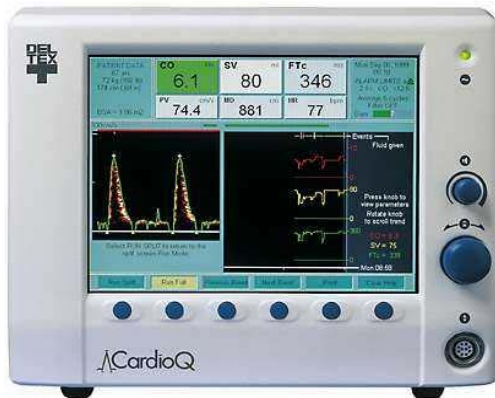


The oesophageal Doppler policy

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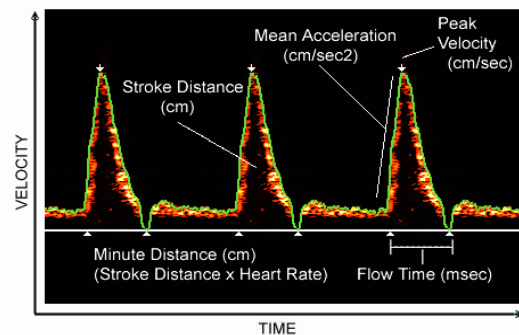


The CardioQ utilises descending aortic blood flow to provide an immediate assessment of left ventricular performance. The technology utilises a thin, disposable, latex free, silicone probe, about 6mm in diameter. The flexible, patient-specific probe is inserted into the oesophagus of an intubated or sedated patient and positioned along side the descending aorta (see figure 1). The other end of the probe is connected to the CardioQ monitoring system, and after simply entering the patient's age, weight and height, the Doppler ultrasound signal is transformed into cardiac function information.

Figure 1



Illustration of Doppler waveform



Updated by. Sam Abdul SSN ICU UCLH, prof. Mervyn Singer, Felicia Kwaku Practice Development Sister the heart hospital, Moira Mackay Research Sister, Siobhan McLernon Practice Development sister NNH, Lorna Graham Deltex Clinical Trainer.

INSERTION AND USE OF OESOPHAGEAL DOPPLER

USE & INDICATIONS:

- For use in patients with a significant change in circulatory status (e.g. drop in blood pressure.
- A reduction in urine output, or increasing metabolic acidosis) that has been unresponsive to the Unit fluid policy (up to 3x 200mls fluid challenges monitoring of CVP to a rise by 3 mmHg).
- To assess cardiac output in the patient with a failing heart & titration of vasoactive drugs (e.g. inotropes, nitrates) and other manoeuvres (e.g. changes in PEEP, fluid removal, etc.).
- To diagnose and manage patients with sepsis and other circulatory disturbances (e.g. pulmonary embolus, haemorrhage).

RELATIVE & ABSOLUTE CONTRAINDICATIONS:

- Abnormalities of the mouth, pharynx, aorta and oesophagus, e.g. oesophageal varices, gastric pull-up, maxillofacial surgery. Trans-oral surgery
- Awake patients who would not tolerate the insertion of a probe
- Coarctation of the Aorta

SPECIAL CONSIDERATIONS:

- Base of skull fractures
- Careful insertion in the patient with head injury.
- Moderate to severe coagulopathies,
- Probe needs to be removed if patient is having an MRI scan
- Probe needs to be disconnected if DC shocking
- No reading is possible on beats augmented by an IABP as this will produce a turbulent flow profile. However, the Doppler can be used to assess the volume generated by unsupported beats (if the patient is on less than a 1:1 ratio), or for assessment of underlying cardiac function when the IABP is stopped
- An epidural will dilate the lower half of the body thus changing the proportion of flow to upper and lower halves. This may affect the absolute cardiac output value but trend following is generally OK.

PREPARATION & USE:

The user needs to have had assessment and training on insertion of the oesophageal Doppler probes by an experienced user, or attend the Oesophageal Doppler training workshop.

Before insertion:

- Consider any contraindications?
- Explain the procedure to the patient and make sure they are either adequately sedated or awake and comfortable with their ET tube/tracheostomy tube

INSERTION AND SET-UP:

- Plug in and switch on CardioQ. Connect probe to the cable. Patient Data screen/Nomogram appears.
- Check the probe is new and free from damage/abrasions and test it prior to placement. You can do this by gently tapping the end and it should generate a noise through the CardioQ's loudspeaker.
- Use the control knob to select and adjust patient variables of weight (in kg), height (in cms or inches) and age. Once you have inserted the correct data, click the control knob to move onto the next variable. Ensure patient data have been entered accurately into the CardioQ as they cannot be changed once you have pressed "Accept data"
- Liberally smear tip of probe with KY jelly to ease insertion and improve contact for ultrasound waves. In most patients, insert the probe to a depth of approx. 35-40 cm, which positions the patient's teeth between the first 2 marks of the probe. In very tall or short patients the depth may need to be varied accordingly. If inserting via a nasal route, the probe needs to be inserted approx 5cm further in (i.e. between 2nd & 3rd marks located at 40 and 45cm).
- Turn both the volume button and 'gain' setting up and rotate/alter depth of probe by small adjustments until a waveform and audible signal characteristic of descending aortic blood flow appear. Once the correct signal has been found, adjust the 'gain' setting until the ideal trace has been achieved i.e. a crisply defined yellow, orange and red outline, with a black centre. The ideal signal has the clearest and sharpest pitch.

If a good trace cannot be obtained (or held), consider the following:

- Is depth of insertion correct for the height of the patient?
- Could a nasogastric or other intraoesophageal tube be 'in the way'? Twist these probes to hopefully allow repositioning of the Doppler probe
- Wait 10-15 minutes for a better contact to build up between probe tip and wall of oesophagus
- A large hiatus hernia may prevent good contact against the oesophageal wall
- Altering patient position, the signal is best obtained in a supine/semi-supine position

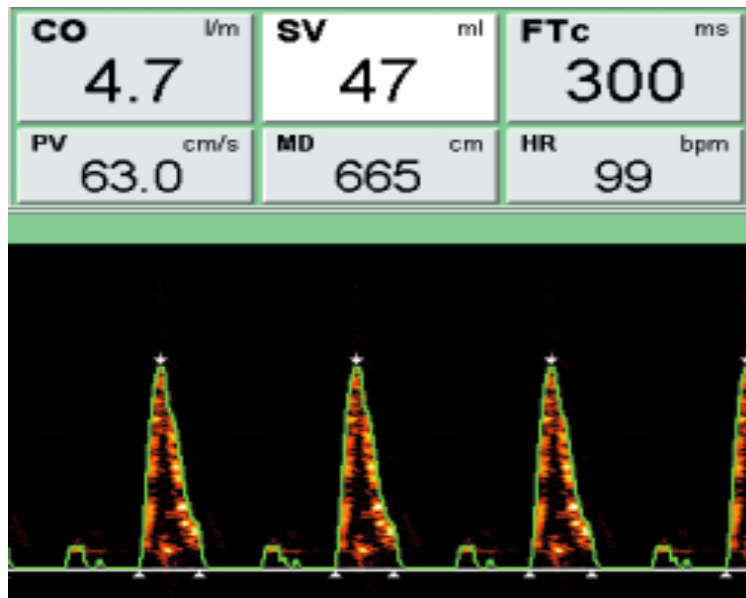
OBTAINING DATA

- Ensure a good signal has been obtained.
- Adjust scale to ensure the whole waveform appears on the screen. The normal default scale on the 'y' axis is 0-100 cm/sec. With high outputs, the scale may need to be increased to 0-200, and in low output states, reduced to 0-50. This can also be done automatically by the CardioQ – see 'Auto Gain' below.
- Press 'Run' when a good signal appears. The waveform will be outlined in green. This green line should closely follow the waveform shape with arrows placed at the beginning, peak and end of each waveform. Confirm the Doppler machine and ECG monitor heart rate readouts coincide.
- If the green line does not closely follow the waveform outline, change the gain setting as appropriate. This can be done manually or by the CardioQ which has an automatic gain optimiser. Press 'Auto Gain'. This will outline the waveform in yellow until a good trace is reached, then it will become green.
- Occasionally, low frequency noises (e.g. a vigorously opening aortic valve) will produce artefacts known as 'wall thump'. In this situation try adjusting the probe up or down to see if this artefact disappears, If not, turn 'Filter' on. Be aware that this will reduce the stroke volume and FTc measurement by approximately 10% but will enable measurement and trend following to occur.
- Occasional interference may occur from other electrical devices in the vicinity - this is seen as horizontal lines on the screen. In this case, change location of device.

Cycles

The Cardio Q is automatically set up to average data taken over 5 waveforms. This can be changed from 1 to 20 to enable measurements to be made either on a beat-by-beat basis (e.g. assessment of 'respiratory swing'), or to provide a better average in patients with fast or irregular heart rates.

Samples of Doppler traces:



Sample of hypovolaemic Doppler trace (note low FTc suggestive of vasoconstriction)



Sample of normovolaemic Doppler trace



Sample of hyperdynamic Doppler trace (note high peak velocity)

How to assess the data and waveform:

As with any monitor, data gained from the Doppler must be used in conjunction with all other patient features

FTc:

The Flow Time Corrected (FTc) parameter corrects systolic flow time to a heart rate of 60 bpm to enable the influence of heart rate to be removed. The actual flow time is the distance between the white arrows at the beginning and end of the waveform. The FTc is the actual FT divided by the square root of the heart rate (fortunately, this is done automatically by the machine!). Normal values of FTc are between 330-360 m/secs.

As the FTc is inversely correlated with systemic vascular resistance, the FTc increases when the patient is vasodilated, and falls when the patient is constricted. The commonest cause of vasoconstriction is hypovolaemia and in this situation, the FTc is a useful guide to filling status when fluid challenges are given. However, it should be stressed that there are other reasons for a low FTc, e.g., vasoconstriction from excessive pressors, heart failure, etc. Consider this if a low FTc does not improve with a fluid challenge and there is no evidence of active fluid loss.-

PV:

Peak Velocity - the apex of the waveform - is a marker of left ventricular contractility. This figure decreases with age. Normal ranges are (approximately):

- At 20 yrs 90-120cm/sec
- At 45 yrs 70-100 cm/sec
- At 70 yrs 50-80 cm/sec

CO:

Cardiac Output is the product of HR and SV. Normal ranges are 4-5 L/min

SV

Stroke Volume is the volume of blood pumped out of the heart with each beat. Normal range is 60-100 mls (decreases with age)

DO₂:

Oxygen delivery is the product of CO (l/min), SaO₂ (expressed as a fraction) and Hb (g/dl) x 10. Normal ranges are 800-1000 ml/min.

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