Esophageal Doppler to Monitor Cardiac Output: A Review

Context
For high-risk surgical patients, fluid balance is crucial to improving outcomes. Intravenous fluid replacement is essential to maintain adequate organ perfusion. If patients do not receive adequate fluids, hypovolemia (low blood volume) could lead to low blood pressure and organ failure. However, excessive intravenous fluids could trigger heart failure. Monitoring cardiac output can help to optimize intravenous fluid replacement. Cardiac output refers to the amount of blood pumped by the heart per unit time and is calculated by multiplying the stroke volume — the amount of blood pumped by the left ventricle of the heart in one contraction — by the heart rate. There are a variety of methods available for determining cardiac output.

Technology
Esophageal Doppler monitoring (EDM) is a minimally invasive procedure used to measure cardiac output. EDM is performed by placing a small probe, which emits an ultrasound beam, in the esophagus of a patient, via the mouth or the nose — usually under anesthesia. The speed of blood flow in the descending aorta is measured by the change in frequency (Doppler shift) of this beam as it reflects off of the moving blood. The speed of blood flow combined with the estimate of cross-sectional area of the aorta is used to determine the cardiac output.

Issue
Given that there are several procedures available to monitor cardiac output and optimize intravenous fluids during surgery, a review of the clinical effectiveness and cost-effectiveness of EDM-based cardiac output monitoring will help to guide decisions about its use.

Methods
A limited literature search was conducted of key resources, and titles and abstracts of the retrieved publications were reviewed. Full-text publications were evaluated for final article selection according to predetermined selection criteria (population, intervention, comparator, outcomes, and study designs).

Key Messages
For monitoring cardiac output during surgery:
- No evidence was found comparing EDM with methods using an arterial line or arterial catheter.
- Evidence suggests that EDM strategies may reduce length of hospital stay, complication rates, and mortality compared with strategies using central venous pressure (CVP) monitoring or non-invasive conventional clinical assessment (CCA).
- Strategies with EDM, together with CVP or CCA, appear more cost-effective than CVP or CCA alone, or CCA and CVP combined.

Results
The literature search identified 153 citations: 18 articles were selected for full-text review and 5 articles were identified from grey literature. Of these 23 articles, 8 met the inclusion criteria: 1 health technology assessment, 2 systematic reviews, 2 randomized controlled trials, 2 non-randomized studies, and 1 cost-effectiveness study.