

# Experience with esCCO in Surgery in Elderly Patients

esCCO is a new parameter to estimate and continuously display cardiac output (CO) and stroke volume (SV) by using pulse waves obtained by pulse oximetry, electrocardiograms, and blood pressure\* on a biological information monitor.

\*Either invasive or non-invasive measurements of blood pressure may be used. This report describes the hemodynamic management with monitoring of esCCO during surgery in elderly patients.

Chief, Department of Anesthesiology,  
Ube Kosan Central Hospital,  
Yamaguchi, Japan

**Yasuhiro Morimoto, MD**



## Background

Elderly people are generally known to have an increased risk associated with anesthesia due to age-related multiple underlying diseases or decreased defenses against invasion. Therefore, careful monitoring of patient status is important in the anesthetic management of the elderly patients.

Estimated Continuous Cardiac Output (esCCO) is a non-invasive continuous cardiac output monitor that uses the negative correlation between stroke volume (SV) and Pulse Wave Transit Time (PWTT), which is determined on the time from the ECG R-wave to the rise point of the pulse oximeter wave and provides a continuous display of hemodynamic changes.

In addition, the cardiac index (CI) and stroke volume index (SVI) can be simultaneously measured as the Estimated Continuous Cardiac Index (esCCI) and Estimated Stroke Volume Index (esSVI), respectively.

esCCO requires calibration at the start of measurement. Calibration can be performed in two modes: a mode using values obtained by other CO measuring devices and a mode using patient information. Pulse pressure is involved in both modes. This report describes cases of brain and colon resection surgeries in which hemodynamics was managed with monitoring of the esCCO, which was calibrated using patient information and radial artery pulse pressure.

## Case

### Case 1

A 68-year-old man with a height of 170 cm and a body weight of 64 kg was scheduled to undergo superficial temporal artery—middle cerebral artery anastomosis. Although the patient had no other concurrent conditions than hypertension, careful management was necessary for the hemodynamic changes during general anesthesia because of a history of repeated episodes of cerebral ischemic symptoms. Anesthesia was introduced with propofol and maintained with sevoflurane and remifentanyl. During the surgery, the systolic blood pressure was maintained at  $\geq 100$  mmHg, but the esCCI was decreased to 1.9 L/min. Continuous infusion of dopamine was therefore initiated at 5  $\mu\text{g}/\text{kg}/\text{min}$ . Following the initiation of dopamine, the esCCI increased to  $\geq 2.2$  L/min. The recovery after general anesthesia was rapid, and no neurological disorder was observed. During surgery, CO measurement by arterial pressure waveform analysis (Arterial Pressure-based Cardiac Index: APCI) was also used. Both measurements were correlated with an R-value of 0.55 ( $n = 24$ ) (Figure 1).

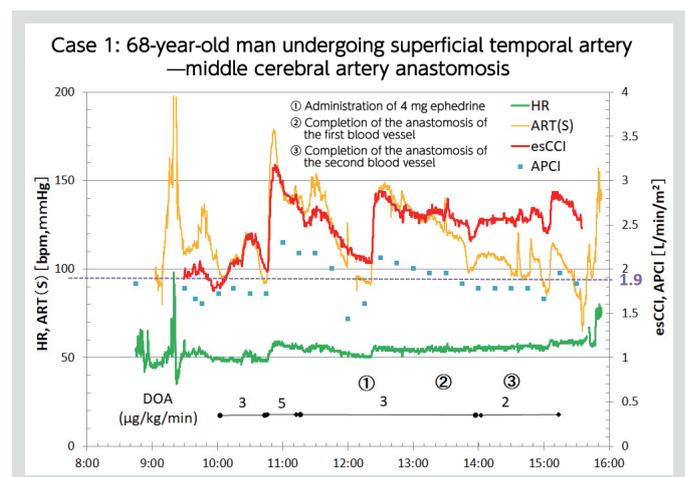


Figure 1 esCCO monitoring in Case 1

During surgery, CO measurement by arterial pressure waveform analysis (Arterial Pressure-based Cardiac Index: APCI) was also used. Both measurements were correlated with an R-value of 0.55 ( $n = 24$ ) (Figure 1).

## Discussion

### Case 1

During the neurosurgical surgery in patients with cerebral ischemia, maintaining cerebral blood flow is important. Although arterial pressure is usually monitored during surgery to maintain hemodynamics, a decrease in esCCI was also used as a guide for administration of vasoactive drugs in this case. Administration of dopamine and ephedrine led to increases in esCCI and blood pressure, resulting in appropriate maintenance of hemodynamics.

Hemodynamic management with monitoring of esCCO is useful during the neurosurgical surgery.

## Case

### Case 2

A 95-year-old woman with a height of 149 cm and a body weight of 27 kg was scheduled to undergo colon resection for transverse colon cancer. The patient had cognitive impairment but no other medical history. Preoperative echocardiography found mild mitral regurgitation but cardiac function was preserved with an ejection fraction of 71%.

Anesthesia was introduced with propofol and maintained with desflurane and remifentanyl with tracheal intubation. Bilateral subcostal TAP block was performed. The esCCI was 3.2 L/min at the start of measurement and ranged from 2.9 to 3.8 L/min with no significant change during surgery. Arterial Pulse Pressure Variation (PPV) was monitored, and 200 mL of Voluven® was administered at the time when arterial PPV was  $\geq 10\%$ . The postoperative course was favorable (Figure 2).

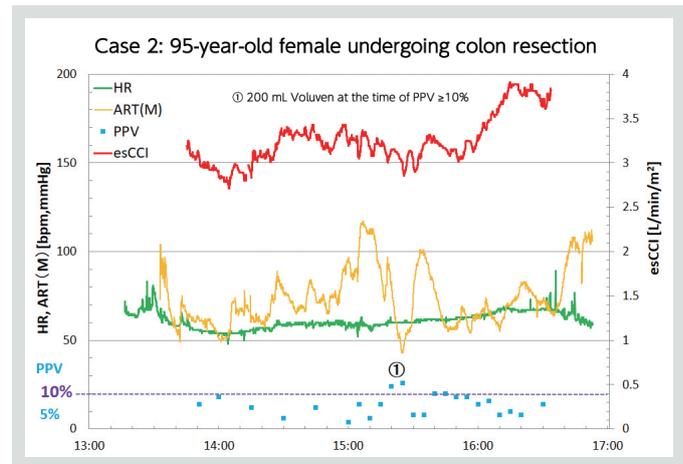


Figure 2 esCCO monitoring in Case 2

## Discussion

### Case 2

In laparotomy in elderly patients, appropriate management of intraoperative fluid volume is necessary and is performed by monitoring of cardiac output as well as fluid volume with urine volume or PPV. The patient monitor used in our institution can calculate PPV using arterial pressure measurements. Arterial pressure measurement and esCCI or PPV monitoring were used as a guide for administration of Voluven®. Use of esCCI and PPV as guides allowed appropriate fluid management, and maintenance of hemodynamics led to a favorable postoperative course.

## Summary

Anesthetic management in elderly patients requires management appropriate for the various risks, including surgical procedures and medical histories. I had the opportunity to use the new technology esCCO in these cases. In case 1, esCCO guided administration of the vasoactive drugs, whereas a combination of esCCO and PPV allowed appropriate fluid management in case 2.

In surgery in elderly patients with high surgical risk, it is desired to monitor more biological information in a non-invasive manner to ensure safe surgery. In particular, the esCCO technology, which provides cardiac output monitoring by using routinely used parameters of ECG, SpO<sub>2</sub> (pulse wave), and blood pressure without requiring additional devices, is of great value in both clinical aspects and patient safety.

In the context of a growing number of elderly people, esCCO monitoring is also expected to lead to improvement in the safety of brief surgeries in which blood pressure is managed with NIBP without using arterial pressure and which will grow in number.

Routine use of esCCO allows us to be prepared for unforeseen situations of sudden hypotension and may therefore lead to safe anesthetic management in elderly patients.

## Points of use of esCCO

1. Guide for administration of vasoactive drugs and evaluation of hemodynamics
2. Realization of appropriate fluid management in combination with PPV
3. Improvement in safety of brief surgeries in combination with NIBP
4. Tool for preparedness for unforeseen emergencies

## Future expectation

Further accumulation of cases is necessary to determine what cases are benefited and to evaluate the reliability of this technology in very elderly patients. Monitoring of estimated stroke volume variation (esSVV) by a non-invasive method based on stroke volume is desired. In addition, it is likely that this technology can also be used in non-sedated patients. As CO and SV can be measured using usual monitoring parameters, the technology can be probably used as first touch in cardiac function assessment in postoperative care or emergency room settings.

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