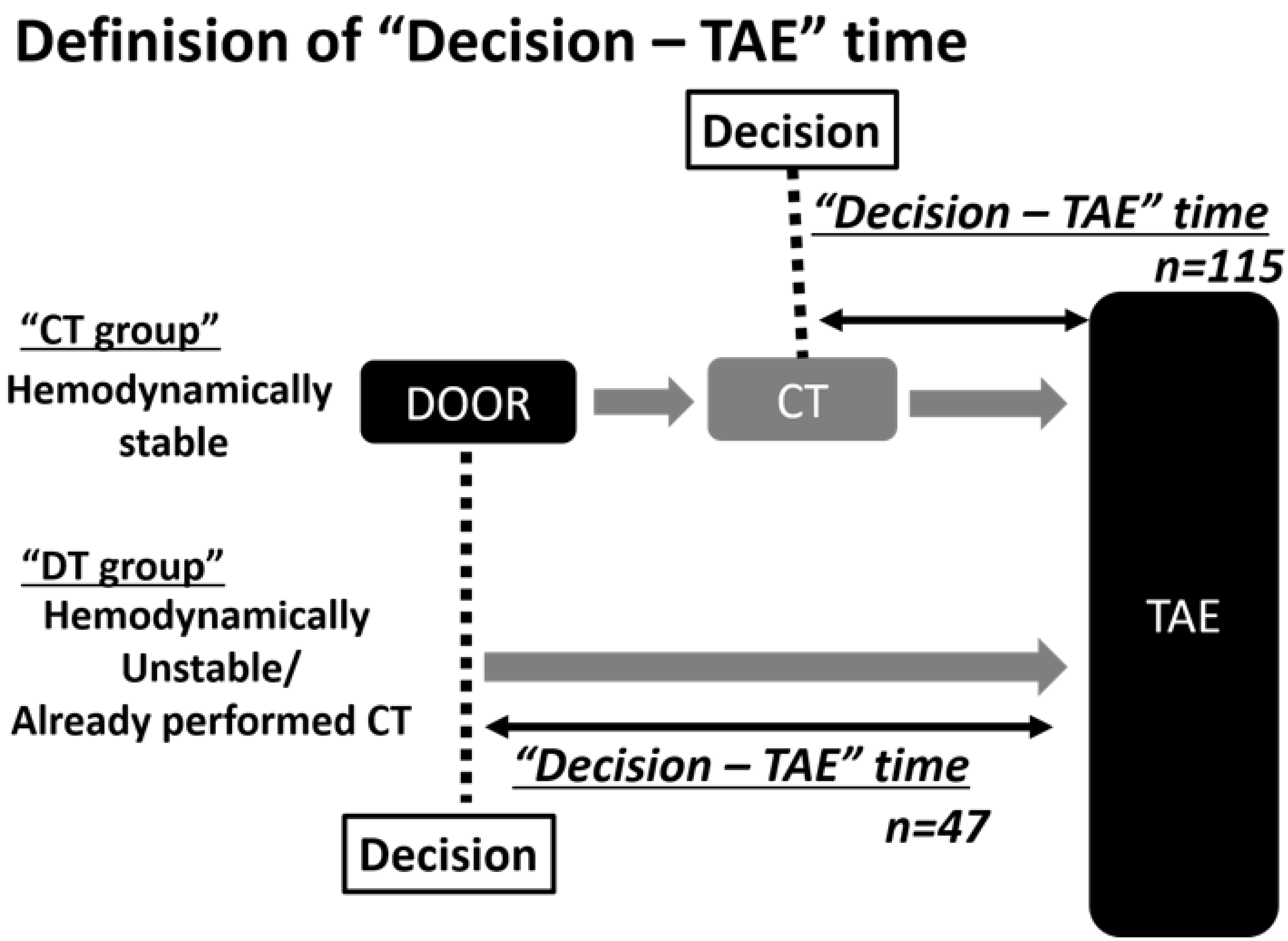

Figure 2

Definition of "decision-TAE" time In the CT (CT-TAE) group, the decision-TAE time is defined as the time from the start of CT to the administration of TAE. In the door-TAE group, the decision-TAE time is defined as the time from arrival to administration of TAE.

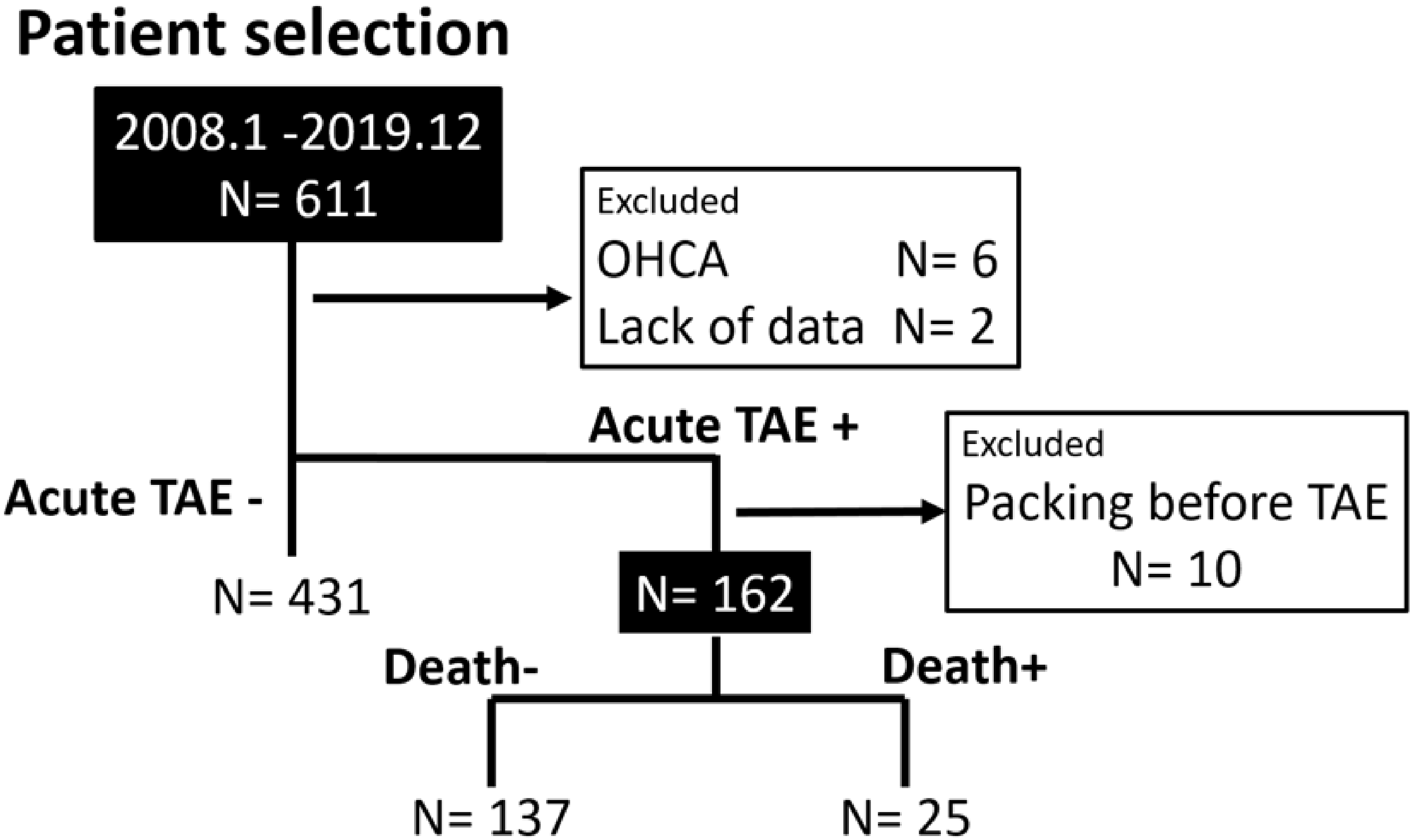

Figure 3

Patient selection Flowchart diagram of eligible patients and excluded patients. OHCA, out-of-hospital cardiac arrest TAE, transarterial catheter embolization

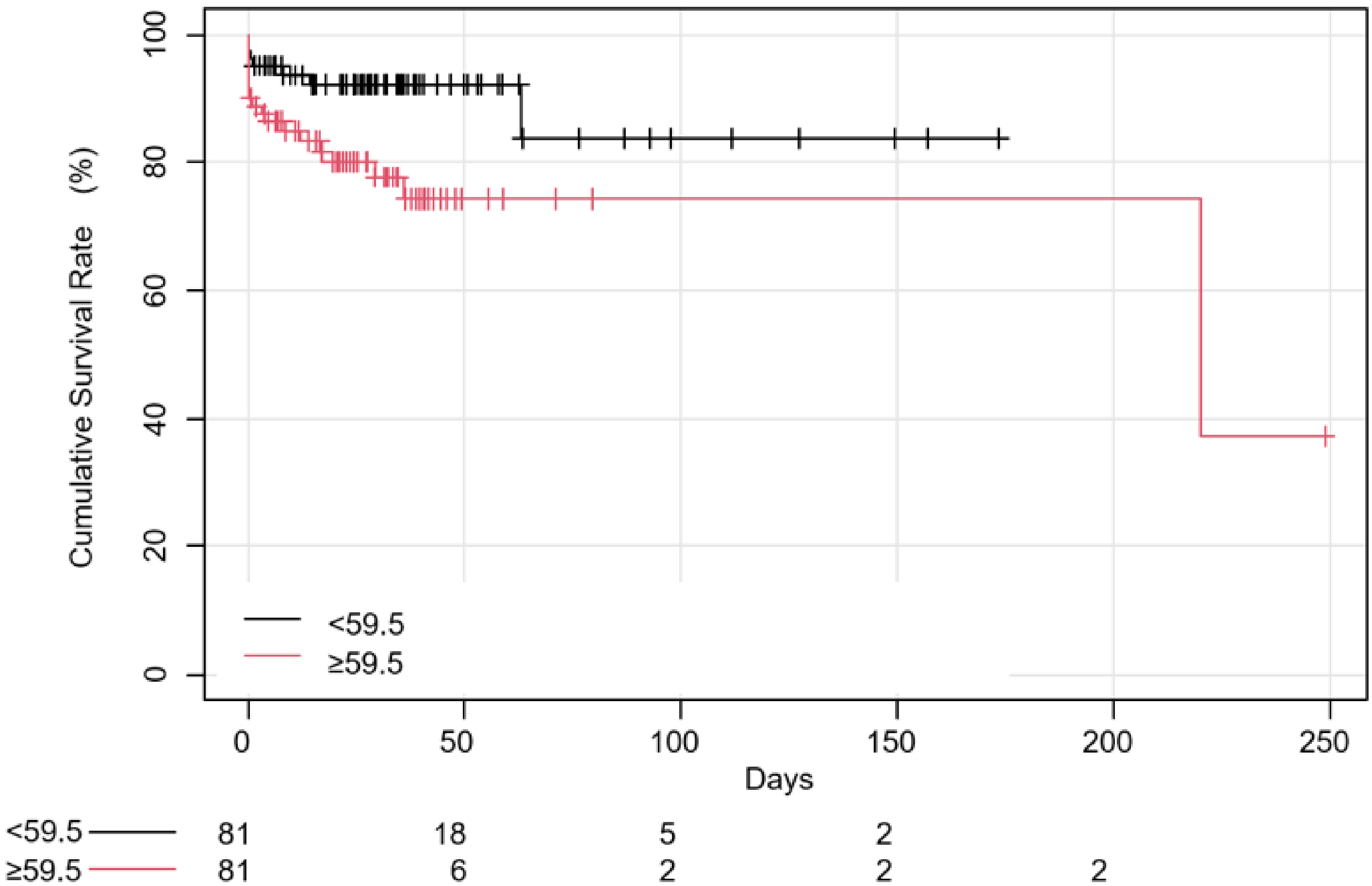

Figure 4

The Kaplan-Meier curves of overall survival The Kaplan-Meier curves of overall survival are compared, and a statistically significant difference is observed between the patients above and below the median cutoff value for decision-TAE time (p=0.02).

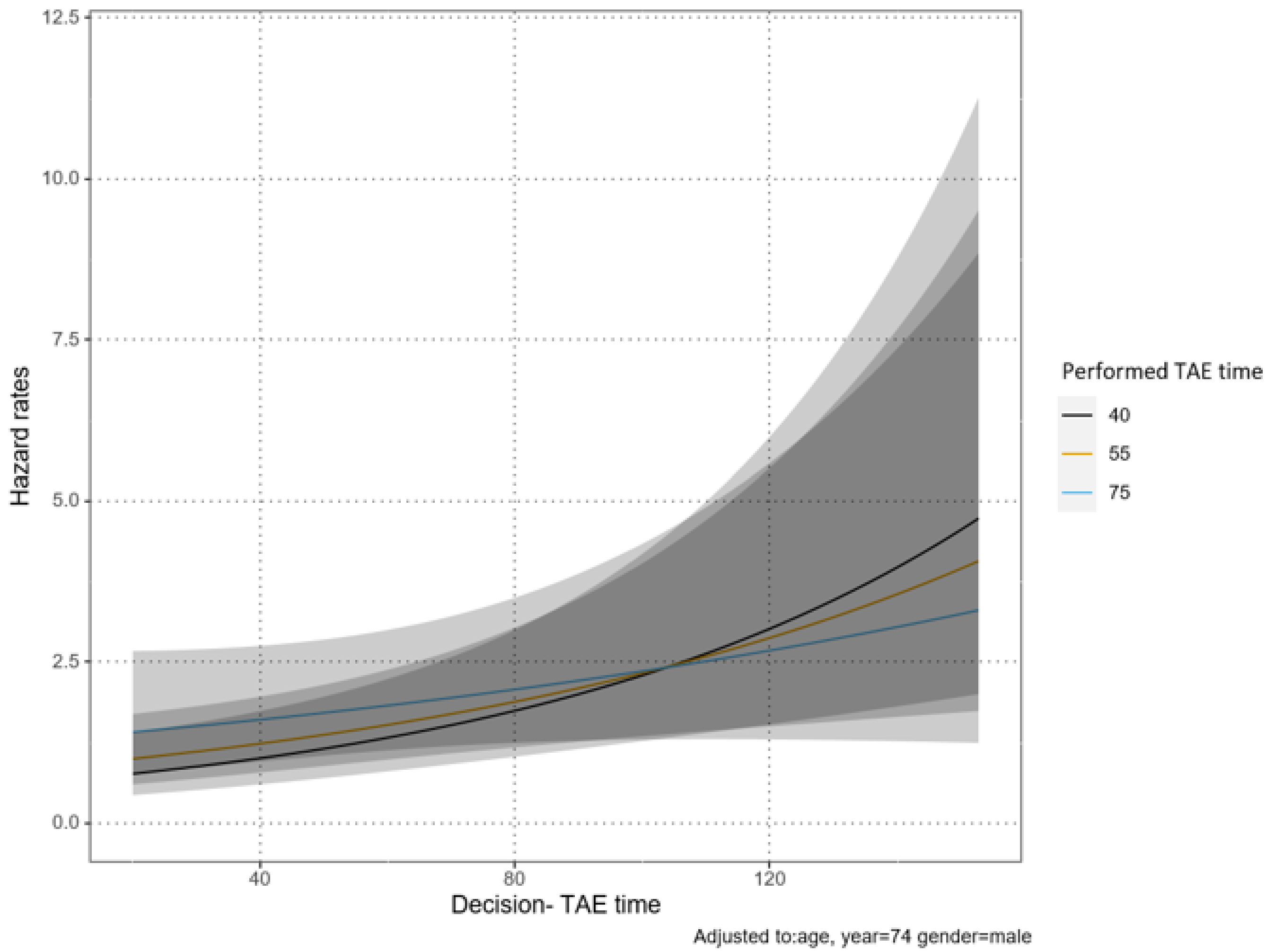

Figure 5

The interaction between TAE duration and decision-TAE time The interaction between TAE duration and decision-TAE time is statistically significant (p=0.044), indicating that TAE duration modifies the effect of decision-TAE time on mortality.