



Hypotension does not always make computed tomography scans unfeasible in the management of blunt abdominal trauma patients



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ABSTRACT

Introduction: Computed tomography (CT) scans have been used worldwide to evaluate patients with blunt abdominal trauma (BAT). However, CT scans have traditionally been considered to be a part of a secondary survey that can only be performed after the patient's haemodynamics have stabilised. In this study, we attempted to evaluate the role of the CT scan in managing BAT patients with hypotension. **Material and methods:** Patients who fulfilled the criteria for a major torso injury in our institution were treated according to the Advanced Trauma Life Support guidelines. The selection of diagnostic modalities for patients with stable and unstable haemodynamics was discussed. Furthermore, patients with hypotension after resuscitation who were administered haemostasis procedures were the focus of our analysis. We also delineated the influence of CT scans on the time interval between arrival and definitive treatment for these patients.

Results: During the study period, 909 patients were enrolled in this study. Ninety-one patients (10.0%, 91/909) had a systolic blood pressure (SBP) <90 mmHg after resuscitation. Fifty-eight of the patients (63.7%) received CT scans before they received definitive treatment. There was no significant difference in the CT scan application rate between the patients with and without hypotension after resuscitation (63.7% vs. 68.8%, $p = 0.382$). Among the 79 patients with hypotension after resuscitation who underwent a haemostasis procedure (surgery or angioembolisation), there was no significant difference in the time between arrival and definitive haemostasis between the patients who received CT scans and those who did not (surgery: 57.8 (standard deviation (SD) 6.4) vs. 61.6 (SD 14.5) min, $p = 0.218$; angioembolisation: [147.0 (SD 33.4) vs. 139.3 (SD 16.7) min, $p = 0.093$).

Conclusion: The traditional priority of diagnostic modalities used to manage BAT patients should be reconsidered because of advancements in facilities and understanding of BAT. With shorter scanning times and transportation distances, hypotension does not always make performing a CT scan unfeasible.

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Introduction

Most deaths following blunt abdominal trauma (BAT) are the result of injury-induced haemorrhage. Additionally, BAT remains the leading cause of morbidity and mortality worldwide [1–3]. In addition to providing aggressive resuscitation, it is important to

identify the haemorrhage source and to rapidly achieve adequate haemostasis when treating BAT patients. Therefore, an accurate diagnostic modality with high image quality is usually required.

Advancements in imaging technology and facility integration have also been made in the past decade. An increasing number of reports indicate the necessity and importance of the CT scan in evaluating BAT patients [4–6]. In contrast to conventional X-rays, which supply limited information, a computed tomography (CT) scan can allow for the evaluation of intra-abdominal and retroperitoneal injuries [7–9]. Furthermore, haemorrhages can be evaluated using the enhanced contrast feature, and further treatments (e.g., surgery, transcatheter arterial embolization (TAE), or observation) can be decided on accordingly [7–10]. Unfortunately, haemorrhages often originate from multiple sites, which may result in unstable haemodynamics. According to the

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traditional concept of the Advanced Trauma Life Support (ATLS) guideline, CT scans are too risky for these critically injured patients [11]. The need for transportation from the emergency department (ED) to a CT room may also interrupt resuscitation during the CT scan. Another concern is scanning time, which may delay a definitive treatment. These factors present a dilemma for physicians when evaluating unstable patients who often have multiple haemorrhage foci and require precise and prompt evaluation.

Previous studies have reported the general definition of unstable haemodynamics as a systolic blood pressure (SBP) of <90 mmHg, a fluid-resuscitation requirement of >2000 ml or a blood transfusion volume of >4–6 unit within 24 h [11–13]. However, the condition of patients with hypotension in the ED seems more severe and dangerous than that of others who are able to receive a blood transfusion and be observed for 24 h. In this study, we attempted to evaluate the role of CT scans in the management of patients with concomitant BAT and hypotension. The traditional ATLS guideline concepts and priorities for selecting diagnostic modalities are also discussed.

Material and methods

From May 2008 to October 2013, we retrospectively reviewed the Chang Gung Memorial Hospital (CGMH) trauma patient registry and medical records. CCMH is a level I trauma centre that treats >25,000 trauma patients in the ED per year. Patients with BAT were the focus of this study. Patients who had significant massive external haemorrhaging (e.g., via wounds or craniofacial origins) or who had out-hospital cardiac arrest status without response to resuscitation and died in ED finally were not included.

During the 66-month investigational period, all of the enrolled patients were identified and treated according to our algorithm, which was based on the ATLS guidelines (Fig. 1). Pelvic X-ray (PXR)

and focused assessment with sonography for trauma (FAST) examinations were performed as adjuncts to the primary survey. After resuscitation with an initial fluid bolus of 2000 ml lactated Ringer's solution or normal saline solution, the patients with SBP >90 mmHg underwent a secondary survey with or without further abdominal/pelvic (A/P) CT scan examination. By contrast, emergency surgery and TAE served as haemostasis procedures for patients with a post-resuscitation SBP of <90 mmHg. Additionally, surgery (laparotomy) was performed to treat intra-abdominal haemorrhage when the FAST examination showed positive results, and TAE was applied for patients with retroperitoneal haemorrhage when PXR revealed pelvic fracture. In the rare case of a patient who had concomitant intraperitoneal and retroperitoneal haemorrhaging (with both positive FAST examination and PXR results), intra-abdominal haemorrhage surgery was given a higher priority than the treatment of the retroperitoneal haemorrhage because the intra-abdominal cavity is a relatively low-pressure space that is not affected by retroperitoneal tamponade. A post-laparotomy TAE might be decided with persistent retroperitoneal hematoma expansions intraoperatively. Patients with negative PXR and FAST examinations received persistent resuscitation in the ED or treatment for other injuries.

In our institution, a 64-slice multi-detector CT scanner is used to evaluate trauma patients. Additionally, the CT and resuscitation rooms are integrated in the same area of the ED. Patients are also transferred between the resuscitation room and the imaging study suites in a notably short time period while receiving continuous resuscitation. Furthermore, at least two physicians and two nurses are on standby in the CT room. Therefore, resuscitation procedures, such as endotracheal tube intubation and chest tube placement, can be performed simultaneously without interruption during the examination. In other words, patient safety in the CT scan room is equal to that in the resuscitation room. Additionally, surgery and TAE are available 24 h a day. Board-certified physicians (trauma surgeons and interventional radiologists), appropriate facilities

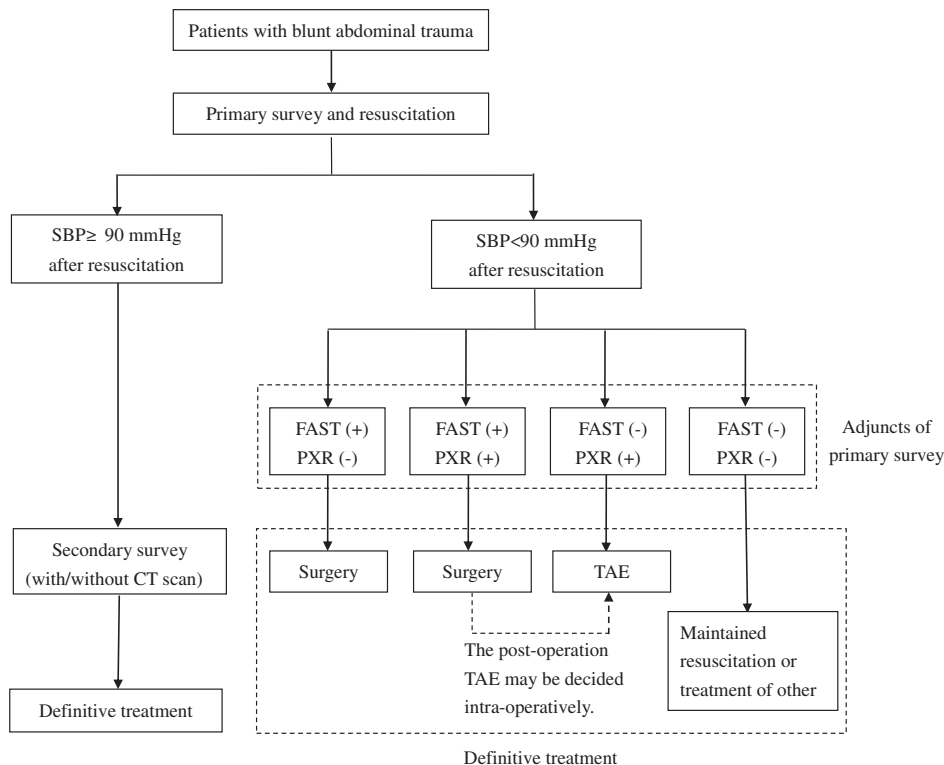


Fig. 1. The algorithm established in this study.

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