



Original Contribution

Intra-abdominal injury is easily overlooked in the patients with concomitant unstable hemodynamics and pelvic fractures



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ABSTRACT

Introduction: Transcatheter arterial embolization (TAE) is usually necessary in the management of hemodynamically unstable patients with concomitant pelvic fractures. Given the critical conditions of such patients, TAE is at times performed only according to the results of a primary evaluation without computed tomographic (CT) imaging. Therefore, the evaluation of associated intra-abdominal injuries (IAIs) might be insufficient. Clinically, some patients have required post-TAE laparotomy due to further deterioration. In this study, we attempted to determine a feasible protocol for post-TAE observation.

Materials and methods: This study focused on patients who received TAE to achieve hemostasis of retroperitoneal hemorrhage and who did not undergo CT imaging due to their unstable hemodynamics. The characteristics of patients with and without associated IAIs requiring post-TAE laparotomy were compared. We also analyzed the effects of the timing of post-TAE CT imaging on patients with IAIs requiring surgery.

Results: A total of 41 patients were enrolled in the study. Of these patients, all of whom underwent primary TAE without preprocedure CT imaging; 15 patients (15/41, 36.6%) required post-TAE laparotomy due to further deterioration. Comparisons between the 2 patient groups revealed no significant differences in the rate of endotracheal intubation (80.0% vs 65.4%, $P = .480$), loss of consciousness (66.7% vs 73.1%, $P = .730$), or abdominal symptoms (20.0% vs 23.1%, $P = 1.000$).

Conclusion: In the management of hemodynamically unstable patients with concomitant pelvic fractures, greater attention should be paid to associated IAIs. Early CT imaging is encouraged after the patient's hemodynamic status is stabilized with TAE.

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1. Introduction

Pelvic fractures are usually caused by high-kinetic-energy blunt trauma. These fractures usually occur with hemorrhage, not only from the fractured pelvis but also from the presacral venous plexus and/or the iliac vessel branches, which can result in retroperitoneal hemorrhage and subsequent mortality [1–3]. Transcatheter arterial embolization (TAE) serves as an effective alternative to surgery in the management of pelvic fracture-related retroperitoneal hemorrhage [4–6]. Previous reports have indicated that 5% to 20% of patients with pelvic fractures require TAE for retroperitoneal hemostasis [7,8]. However, in many cases, pelvic fracture occurs concurrently with

injuries to other organs. Past studies have reported that up to 16.5% of patients with pelvic fractures have associated intra-abdominal injuries (IAIs) [9]. Although the principles of managing blunt abdominal trauma have shifted to nonoperative management since the advancement of treatment concepts and improvements in diagnostic modalities, laparotomy for IAI is still necessary in some clinical situations [10,11]. Therefore, early diagnosis of associated IAI and detection of the necessity of further laparotomy are both necessary in the management of patients with pelvic fractures.

According to the concept of Advanced Trauma Life Support guideline, the controlling of life-threatening hemorrhage takes priority over the treatment of other injuries. Furthermore, the definitive hemostasis should be decided and performed primarily for the patients with unstable hemodynamics under such critical condition. Therefore, when the cavitory hemorrhage, which requires operation, is excluded by the primary examination (sonographic examination), the TAE should be considered for the retroperitoneal hemorrhage in the patients with concomitant pelvic fracture and unstable hemodynamics [12,13]. For most of these patients, conservative management, consisting of observation in the intensive care unit (ICU), is

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appropriate after TAE. However, some patients still require post-TAE laparotomy due to further deterioration.

This study seeks to determine the characteristics of hemodynamically unstable trauma patients with pelvic fractures who undergo TAE. Furthermore, we attempt to determine any differences in patients who underwent post-TAE laparotomies to those who did not. Finally, whether time to computed tomography (CT) impacted on patient management is also discussed.

2. Materials and methods

From May 2008 to September 2012, the trauma registry and medical records of patients with pelvic fractures were reviewed retrospectively. In our institution, the in-house trauma surgeons provide the primary survey and resuscitation, according to the Advanced Trauma Life Support for trauma patients in the emergency department (ED) [14]. The operating room was available 24 hours per day, and a TAE procedure could be performed within 1 hour. Attending physicians (trauma surgeons and interventional radiologists), appropriate facilities (monitors and rapid-transfusion sets), and a blood bank were available during the procedures.

During the 53-month investigational period, hemodynamically unstable patients with concomitant pelvic fractures were recruited. *Hemodynamic instability* was defined as systolic blood pressure less than 90 mm Hg without a response to fluid resuscitation of 2000 mL. All such patients were treated using our established protocol (Fig. 1). They received a detailed abdominal physical examination and a sonographic examination during resuscitation. Sonography, performed by attending trauma surgeons, was used as an adjunct to the primary survey to evaluate patients for intra-abdominal hemorrhages [14]. The results of the sonographic examination were used to determine the necessity of laparotomy. Laparotomy was performed immediately in patients with positive sonographic examinations that indicated intra-abdominal hemorrhages [15,16]. In

contrast, if hemoperitoneum was excluded by the sonographic examination, the patients received immediate angioembolization for hemostasis [12,13].

This study focused on patients who received TAE for hemostasis of retroperitoneal hemorrhage without undergoing a primary CT scan due to their unstable vital signs. The patients' demographic characteristics, Abbreviated Injury Scale (AIS) scores of the pelvis, Injury Severity Score (ISS), numbers of blood transfusions in the ED, hemodynamic status, levels of consciousness, hemoglobin levels, urine output, and intra-abdominal pressures (IAPs) were recorded routinely in the ICU. The characteristics of patients with and without associated IAI's requiring post-TAE laparotomy were compared. The role of post-TAE CT imaging was discussed and delineated. Furthermore, the effects of the timing of CT imaging and further laparotomy after TAE were also analyzed.

All of the data are presented as percentages of patients or means with SDs. The numerical data were compared using Wilcoxon 2-sample exact test with 95% confidence intervals. The nominal data were compared using Fisher exact test with 95% confidence intervals. All of the statistical analyses were performed using the SPSS computer software package (version 13.0; Chicago, IL).

3. Results

Over the study period, 899 patients were admitted to our institution with diagnoses of pelvic fractures. A total of 69 patients had concomitant pelvic fractures and were hemodynamically unstable without responses to fluid resuscitation of 2000 mL. Twenty-eight of these patients underwent primary laparotomy due to positive sonographic examinations indicating intra-abdominal hemorrhages. The other 41 patients who were unable to receive a CT scan evaluation due to their unstable hemodynamics were enrolled in our study. These patients received primary TAE without CT imaging after intra-abdominal hemorrhage was excluded by sonographic

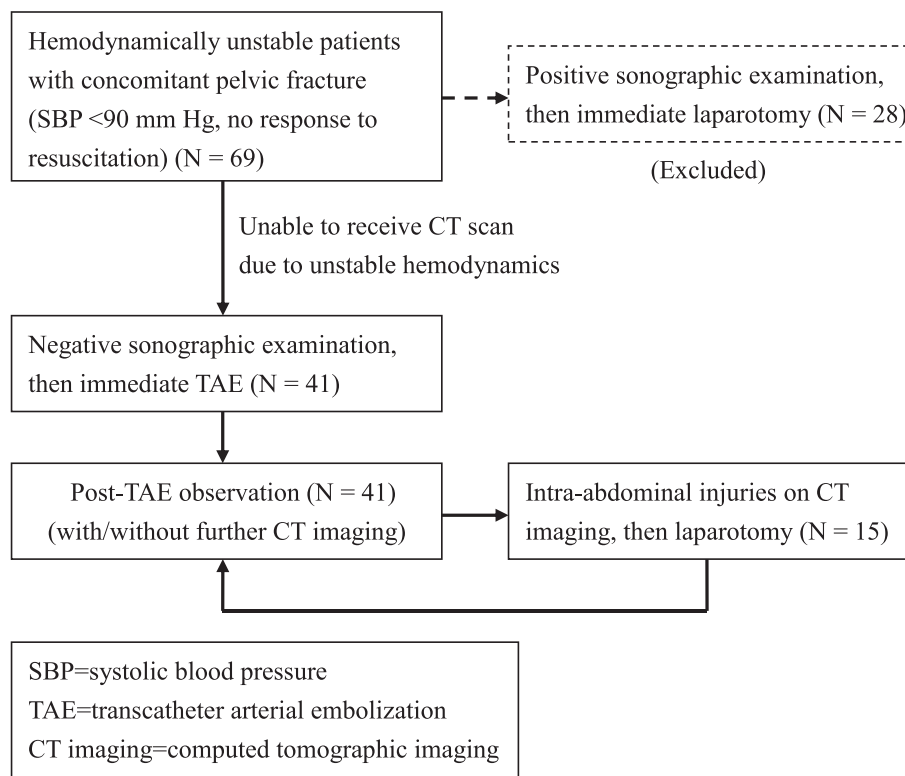


Fig. 1. The established protocol in this study for the management of hemodynamically unstable patients with concomitant pelvic fractures.

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