CASE REPORT

Prehospital ultrasound detects pericardial tamponade in a pregnant victim of stabbing assault

Christian Byhahn, Tobias M. Bingold, Bernhard Zwissler, Marcus Maier, Felix Walcher

Department of Anaesthesiology, Intensive Care Medicine and Pain Therapy, J.W. Goethe-University Medical School, Frankfurt/M, Germany
Department of Trauma Surgery, J.W. Goethe-University Medical School, Frankfurt/M, Germany

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Summary

The development of handheld, portable ultrasound devices has enabled the use of this diagnostic tool also in the out-of-hospital environment. We report on a pregnant teenager who was found haemodynamically unstable after a stab assault. When she suffered cardiac arrest shortly thereafter, diagnosis of cardiac tamponade was made by portable ultrasound, and immediate pericardiocentesis was performed by the emergency physician. While her baby died after emergency Caesarean section, the teenager survived after thoracotomy and prolonged resuscitation without neurological sequelae.

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Case report

An emergency medical technician unit and a physician-staffed ambulance were dispatched simultaneously to an apartment when a caller to the police reported that he just stabbed his girlfriend multiple times. Six minutes later both units arrived at the scene. The emergency physician, a board-certified anaesthesiologist and intensivist, found a 17-year-old girl unresponsive (Glasgow Coma Scale score 7) and in severe shock. A bystander reported her to be pregnant in the 26th week of gestation. The injury pattern consisted of multiple stab wounds to the left hemithorax, three stab wounds to the upper abdomen, and some superficial cuts to the left cervical region. While no blood pressure could be recorded, the patient’s carotid pulse was weak, but palpable. The initial 3-lead ECG showed supraventricular tachycardia.

After two large-bore IV lines were inserted into the cubital veins and fluid resuscitation started, the patient’s trachea was intubated uneventfully, and a chest tube was inserted into the left thoracic cavity, immediately evacuating air and approximately 800 mL of blood. Despite these measures and continued aggressive fluid resuscitation, the patient’s vital signs declined to pulseless electrical activity.
unresponsive to adrenaline (epinephrine). For further diagnosis, a portable, battery-powered, handheld ultrasound device was used (Primedic Handy Scan, Metrax GmbH, Rottewil, Germany). Abdominal sonography revealed some free fluid in the Douglas space not explaining the patient’s poor condition. The subcostal view of the heart showed weak myocardial wall motions and significant amounts of pericardial fluid. Pericardial puncture was performed immediately with a 14G IV line using a subxiphoid approach. One-hundred milliliters of blood were evacuated, and the patient’s circulation resumed immediately. During transport to the hospital pulseless electrical activity recurred, requiring external chest compressions until arrival in the emergency room.

The patient was admitted to the emergency room 37 min after the attack. Without any further diagnostic measures, Caesarean section and median sternotomy were performed almost simultaneously, thereby continuing cardiopulmonary resuscitation. Again, significant pericardial tamponade was found, the source of which were two stab wounds to the left ventricular wall that were sutured on the beating heart. The patient returned to a stable spontaneous circulation immediately thereafter and was transferred to the operating room for explorative laparotomy. Multiple large bowel injuries and a tear in the anterior gastric wall were repaired. The patient was admitted to the intensive care unit (ICU) in a stable condition, cooled to 34.0 °C for 48 h according to recent post-resuscitation guidelines,1 and, after prolonged therapy in the ICU for various complications (septic shock, recurrent intra-abdominal infections, etc.) was transferred to a rehabilitation facility on day 31. She made a full recovery and was discharged home on day 59 after the assault. Unfortunately, her baby died on day 16 of its ICU stay due to extreme prematurity.

Discussion

Injury to the large thoracic vessels and cardiac tamponade are the leading causes of prehospital mortality in patients with blunt or penetrating chest trauma.2 While therapeutic options for aortic injuries are almost unavailable at the site of the accident, cardiac tamponade can, however, be treated temporarily by pericardial puncture even in the prehospital environment. This gains time until definitive treatment becomes available in the hospital. However, if the diagnosis of cardiac tamponade is missed initially, the patient is likely to die at the scene.3,4

With the invention of battery-powered, handheld ultrasound devices (Figure 1), a significant step towards earlier, prehospital diagnosis of abdominal bleeding and cardiac tamponade was made. Should significant amounts of fluid in the abdominal cavity be detected, treatment may be modified, i.e. restricted fluid resuscitation,5,6 load-and-go strategies, and more timely information passed to the hospital with a definitive diagnosis. Identifying significant cardiac tamponade at the scene within seconds will increase the patient’s chances of survival due to subsequent prehospital pericardial puncture and/or drainage that, most likely, would not have been performed on the basis of clinical findings alone.

Recently, it has been demonstrated that both the detection of abdominal bleeding and the evaluation of cardiac function can be achieved before hospital admission using focused abdominal sonography for trauma (FAST) and focused echocardiographic evaluation during resuscitation (FEER) to be performed in a time-sensitive manner with sensitivity and specificity for abdominal bleeding or cardiac tamponade of 93% and 99%, respectively. Changes in out-of-hospital therapy based on sonographic findings were reported in 30% (FAST) and 80% (FEER) of patients, respectively.7,8

Emergency physicians who were not familiar with abdominal and cardiac ultrasound imaging underwent training in a 2-day course7,8 that first comprised the basics of sonography and the operation of the handheld ultrasound device. Further lectures refreshed cardiac and abdominal anatomy. The main focus of the training was on hands-on training, during which every participant performed 40–50 supervised ultrasound examinations according to the FAST and FEER protocols on healthy and diseased volunteers. This training programme was based on data from previous studies that quantified a steep learning curve for FAST examinations.9,10

In the case described, the diagnosis of cardiac tamponade would not have been made based on physical examination alone, because typical clinical findings, such as distended neck veins, were missing due to severe haemorrhagic shock. Using FAST, significant abdominal bleeding could be ruled out in less than 1 min, while FEER revealed cardiac tamponade in seconds. The changes in therapy on the scene included immediate pericardial puncture, restricted fluid resuscitation, a scoop-and-run rescue strategy and providing the hospital with the diagnosis of severe cardiac injury approximately 15 min before patient’s admission. As a result, a fully equipped cardio-surgical team was present in the emergency room upon arrival of the patient, and a perfusionist on stand-by in the operating room.

In conclusion, prehospital ultrasound demonstrated its diagnostic value and immense impact on out-of-hospital management in a severely injured trauma patient. Despite the first promising results,7,8,11 further studies are required to determine whether wider distribution and availability of handheld ultrasound in prehospital emergency medicine will improve overall survival and outcome after trauma and/or cardiac arrest.
Conflict of interest statement

None to declare.

References