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## Anaesthetic management of cytoreductive surgery and hyperthermic intraperitoneal chemotherapy (HIPEC) in a patient with severe uncorrected coarctation of aorta (CoA): A case report

Sir,

Hyperthermic intraperitoneal chemotherapy (HIPEC) in a patient with coarctation of the aorta (CoA) poses a challenge to the anaesthesiologist as it is a fixed cardiac output state associated with massive fluid shifts, blood loss, haemodynamic perturbations and temperature imbalance. Anaesthetic management for non-cardiac surgeries in patients with uncorrected coarctation of aorta has been described previously<sup>[1,2]</sup> but probably this is the first reported anaesthetic management of HIPEC associated with severe uncorrected CoA.

A 31-year-old, 65 kg male patient of obstructive left colonic adenocarcinoma was posted for open left hemicolectomy. He was a known case of CoA detected incidentally on 2-D transthoracic echocardiography done as a part of the evaluation for hypertension at such a young age. During preanaesthetic assessment, the recorded non-invasive blood pressure (NIBP) measurements were as follows: right arm 166/67 mmHg, right thigh 98/52 mmHg, left arm 168/72 mmHg and left thigh 100/54 mmHg. The femoral pulse was delayed and diminished and a systolic murmur was

audible in the left interscapular region. His exercise tolerance was more than 4 metabolic equivalents. Preoperative investigations including prothrombin time, activated partial thromboplastin time and international normalised ratio were within normal limits. The latest transthoracic echocardiography revealed the presence of a bicuspid aortic valve, severe coarctation of aorta-post left subclavian artery with a coarctation gradient of 73/42 mm Hg (53 mmHg), normal resting left ventricular ejection fraction (LVEF 61%) and concentric left ventricular hypertrophy. Our in-house cardiologist advised for close perioperative haemodynamic monitoring. The consideration for preoperative correction of the coarctation was not considered in view of his malignant colonic disease, the urgency of the surgery and the limited success rate of the corrective surgery for coarctation. The patient was made completely aware of the possible major complications associated with severe proximal aortic hypertension include cerebral haemorrhage, aortic dissection and rupture, aortic valve failure and left ventricular failure<sup>[3]</sup> and the scope of management of those in our institution.

Inside the operation theatre, baseline NIBP recorded in all four limbs were: right arm-177/96 mmHg, right thigh- 103/63 mmHg, left arm-184/93 mmHg and left thigh-113/60 mmHg. Inj. midazolam 1 mg was given as premedication. The thoracic epidural was sited at the T9-T10 intervertebral level. The right radial artery was cannulated after infiltration with 2% lignocaine. NIBP monitoring in the right lower thigh was also continued at regular intervals. Inj. fentanyl 100 mcg, propofol 180 mg and rocuronium 50 mg were administered sequentially and the airway was secured with an 8.5 mm endotracheal tube. Endotracheal intubation

induced sympathetic response was attenuated with In. labetalol 5 mg and lignocaine 2% 3 mL. Balanced general anaesthesia was maintained with sevoflurane, oxygen in air and atracurium infusion. Central venous cannulation was done and the core temperature was monitored. Epidural infusion of 0.2% ropivacaine and fentanyl 2 mcg/mL was continued throughout the surgery. Bolus epidural dose of ropivacaine was not given to avoid sudden hypotension.

In view of the scattered metastatic peritoneal deposits, it was decided to perform segmental colectomy with HIPEC. We ensured continuous cardiac output monitoring with EV 1000™ and FloTrac™ (Edwards Lifesciences LLC, Irvine, USA).<sup>[4]</sup> Fluid therapy was guided by stroke volume variation (SVV), haematocrit and lactate in the arterial blood gas analysis (ABG) done periodically. Systemic vascular resistance index (SVRI) and packed cell volume (PCV) guided the intraoperative vasopressor requirement and packed cell transfusion, respectively.

Maintenance crystalloid at 5 mL/kg/h and intermittent colloid boluses of 200 mL were infused to maintain the SVV  $\leq 10$ –13%. Anticipating significant protein loss from the raw peritoneal surface and to minimise the deleterious effects of massive crystalloid resuscitation, we started 20% human albumin infusion at 10 mL/h.<sup>[4]</sup>

The highest recorded lactate and the lowest recorded haematocrit were 2.6 mmol/L and 23%, respectively. Approximately 2200 mL of crystalloid, 1000 mL of colloid and 2 units (536 mL) of the packed red cells were transfused intraoperatively. Blood loss was 400 mL whereas urine output was 850 mL. Passive cooling was done (35.5°C) before HIPEC<sup>[4]</sup> to avoid core hyperthermia during HIPEC. The maximum temperature recorded was 37.5°C. The duration of the procedure was approximately 7 h. The patient's trachea was extubated successfully at the end of the procedure and shifted to the intensive care unit (ICU).

Coarctation of the aorta occurs in ~7% of patients with congenital heart disease. It is the most common congenital cardiovascular cause of hypertension. Most children and young adults with isolated coarctation remain asymptomatic though occasional headache, epistaxis, chest tightness and claudication with exercise may happen. It is often diagnosed incidentally when a heart murmur or hypertension in the upper extremities and

diminished or delayed femoral pulses are detected on physical examination.<sup>[3]</sup>

The abiding principle, in this case, was to prevent hypo/hypertension, tachycardia and hypo/hyperthermia while simultaneously ensuring urine output of at least 1 mL/kg/h during the cytoreductive surgery and around 2 mL/kg/h during the heated chemotherapeutic agent administration.<sup>[4]</sup> Great care should be taken to prevent sympathetic stress response during intubation, extubation or surgical stimulations leading to adverse cardiovascular and/or neurological events. In our case, we initiated invasive blood pressure monitoring before the induction of anaesthesia to manage such surges. Epidural analgesia<sup>[4]</sup> along with systemic opioids ensured adequate analgesia due to surgical stimulation. It is crucial to correct hypotension distal to the coarctation to maintain perfusion of the vital organs. Mean blood pressure in the lower limb was maintained above 60 mmHg and we targeted to keep the upper limb systolic pressure between 160–180 mmHg in order to maintain sufficient lower limb mean pressure based on his preoperative measurements in all four limbs [Chart 1]. Heart rate was maintained between 60–80 beats/min.

Vasodilation caused by anaesthesia and hyperthermia during HIPEC reduces cardiac preload and afterload which is aggravated by sympathetic blockade caused by the central neuraxial blockade. Cardiac output also

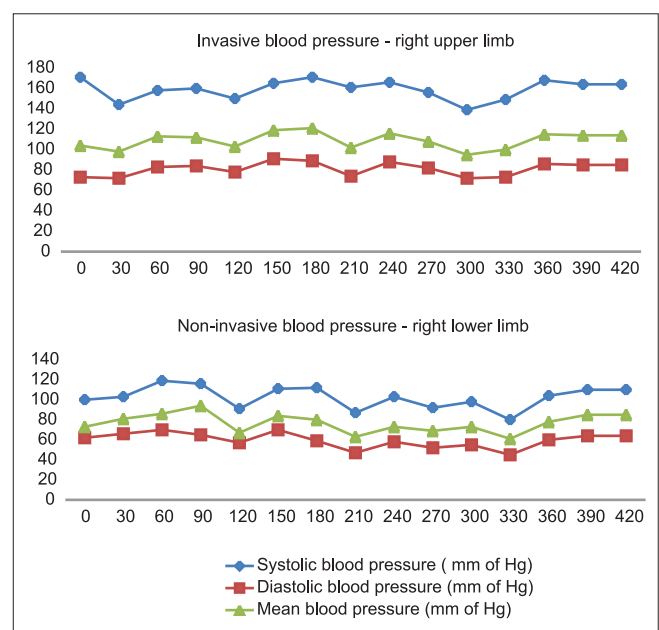


Chart 1: Intraoperative blood pressure monitoring

may be reduced by the negative inotropic effect of anaesthetic drugs<sup>[5]</sup> especially in the setting of fixed LV outlet obstruction. Blood and fluid loss happen with alarming frequency during debulking surgery coupled with continuous evaporative loss from the open abdomen. The peripheral vasculature dilates in response to the rising body temperature associated with the heated chemotherapeutic agent. Furthermore, HIPEC causes peritoneal inflammation that can cause perioperative third-space losses.<sup>[6,7]</sup> Goal-directed fluid therapy was used to guide fluid management and to prevent hypotension.

To summarise, careful hemodynamic monitoring, fluid and temperature homeostasis are the keys to success.

#### Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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#### Conflicts of interest

There are no conflicts of interest.

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