Trauma Case Reports 21 (2019) 100183

Contents lists available at ScienceDirect

Trauma Case Reports

journal homepage: www.elsevier.com/locate/tcr

Case Report

Efficiency of a pelvic circumferential compression device for continuous hemorrhage of peripheral soft tissue of the pelvis: A case report

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ARTICLE INFO

Keywords:
Pelvic circumferential compression device
Pelvic fracture
Hemorrhage shock
Acute traumatic coagulopathy

SUMMARY

Background: A pelvic circumferential compression device (PCCD) is a belt that is wrapped around a fractured pelvis and tightened with a closing mechanism. The SAM Sling® is one of the most common PCCDs used for trauma management. Although the use of the SAM Sling® for reduction and stabilization of unstable pelvic ring fracture has become the standard of care in most relevant trauma scenarios, it is not usually used for stopping continuous hemorrhage of the peripheral soft tissue of the pelvis without unstable pelvic ring fractures.
Case presentation: We report the case of a 79-year-old woman with life-threatening and unexpected continuous subcutaneous and intramuscular hemorrhage of the buttocks and groin area. She did not have unstable pelvic ring fractures but had hemorrhagic shock and acute traumatic coagulopathy (ATC). By use of the SAM Sling®, the hemorrhage was controlled, and she was eventually rescued.
Conclusions: We propose the use of the SAM Sling® to stop continuous bleeding in the state of ATC regardless of unstable pelvic ring fracture.

Background

A pelvic circumferential compression device (PCCD) is commonly used in the acute treatment of unstable pelvic ring fractures for the reduction of pelvic volume and the initial stabilization of the pelvic ring [1]. The SAM Sling® (SAM Medical Products, Newport, OR, USA) is one of the most common PCCDs [2]. Although the use of the SAM Sling® for unstable pelvic ring fracture reduction, stabilization, and lifesaving hemorrhage control has become the standard of care in most trauma situations [3–5], it is not usually used to control hemorrhage of the peripheral soft tissue of the pelvis without unstable pelvic ring fractures.

Moreover, hemorrhagic shock sometimes triggers acute traumatic coagulopathy (ATC) through the dysfunction of the coagulation cascade caused by a defect of the platelet and coagulation factors following massive hemorrhage. In this state, hemostasis of the subcutaneous hemorrhage is no longer possible, which can result in a fatal outcome. Herein, we report a case of life-threatening ATC following pelvic subcutaneous hemorrhage, which was successfully treated with the use of the SAM Sling®.

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https://doi.org/10.1016/j.tcr.2019.100183
Accepted 13 March 2019
Available online 22 March 2019

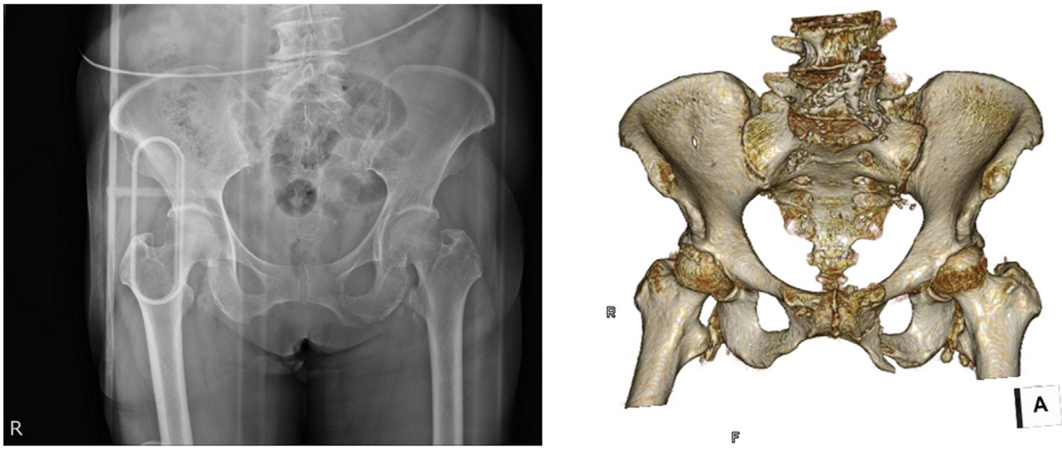

Fig. 1. Radiograph and 3D-computed tomography (CT) scan showing a stable pelvic fracture.

Case presentation

A 79-year-old woman with a history of hypertension was injured in a bicycle-car accident and transferred to our emergency department with a high-energy trauma injury. She had no history of hematologic disease or of taking antithrombotic drugs. She was 152 cm in height and weighed 55 kg. On physical examination, she had swelling of the left head. Her vital signs on admission were: Glasgow Coma Scale (GCS), E1V2M5; temperature, 35.9 °C; heart rate (HR), 124 beats/min; left arm blood pressure (BP), 119/85 mm Hg; respiratory rate, 18 breaths/min; and 100% oxygen saturation, on a 100% non-rebreather reservoir mask at 10 L/min of oxygen. Because she was in a state of hypovolemic shock upon arrival of the hospital, she was administered a transfusion of both red blood cells (RBC) and fresh frozen plasma (FFP) at the initial treatment. She was intubated because of severe cognitive impairment (GCS score ≤ 8). To detect the hemorrhage in the trunk, contrast-enhanced, total-body computed tomography (CT) scanning was performed. It revealed a traumatic subarachnoid hemorrhage, head ecchymoma, stable pelvic ring fracture (AO/OTA classification, 61-A2) (Fig. 1), and slight subcutaneous hemorrhage of the right groin area (Fig. 2a).

She was transported to the intensive care unit (ICU) after 3 h and 30 min of the treatment in the emergency room. After admission

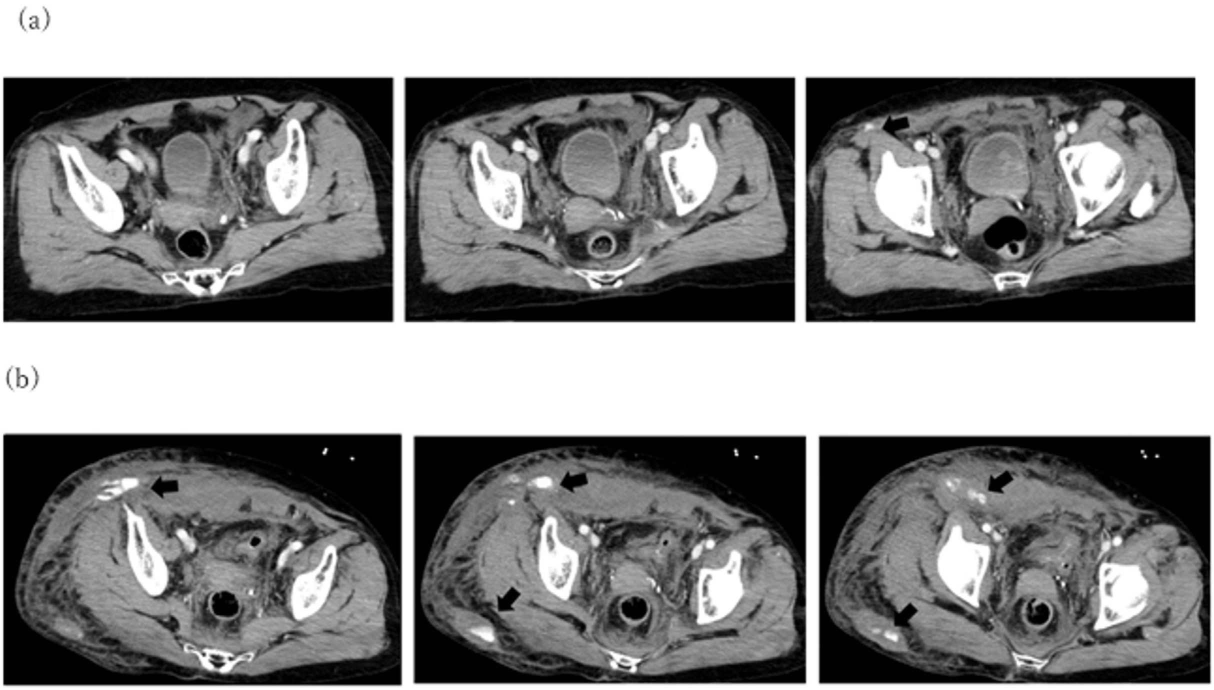

Fig. 2. (a) The initial enhanced computed tomography (CT) scan shows slight subcutaneous hemorrhage of right groin area (arrow).
(b) The other enhanced CT scan shows extravasation of both the right superficial circumflex iliac artery and right superficial epigastric artery, as well as the subcutaneous arteries of the gluteal (arrows).

Fig. 3. The SAM Sling® for circumferential compression of multiple regions of bleeding.

to the ICU, her BP gradually decreased and her HR increased, despite continuous transfusion of both RBC and FFP since her initial arrival in the emergency department. Because of insufficient improvement in both hemoglobin levels (6.5–8.0 g/dL) and vital signs (low systolic BP, 70–80 mm Hg; high HR, 100–120 beats/min), we performed another contrast-enhanced, total-body CT (Fig. 2b). Then, we found subcutaneous hemorrhage demonstrated as extravasation from the right superficial circumflex iliac artery, the right superficial epigastric artery, and the subcutaneous arteries of the gluteal. Furthermore, blood examination showed that platelet count was 1.6×10^4/μL, prothrombin time-international normalized ratio (PT-INR) was 1.25, fibrinogen was 114 mg/dL, and fibrin depredation products (FDP) were 28 μg/mL, all of which indicated that the patient was in a state of acute traumatic coagulopathy (ATC) following the hemorrhagic shock. Therefore, we promptly added platelet transfusion to her management protocol. To enhance the control of the hemorrhage in the subcutaneous tissues and muscles of the pelvis, we used the SAM Sling® for circumferential compression (Fig. 3). Her blood pressure reverted back to normal levels within about 30 min (Fig. 4). Three hours after equipping the SAM Sling®, we confirmed an improvement in hemoglobin value (10.9 g/dL) and platelet count (9.0×10^4/μL), with her vital signs stabilized. Then, we removed the SAM Sling® from the patient. Ultimately, the total time that the patient wore the SAM Sling® was 3 h and 15 min. The total transfusion values for this case were: RBC, 2240 mL; FFP, 2400 mL; platelet count (PC), 200 mL. After the removal of the SAM Sling®, we found there were no skin complications. The patient was discharged from the ICU to the ward seven days later. After that, her vital signs were stable in the ward. Although the patient was recovered from a state of the life-threatening hemorrhagic shock, eventually, she had aftereffects of left hemiparesis caused by the subdural hematoma.

Discussion

This is the first report to state the usefulness of the SAM Sling® for treating continuous hemorrhage of the pelvis without unstable pelvic ring fracture. Our usage of the SAM Sling® may not be typical, but we found it was effective for hemorrhage control in the peripheral soft tissues without complications. With regard to the initial enhanced CT findings, it was difficult to predict the subsequent continuous hemorrhage resulting in severe hemorrhagic shock and subsequent ATC. The pelvic fracture was a stable fracture and thus we could not anticipate that severe hemorrhagic shock from this fracture was a likely consequence.

In this case, we selected the non-invasive, circumferential compression by device for treating this patient because there were several bleeding sites in the subcutaneous tissues and muscles. Methods of circumferential compression include bed-sheet wrapping, internal rotation and taping of the lower extremities, PCCDs [6]; bed-sheet wrapping is the common procedure for the hemorrhage in the pelvis. We chose a PCCD because it can be installed in a short time without specialized skills and it could provide more secure compression on the hemorrhage site than bed-sheet wrapping.

PCCDs act by applying pressure onto the pelvis. Consequently, pressure is also applied on the skin overlying the pelvis and thus is associated with the risk of skin breakdown; therefore, upon achievement of hemodynamic stability, PCCDs should be removed as soon as possible to prevent this risk [7]. Tissue damage may occur if a continuous pressure exceeding 9.3 kPa is sustained on the skin for more than 2 or 3 h [2,7]. Compared with other PCCDs, some suggest the merit of the SAM-Sling® with the lowest risk of tissue damage [7]. In this case, it took 3 h to ensure that the patient recovered from the state of ATC with the evaluation of blood

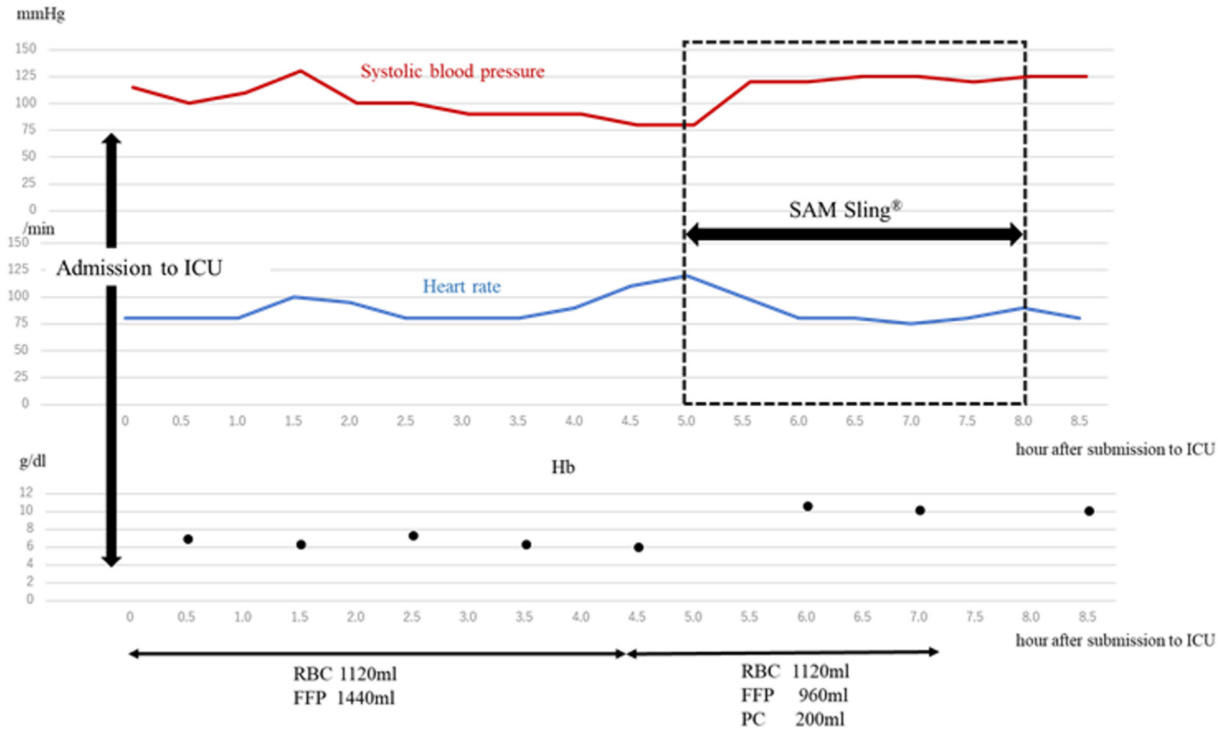

Fig. 4. Due to insufficient improvement in both hemoglobin value, according to blood gas analysis, and vital signs, we performed contrast-enhanced, total-body computed tomography (CT) scan and blood examination 4 h after admission to the intensive care unit (ICU). We applied the SAM Sling® approximately 5 h after admission and blood pressure reverted to normal within about 30 min. FFP, fresh frozen plasma; PC, platelet count; RBC, red blood cells.

examinations. Ultimately, we applied the SAM-Sling® for as long as 3 h, fortunately, no skin complications developed.

In addition to the hemorrhagic shock, the patient was in a state of ATC, which induces the deterioration of the coagulation mechanism, ultimately inducing a vicious circle of hemorrhage. ATC is an endogenous process, driven by the combination of tissue injury and shock that is associated with increased mortality and worse outcomes in polytrauma patients. Continued blood loss, hypothermia, acidosis, and hemodilution potentiate ATC, leading to a global derangement in all components of hemostasis including coagulation, anticoagulation, fibrinolysis, platelets, and endothelium [8,9]. Because the pathology of ATC rapidly worsens and becomes difficult to manage, early intervention is required. Considering that we had to administer both plasma and platelet transfusions, after unresponsive hemodynamic state to crystalloid infusion, we should have initiated the platelet transfusion earlier in the treatment course [10]. While reviewing the treatment of the patient who had critical ATC, we assumed that she could not be treated with PCCD use only. We concluded that the combined treatment, including coagulation therapy, volume addition, and PCCD use, contributed to the improvement of ATC and recovery of the patient.

Conclusions

In this report, we presented a case of successful treatment of life-threatening hemorrhagic shock accompanied by ATC caused by unexpected continuous subcutaneous and intramuscular hemorrhage in the buttocks and groin region. We conclude that the use of the PCCD was effective in the control of the hemorrhage in the pelvis, and recommend its use, especially in cases which are likely associated with ATC.

Acknowledgements

Not applicable.

Funding

No funding was required in preparation of the manuscript.

Availability of data and materials

Not applicable.

Ethics approval and consent to participate

Study approval was obtained from the Institutional Review Board at our institution. Written informed consent was obtained from the patient for publication of this case report and accompanying images.

Conflict of interests

None.

Consent for publication

Not applicable.

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