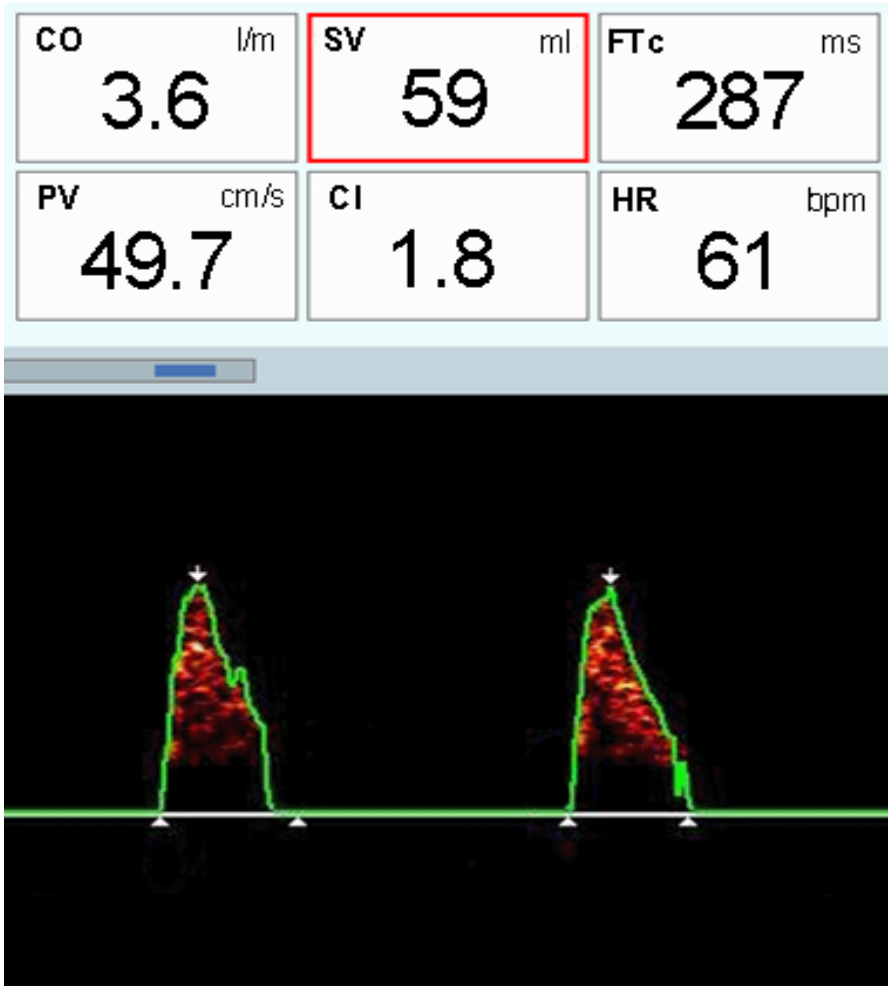
Oesophageal Doppler Monitoring identifies hypovolaemia where other indicators fail to do so

70 year old man, weight 87kg, height 178cm, BSA 2.06m2.

Postoperative cardiac surgery in cardiac recovery unit. Patient remained ventilated and sedated. BP adequate, patient warming up, urine output adequate, CVP 4mmHg.

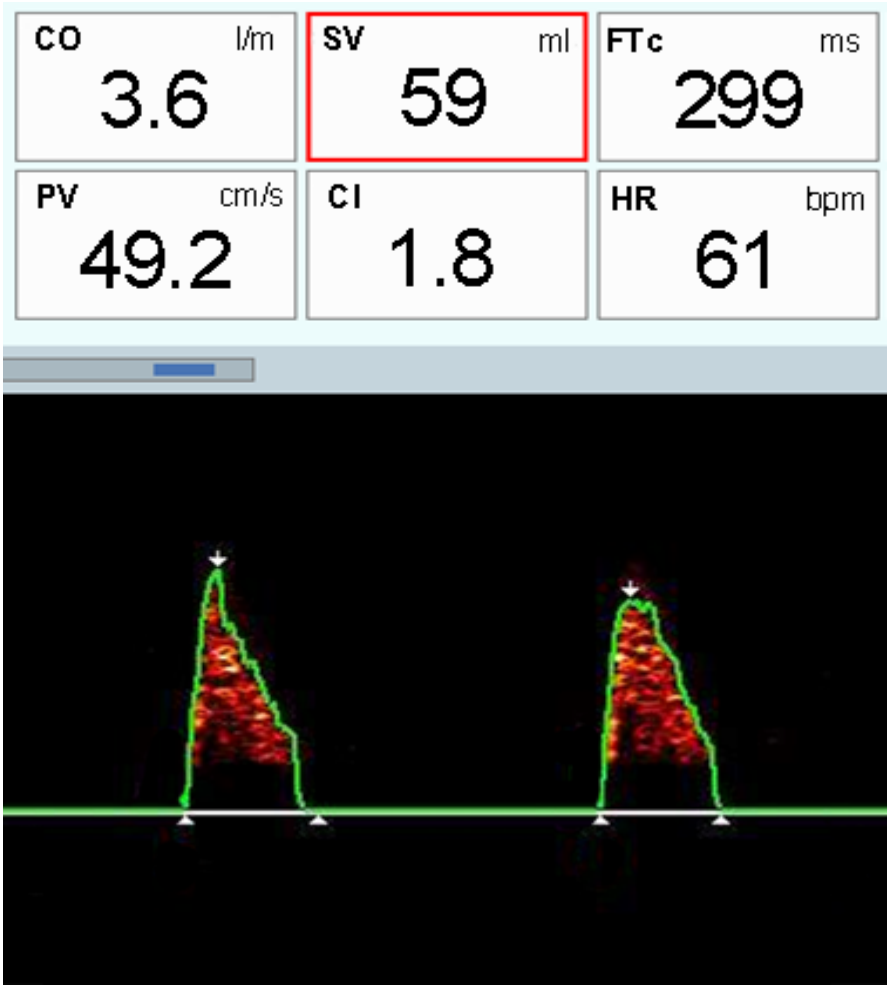
Screenshot 1 **– Baseline**



For abbreviations see Appendix 1

CO/CI low. HR not necessarily compensating CO/CI at this stage. SV low. Possible relative hypovolaemia due to vasodilating with warming/sedation. FTc low. Possible relative hypovolaemia due to vasodilating with warming/sedation. PV reduced. For a healthy individual at age 70, PV should be approximately 50-80cm/s. The clinician suspected hypovolaemia and a rapid 200ml fluid challenge was given.

Screenshot 2 - **Following a 200ml fluid challenge**



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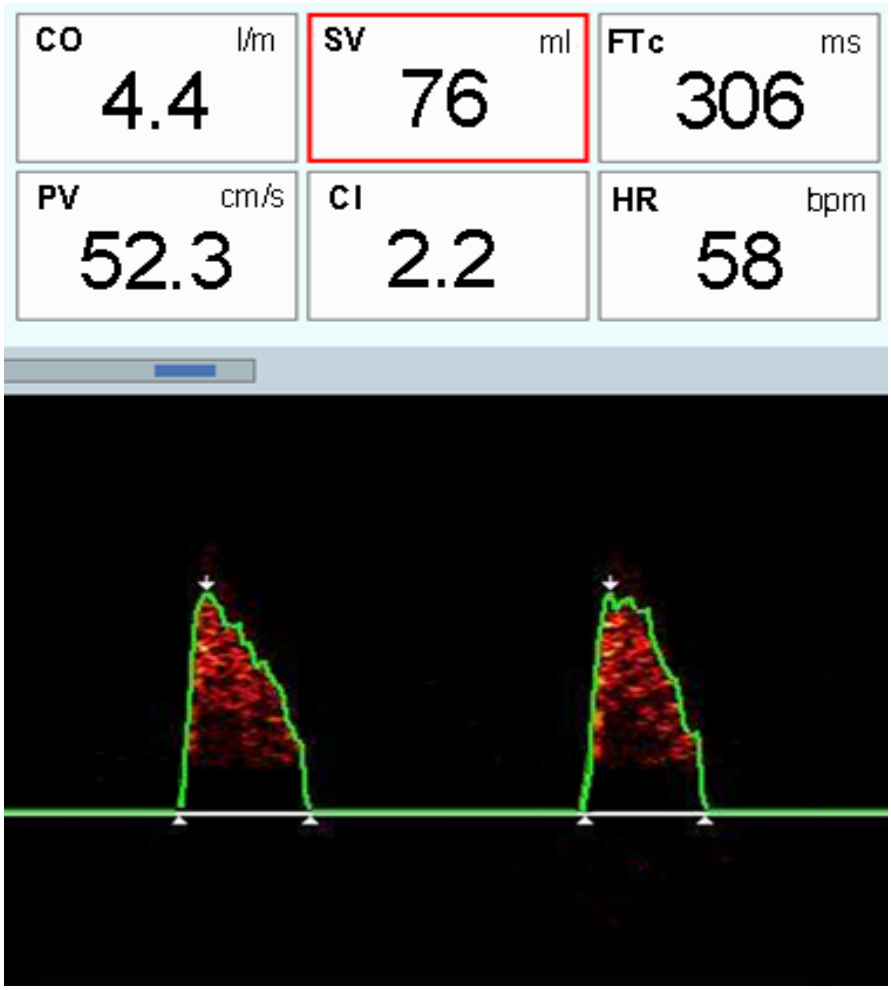
Using the Frank-Starling mechanism and following a rapid fluid challenge, SV is expected to rise by 10% or more in a fluid responsive patient. No increase in SV. CO, BP and HR unchanged. FTc increased slightly. The clinician believed that there was a sustained relative hypovolaemia because the patient was continuing to warm and therefore decided to give further fluid.

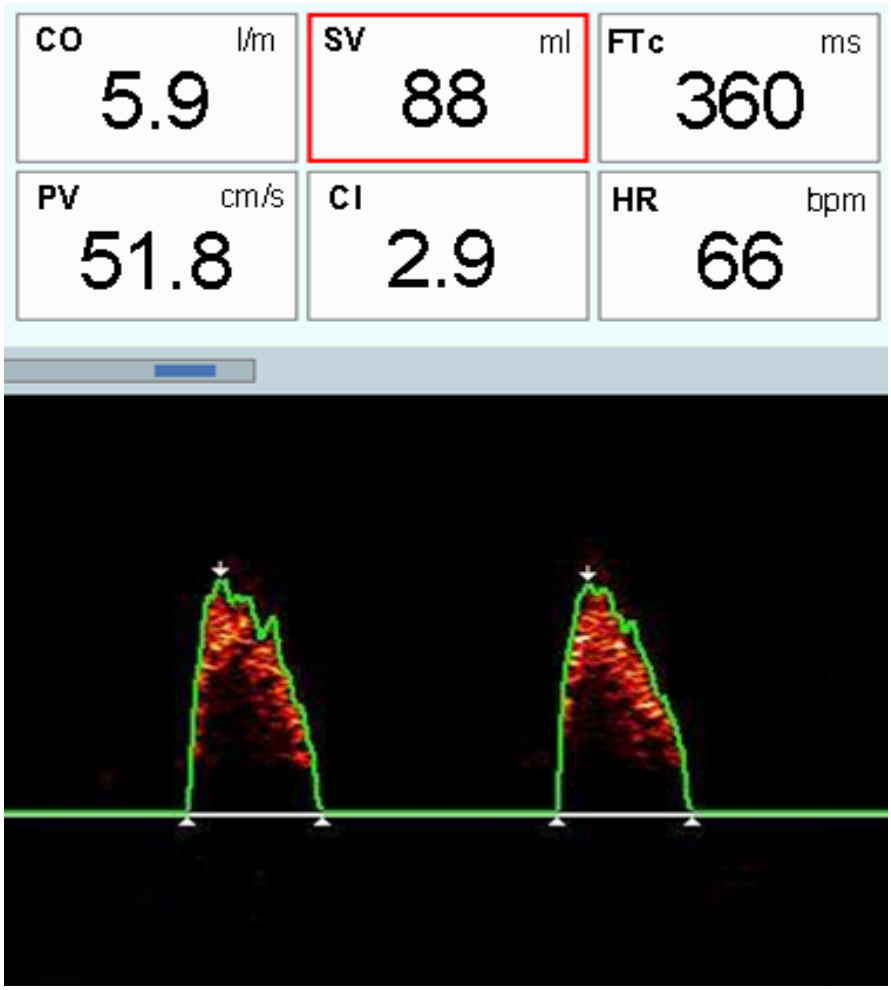
Screenshot 3 **- Following a 2nd 200ml fluid challenge**



For abbreviations see Appendix 1

SV now increased by more than 10% from 59ml to 76ml. Other ODM parameters also increasing. FTc increase is consistent with a reduction in the vasoconstriction associated with compensation therefore reducing afterload. The clinician believed that PV is increasing to match the increased preload. HR and BP are essentially unchanged. Since the SV has now increased appropriately, a further 200ml was given.

Screenshot 4 - **Following a 3rd fluid challenge**



For abbreviations see Appendix 1

SV increased by more than 10% indicating the heart was still fluid responsive.

FTc, CO and PV also continue to increase. BP increased slightly. CVP increased to 8mmHg.

Following a 4th fluid challenge, the SV did not increase by 10% and since the flow parameters, BP and HR were all now acceptable; the clinician decided not to give further fluid and reassess within 15 minutes.

Summary

Despite no changes after the first challenge, a decision to try further fluid resulted in the appropriate response. This will depend on the clinical situation as to whether to give a second bolus or not. In this case scenario, the patient was dilating due to postoperative warming. This caused a relative hypovolaemia where the circulating volume was inadequate. BP, CVP, HR and urine output did not indicate a hypovolaemic situation and responded slower to the fluid. Without this type of monitoring, the appropriate resuscitation for covert hypovolaemia would have been missed.

Appendix

Abbreviations:

CO - cardiac output	**SV** - stroke volume	**FTc** - flow time corrected	
CI - cardiac index	**SI** - stroke index	**PV** - peak velocity	**HR** - heart rate
BP - blood pressure	**CVP** - central venous pressure	**BMI** - body mass index area	**BSA**- body surface area

Doppler parameter details:

FTc - duration of flow during systole and is inversely affected by afterload. Normal range in a resting healthy individual approximately 330-360ms. If afterload is increasing, **FTc** is likely to reduce and vice versa. Most common cause of a low **FTc** is hypovolemia - a low circulating blood volume causes vasoconstriction and subsequent reduced **FTc**. A high **FTc** is seen in low resistance/afterload states such as sepsis or anaesthesia.

PV - can be a good indicator of contractility but is affected by load and age. The shape of the waveform can indicate left ventricular function - more upright waveforms usually indicate good ventricular function whereas a flatter waveform usually indicates reduced ventricular function.