USCOM in the Emergency Department: Clinical Case 4

Trauma? Internal Bleeding

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The measure of life.

Rapid evaluation of haemodynamics is carried out in every emergency department in the world every single day. In the main however, this usually consists of looking at some general parameters such as blood pressure, pulse rate and perhaps oxygen saturation. Some clinical evaluation of perfusion may also be made, but how much better would it be if we knew exactly what the haemodynamics were doing. Because of the non-invasive nature of the USCOM, and the speed with which such data can be acquired, the USCOM is beautifully suited to the emergency environment. Let's take a look at a case that was presented in our own emergency department and see just how the USCOM improves clinical management of the patient.

Female 5 years old, struck by car, multiple trauma.

- Conscious, GCS 13
- Clinically shocked
- BP 65/?
- Pulse 165
- Resps 46/min
- SpO_2 93% on 4 l/min O_2

Her examination and radiographic findings were:

- Fracture - Pelvis (inferior and superior pubic rami, left side)
- Fracture - Left femur
- Fracture - Right humerus
- Fracture - Left radius and ulna
- Fracture - 5th, 6th, 7th, 8th ribs right side
- Scalp laceration, right parietal – 6cm, bleeding+
- Lacerations / contusions to both thighs
- Bruising over right upper abdomen
- Abdomen tender and guarding
- In severe pain

She was given 1 l Hartmann's at scene / during transfer. In ED, she was given N/Saline 1 l, Gelofusine 500 ml, and packed red cells (red cell concentrate) x 2, Morphine 4 mg IV + further 1.5 mg.

Her observations after 45 minutes were:

- Pulse 124
- BP (right thigh)
- 85/42
- SpO_2 = 96% (4 l/min O_2)
- The skin felt cool and she felt sweaty to the touch

Is the patient adequately volume resuscitated?

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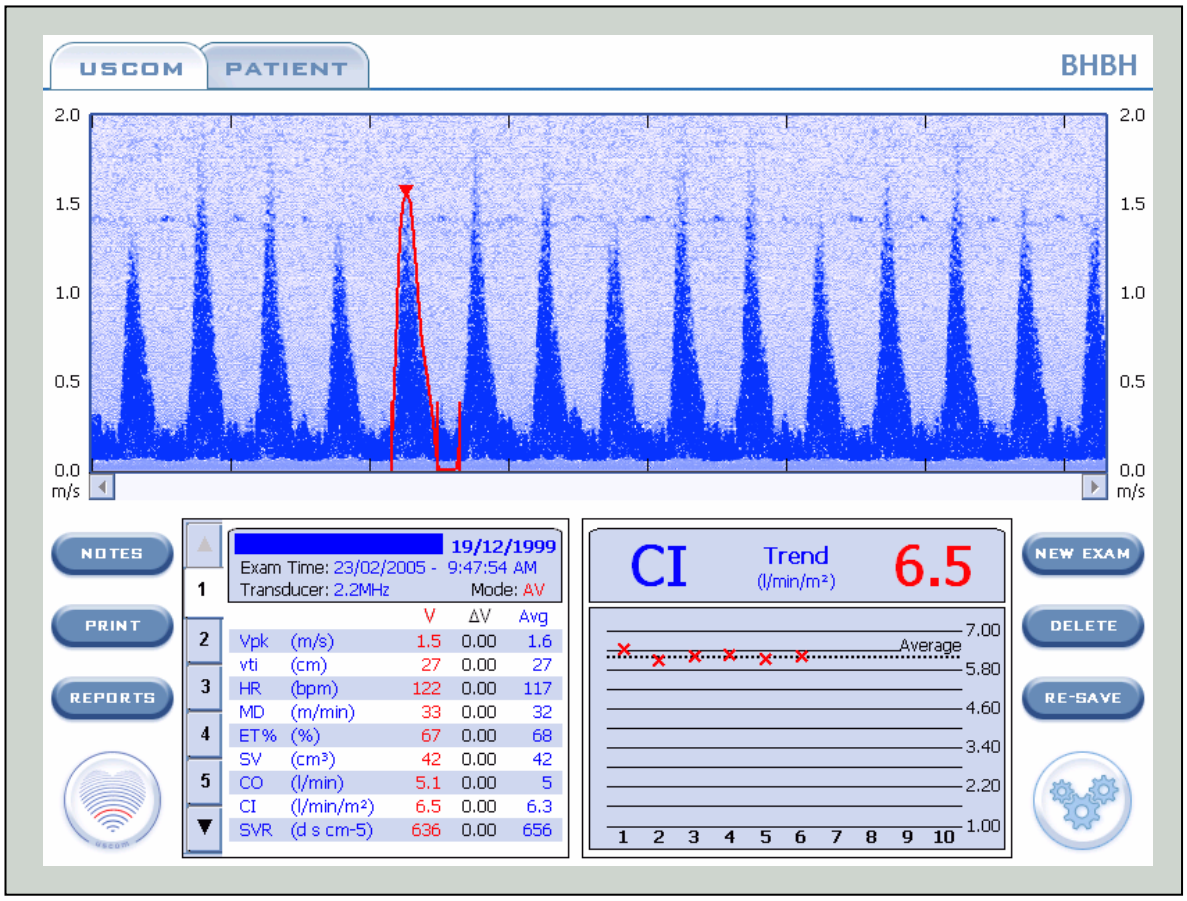

Peak ejection velocity increases with fluid loading. The normal at 5 years is 1.3 – 1.4 m/s. 1.5-1.6 m/s indicates adequate to excessive fluid loading. It also suggests a vasodilated vascular tree, as vasoconstriction produces back pressure on the ventricle (a high afterload) which limits peak ejection velocity. Mean aortic flow velocity as indicated by the MD is increased above normal, indicating a hyperdynamic circulation. Again, this suggests excessive fluid loading and vasodilation. The normal Stroke Volume is 1.5-2 ml/kg at this age. A child of this age would typically weigh around 18kg and an SV of 42 ml suggests she is "well filled".

The Cardiac Index is high and given the Stroke Volume, is more due to excessive heart rate. The SVR of 636 shows that the patient is vasodilated. This could well be due to the morphine that she has received as morphine is a potent vasodilator. Although the potential exists with these injuries for major blood loss to occur, in fact, the patient is now slightly hypervolaemic rather than hypovolaemic.

When the patient was catheterised, urine output exceeded 3 ml/kg for the next few hours. Over the first 24 hours, only 750 ml of crystalloid and 1 unit of red cell concentrate were needed to maintain normal haemodynamics and urine output. The haematocrit at 24 hours was 0.41 and Hb 142 g/l. The right lung showed patchy contusion, but no major opacification on CXR. Supplemental oxygen at 2 l/min was required for 24 hours, but no ventilatory support.

The child made a full recovery.

It would be extremely easy in a case such as this to over estimate the blood and fluid requirements for the patient. Injuries such as these could lead to virtual exsanguination of the patient if they all produced their maximum possible blood loss. In fact, in this case, the blood loss from the injuries was very much less than one might normally expect. Excessive fluid loading in this patient could well have led to significant pulmonary compromise with respiratory distress syndrome and the need for ventilatory support.
Using the USCOM to guide fluid therapy may well have prevented this eventuality, we'll never know, but it certainly made the clinical judgment of fluid requirements very much easier. Had the blood loss been on a more massive scale, then we could have used the USCOM to detect the hypodynamic circulation due to underfilling and responded accordingly. No more guesswork!

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