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## Spontaneous non-traumatic massive intraabdominal spleen bleeding in young females: Importance of ATLS principles and trauma alarm

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Data Collection B  
Statistical Analysis C  
Data Interpretation D  
Manuscript Preparation E  
Literature Search F  
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**Conflict of interest:** None declared

**Patient:** Female, 28  
**Final Diagnosis:** Rupture of the splenic artery aneurysm  
**Symptoms:** Hypovolemic shock  
**Medication:** —  
**Clinical Procedure:** —  
**Specialty:** Surgery

**Objective:** Rare disease  
**Background:** ATLS principles have become a standard of care for trauma patients. However, there is poor documentation in regard to spontaneous non-traumatic life-threatening bleedings.

**Case Report:** Two women, a 21-year-old and a 28-year-old, presented to the admissions department in hemorrhagic shock. The latter woman was in her 26<sup>th</sup> week of pregnancy. The trauma alarm was raised and the patients received prompt, complex diagnostics including ultrasonography verifying massive intraabdominal fluid. Massive infusion therapy was initiated. The first patient was intubated in the emergency room and required cardiopulmonary rescue due to cardiopulmonary arrest. The patients were moved to the surgical theatre for life-saving operations at 30 and 60 minutes, respectively, after arrival in the emergency department.

**Results:** In the first case, we found 4 L of intraabdominal blood and a rupture in the lower pole of the splenic capsule. Splenectomy was performed. The patient developed disseminated intravascular coagulation syndrome and was transferred to a first-level trauma centre for further treatment. She survived with slight sequelae in the form of psychosocial maladjustment, and low-grade spasms and myoclonic twitches due to prolonged brain ischemia. She was steadily improving at 17 months of follow-up. Viral mononucleosis was established as the cause of the spontaneous rupture of the spleen. In the second case, we found 2.5 L of intraabdominal blood and persistent bleeding from an aneurism of the splenic artery. A splenectomy was performed. She was transferred to a first-level trauma centre for further treatment. She lost the fetus and underwent autotransplantation of the right kidney after 3 months, due to the finding of an aneurism of the right renal artery on the abdominal CT. We also found an ectasia in the ascending aorta, which will require follow-up. The patient does not have any other sequelae and has made a complete recovery at 12 months of follow-up.

**Conclusions:** ATLS principles and trauma alarm readiness play a major role in lifesaving surgery in patients with non-traumatic hemorrhagic shock.

**MeSH Keywords:** Advanced Trauma Life Support Care • Aneurysm, Ruptured • Shock, Hemorrhagic • Splenectomy

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## Background

ATLS (advanced trauma life support) principles were designed to standardize the initial management of severely injured trauma patients. This system has become a criterion standard worldwide [1,2]. One key aspect of ATLS is the early recognition and management of hypovolemic shock [2]. There is poor documentation of the utility of ATLS in regard to spontaneous non-traumatic life-threatening bleedings.

Two relevant cases from the Telemark Central Hospital (Skien, Norway), a second-level trauma center, are presented in this report to accentuate the importance of ATLS principles and trauma alarm readiness in treatment of patients with non-traumatic life-threatening bleedings.

## Case Report

### Case 1

A 20-year-old woman presented to the admission department in hemorrhagic shock with no history of recent trauma. She used acetylsalicylic acid due to intravascular occlusion of an atrial septal defect with placement of an Amplatzer device 4 months earlier. She had symptoms of the common cold for about 1 week prior to the event, with suspected mononucleosis. She had some abdominal pain since the morning, and thereafter dizziness and nearly syncope. The patient was conveyed by the ambulance, initially conscious; thereafter, she had altered consciousness level.

She was initially conscious in the admission department, and the trauma alarm was released right away. The patient fainted instantly.

ATLS primary survey in the emergency room included: A: Free airways; B: Unstable respiration; and C: Blood pressure 80/50 mm Hg, but shortly afterward she developed agonal rhythm of 50–60 per min with no measurable blood pressure and with dilated pupils.

She was intubated, and heart compressions were initiated. Venous access in the groin and intraosseous access were established. Fluid transfusion, including 2 units of erythrocyte concentrate (SAG) was also initiated.

The focused assessment with sonography in trauma (FAST) revealed large amounts of free liquid in the abdomen, and no signs of pericardial tamponade.

Arterial blood gas measured BE –33, pH was 6.67; pCO<sub>2</sub> was 12.6; pO<sub>2</sub> was 6.2, and lactate was beyond measurable values.

Venous blood test results were Hemoglobin 9.1 g/dL; Leukocytes 85×10<sup>9</sup> /L; Platelets 144×10<sup>9</sup> /L; and Creatinine 119 umol/L.

The patient was transferred to the surgical theatre under continuing cardiopulmonary rescue and fluid resuscitation. She had a brief return of spontaneous circulation in the admissions department, then again pulseless electrical activity. The operation was initiated 30 min after admission to the hospital.

Laparotomy revealed 4 L of blood and clots, and a large rupture in the lower pole of the spleen. Splenectomy was performed under continuing resuscitation, and a defibrillation shock for ventricular fibrillation was applied during the procedure. A small retroperitoneal hematoma was revealed as well. The abdomen was packed with 6 large compresses and closed.

Adequate circulation was established after the end of the procedure.

In the postoperative period, the patient developed severe disseminated intravascular coagulation syndrome. She received 10 units of SAG, 10 units Octaplas, and 3 units of platelet concentrate (PC) during the stay at the Telemark Hospital. The patient was transferred to a first-level trauma center (Oslo University Hospital – Ullevål).

Unpacking of the abdomen was done after 24 h. She stayed 53 days at the intensive care department, plus 2 weeks at a rehabilitation department. The patient developed ischemic hepatic and renal insufficiency and coagulopathy. The highest bilirubin value was 400 μmol/L, and she required 7 weeks of continuous dialysis and 7 weeks on a respirator.

Very slow awakening, characterized by dysautonomic interference with tachycardia, hypertension, myoclonus, spastic attacks, together with postoperative cytopenia was observed. Mononucleosis was verified as a reason for the ruptured spleen.

The patient was discharged to a rehabilitation centre 1 month after admission, where she spent another month. Thereafter, she has been followed by regular ambulatory visits.

At 17-month follow-up, we observed nearly normal cognitive function, although the patient mentions some problems with memory and self-confidence. She also has not returned to her regular occupation yet. The patient has a normal renal and hepatic function. Low-grade spasms and myoclonic twitches are the only sequelae.

### Case 2

A 28-year-old woman presented to the admission department due to hypotension and near syncope. She was in her 26<sup>th</sup>

week of pregnancy. She had congenital aortic stenosis and a bicuspid aortic valve. There was no history of any recent trauma, but she recalled falling down a set of stairs 4 weeks earlier. The patient had pain in her back and upper abdomen the morning of the fall. Thereafter, she felt unwell and dizzy, and she had to sit down to avoid fainting. The patient was transported to the hospital, with remarkably low oxygen saturation.

In the admissions department, the patient was not initially admitted as a trauma patient. She was awake, alert, and oriented, but she was clammy and pale, with slight pain at palpation of the right upper abdominal quadrant. She was tachypneic and hypotensive, therefore the trauma alarm was raised. A gynecologist on duty was also summoned to the emergency department.

A primary survey in the emergency room found A: Free airways; B: Stable respiration sounds over the whole lung surface, but a respiratory rate of 25 per min; C: Unstable condition. Blood pressure was 70/40 mm Hg and pulse was 110 beats/min.

Intravenous infusion with 2 liters of Ringer solution was initiated.

FAST revealed moderate amounts of free liquid in the abdomen, mainly around the liver, and small amounts of liquid in the spleen bed and in the pelvis (Figures 1–3). The intrauterine fetus was found to be vital with a normal cardiotocography. Echocardiography did not reveal significant disturbance in the heart function. The blood tests showed hemoglobin 11.5 g/dL and leucocytes  $17.4 \times 10^9/L$

Positioning the patient on the left side increased the systolic blood pressure from 80 up to 105 mm Hg, but did not affect the pulse.

The gynecologist considered the hypotension as physiologic due to pressure of the gravid uterus on the inferior caval vein and suggested treatment with intravenous liquid, control with cardiotocography, and observation in the maternity department.

The surgeon, however, believed the patient was in a state of hypovolemic shock and, after a new drop in blood pressure, decided the patient should be transported directly to the surgical theatre. The operation was initiated 60 min after admission to the hospital.

We first performed a diagnostic peritoneal lavage, which was positive. The following laparotomy revealed 2.5 L of blood and clots, mainly in the upper abdomen. Unstable hemodynamics were observed intraoperatively. A clear source of bleeding was initially not found. The spleen and the liver were packed. Perioperative observation did not show further bleeding, and the abdomen

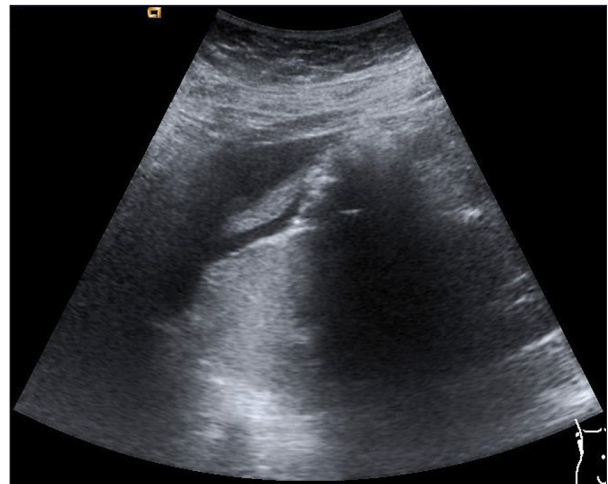


Figure 1. Fluid in the Morrison's pouch.

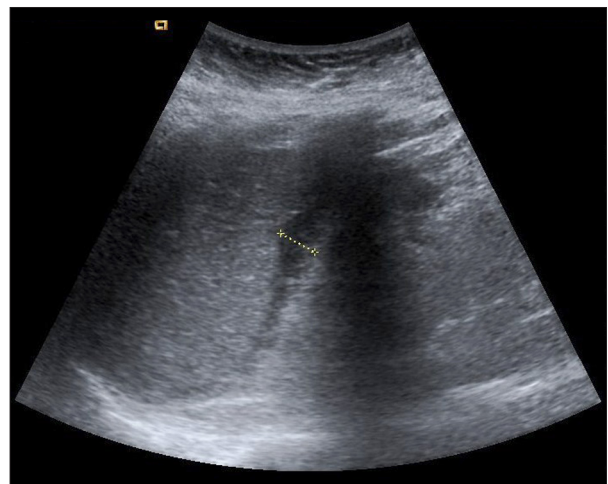


Figure 2. Fluid in the perisplenic space.

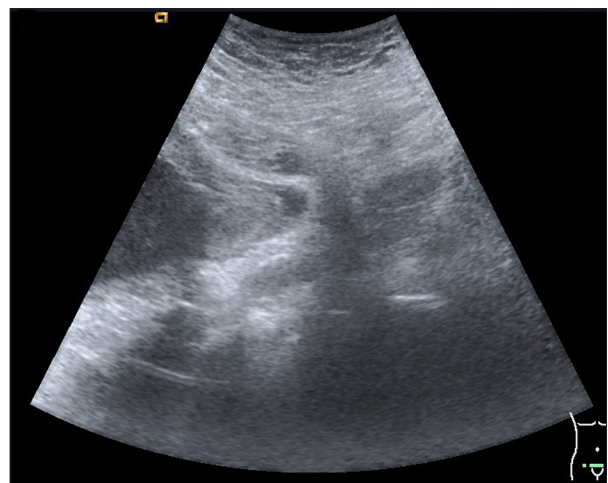


Figure 3. Fluid in the pelvis.

was closed. The patient had tachycardia and a new drop in blood pressure immediately after the abdomen closing. The abdomen

was reopened and we observed dry compresses around the liver and blood collection in the left upper quadrant. Further exploration in the upper left quadrant revealed a ruptured aneurysm of the splenic artery. We performed a splenectomy and ligation of the splenic artery in the middle part. Exploration also revealed a hematoma around the pancreas. Hemodynamics stabilized. Drainage and closure of the abdomen was done.

There was no fetal heart activity after the operation. The patient received 16 units of SAG, 12 units Octaplas, and 5 units of PC during her stay at the Telemark Hospital. The patient was observed 2 h postoperatively and was transferred to the first-level trauma center (Oslo University Hospital – Ullevål).

Computerized tomography (CT) revealed a retroperitoneal hematoma, "a horseshoe kidney", and an aneurysm of the right renal artery. We also found an ectasia of the ascending aorta, which will be subject to follow-up. Caesarian section was done 2 days after the first operation.

The patient underwent autotransplantation of the right kidney after 3 months, due to the aneurysm of the right renal artery, as seen on the abdominal CT scan.

It was concluded that the bleeding from a ruptured aneurysm of the splenic artery was responsible for the reported case.

The patient does not have any other physical sequelae and has made a complete recovery at 12-month follow-up.

## Discussion

ATLS principles have been developed since the middle of the 1970s by the American College of Surgeons as a reliable tool to assess and initially manage trauma patients [4]. These principles have been widely introduced within Europe, including Scandinavia, during the 2000s [5,6]. Different hospitals have established their own routines of medical personnel engagement, summoning, and team governing. The routines largely reflect hospital size and capacity. However, the trauma alarm assisting in prompting assembly of core relevant health professionals can also be utilized at admission of all critically ill patients, not just trauma patients.

In our hospital, the organized trauma team was established in 2001. The same year, a "trauma alarm", a designated pager with a shrill continuous sound, was introduced. In 2002 the hospital joined a national Norwegian professional network called BEST (*Bedre og Systematisk Traumebehandling* – better and systematic trauma care), which was established in 1997 [6]. It started regular training of medical staff in the ATLS principles. The composition of the trauma team has been in steady

development. Inclusion of a radiologist was an important improvement, which was initiated quite late, in 2012.

Both patients survived the above-described life-threatening hemorrhagic shock, with nearly full recovery of health, although professional and psychosocial maladjustment in the first case and the fetus loss in the second case were present as sequelae. This would not have happened in the case of a delayed or absent trauma alarm, enabling faster diagnostics and treatment of hemorrhagic shock. Hemorrhagic shock mainly occurs as a consequence of injury from trauma. Life-threatening spontaneous intraabdominal bleeding is very uncommon in patients not suffering from coagulopathy [7], although such cases with good outcomes have been reported [8–11]. However, many spontaneous, non-traumatic, intraabdominal bleedings have had fatal outcomes, including recently reported cases [12,13]. Absence of a unified systemic approach to such patients was noticed as early as in the middle of the 20<sup>th</sup> century [14]. In the vast majority of published cases, there was no mention that the patients were evaluated in accordance with the ATLS principles, and the trauma alarm was in all cases probability not utilized. Furthermore, the ATLS principles and trauma alarm readiness were not mentioned as potential tools to avoid fatal consequences of the spontaneous, life-threatening, intraabdominal bleedings. It is undoubtedly significant that awareness about the ATLS principles and trauma alarm release largely contributed to survival of the 2 two young women reported in our series.

The second case was initially considered by the gynecologist to be related to pregnancy-associated hypotension. This was credibly a cause of some delay in patient transportation to the surgical theatre. It accentuates a need to include education in ATLS principles in the obligatory curriculum of gynecology residents. This case also confirms the role of the surgeon as a team leader in evaluation of patients eligible to emergent admission under ATLS principles.

There are still many countries where the ATLS principles are still not introduced [15,16]. One may assume that in serious trauma accidents, a considerable number of human lives could potentially be saved. However, the situation with spontaneous intraabdominal bleeding is tremendously worse. The mechanism of injury itself requires the attention of medical personnel in regard to possible serious intraabdominal bleeding in patients with external injury, while patients with spontaneous intraabdominal bleedings fail to receive this attention due to the absence of trauma anamnesis.

## Conclusions

We would like to emphasize the importance of trauma alarm readiness in treatment of patients with non-traumatic

hemorrhagic shock. The international professional societies active in the field of ATLS and trauma alarm readiness, as well as international health authorities, are strongly advised to intensify their endeavors to further establishment of national trauma alarm readiness and the ATLS principles in countries which have not yet introduced such principles as a routine practice of emergency hospitals.

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## Conflict of interest statement

None.