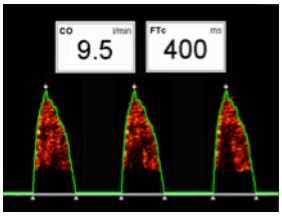
UNDER PRESSURE?

Is BP giving you the complete picture?

What is happening? What do you do next? How do you intervene without doing harm?
Choice is usually fluids, inotropes and/or vasopressors?

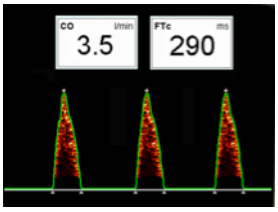
Now add in central blood flow monitoring using the oesophageal Doppler monitor (ODM) and you are able to see if the patient is in a high or low cardiac output state. **The treatment protocols for each of these two scenarios are very different despite *the same BP!***



*FTc is indicating a **low resistance/afterload** state

- Diagnosis here may be septic shock or other causes of vasodilation.
- Treatment: Challenge with fluid and/or vasopressors
  - Challenge separately to gauge CO and BP responses.

OR



*FTc is indicating an **increase in resistance/afterload.**

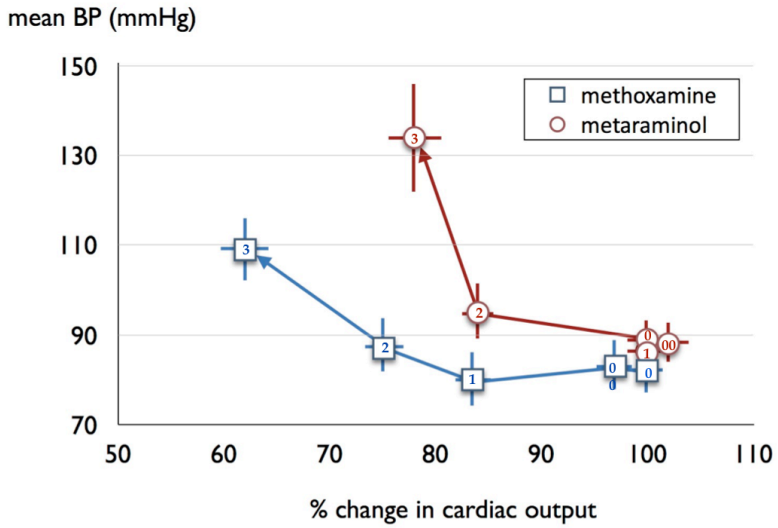
- Diagnosis here is any cause of vasoconstriction (where hypovolaemia is the most common)
- Treatment: Usually fluid first
  - Improvement?
    - Yes
      - More fluid as needed
    - No
      - More fluid if massive blood loss still present
      - Inotrope and consider dilator

VASOPRESSORS WILL OFTEN DECREASE SV ESPECIALLY IF CARDIAC FUNCTION IS POOR

"Changes in peripheral tone and blood flow re-distribution, especially in shock or in response to vasoactive drugs, affect the relationship between peripheral flow, peripheral pressure and central cardiac output. Thus the need to measure flow centrally."
M Singer, Professor of Intensive Care, UCLH. 2016.

**FTc is the duration of flow during systole. Normal for a resting healthy individual is 330 – 360 ms and is inversely related to resistance/afterload, where the most common cause of low FTc is hypovolaemia. A high FTc is seen in low resistance states.*

Dose response curve in healthy volunteers to methoxamine (alpha-agonist) and metaraminol (alpha- and beta-agonist)
[from Singer Crit Care Med. 1991;19:1138–45]



Time points 0 and 00 are baseline mean arterial pressure (MAP) and cardiac output (CO) showing constancy. 1, 2 and 3 are the increasing drug infusions. Reading from right to left, ***the magnitude and direction of change in CO does not correlate with changes in BP*** *e.g. minimal percentage change of CO at baselines (as expected) but a 13.5% drop in CO between 00 and 1 for methoxamine with a small drop in MAP, then a 10% drop in CO between 1 and 2, but with an increase in MAP etc.*

"… the fundamental problems in the circulation derive from the fact that the supply of adequate amounts of blood to the organs of the body is the main purpose of the circulation and the pressures that are necessary to achieve it are of secondary importance; but the measurement of flow is difficult while that of pressure is easy so that our knowledge of flow is usually derivatory."
Karl Ludwig 1860s.

BIBLIOGRAPHY AND FURTHER READING

- Bayliss et al. Bedside haemodynamic monitoring: experience in a general hospital. *Br Med J (Clin Res Ed).* 1983 Jul 16;287(6386):187-90. **PubMed link -** http://www.ncbi.nlm.nih.gov/pubmed/6409246
- Connors et al. Assessing hemodynamic status in critically ill patients: Do physicians use clinical information optimally? *Journal Crit Care.* **PubMed link -** http://www.jccjournal.org/article/0883-9441(87)90004-9/abstract
- Deltex Medical Ltd www.deltexmedical.com and www.dopplerdecisiontree.info
- Hamilton-Davis et al. Comparison of commonly used clinical indicators of hypovolaemia with gastrointestinal tonometry. *Intensive Care Medicine* 1997 23:276-281. **PubMed link -** http://www.ncbi.nlm.nih.gov/pubmed/9083229
- Iregui et al. Physicians' estimates of cardiac index and intravascular volume based on clinical assessment versus transesophageal Doppler measurements obtained by critical care nurses. *Am J Crit Care* 2004 *12*(4):336-42. **PubMed link -** http://www.ncbi.nlm.nih.gov/pubmed/12882064
- NHS England http://chfg.org/learning-resources/patient-safety-2030/
- NICE http://guidance.nice.org.uk/MTG3
- Patient safety http://chfg.org/learning-resources/patient-safety-2030/
- Price et al. Haemodynamic and metabolic effects of haemorrhage in man with particular reference to the splanchnic circulation. *Circulation Research* 1966 18:469-474. **PubMed link -** http://www.ncbi.nlm.nih.gov/pubmed/5937539
- Reisner. Academic assessment of arterial pulse contour analysis: missing the forest for the trees? *Br J Anaesth.* 2016 Jun;116(6):733-6. **PubMed link -** http://www.ncbi.nlm.nih.gov/pubmed/27199303
- SFAR http://sfar.org/wp-content/uploads/2015/09/2b_AFAR_ANGLAIS_Strategie-du-remplissage-vasculaire-perioperatoire.pdf
- Singer et al. Effects of alterations in left ventricular filling, contractility and systemic vascular resistance on the ascending aortic blood velocity waveform of normal subjects. *Critical Care Medicine* 1991 19:1132-1145 **PubMed** link - http://www.ncbi.nlm.nih.gov/pubmed/1679385
- Singer and Glynne. Treating critical illness: the importance of first doing no harm. *PLosMed* 2005 Jun;2(6):e167. **PubMed link -** http://www.ncbi.nlm.nih.gov/pubmed/15971943
- Singer. Oesophageal Doppler. Current Opinion in Critical Care 2009, 15:244 – 248. **PubMed link -** http://www.ncbi.nlm.nih.gov/pubmed/19417642
- Urrunaga et al. Hemodynamic evaluation of the critically III in the emergency department: A comparison of clinical impression versus transesophageal doppler measurement *Annals of Emergency Medicine* 1999 34(4):S46. **Link -** http://www.annemergmed.com/article/S0196-0644(99)80261-3/abstract
- US AHRQ https://www.cms.gov/Medicare/Coverage/DeterminationProcess/downloads/id45TA.pdf
- WHO http://www.euro.who.int/en/health-topics/Health-systems/patient-safety/patient-safety

For further information, please contact clinical@deltexmedical.com