International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Anesthetic Challenges in a Heart Failure Patient for Cytoreductive Surgery with Hyperthermic Intraperitoneal Chemotherapy: A Case Report

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Abstract

CRS-HIPEC is a procedure for the treatment of peritoneal malignancies. It is a multi-step procedure consisting of initial tumor debulking, followed by heated application of chemotherapy. Throughout the procedure multiple physiologic changes occur: large fluid losses and shifts, hemodynamic derangements, extremes of temperatures.

Knowledge of the physiologic changes during each phase is essential in forming an anesthetic plan for this case. For this particular case, the patient has an ejection fraction of 35%. The reduced ejection fraction requires careful attention and modification in management. Thus, a tailored anesthetic plan is of particular importance. There is a scarcity of studies regarding anesthetic management in a heart failure patient for CRS-HIPEC, hence it is important to explore the implications of this disease process on anesthetic management.

Keywords: CRS-HIPEC, Reduced Ejection Fraction, Heart Failure

Introduction

CRS-HIPEC is a long and extensive procedure lasting approximately nine hours. It involves large fluid shifts, possible massive losses, temperature changes, a hypermetabolic state, and hemodynamic disturbances. Along with the hyperthermic application of chemotherapeutic agents, this procedure consists of tumor debulking leading to large fluid shifts, fluid losses, acidosis, hypermetabolic state, hemodynamic changes and risk of tissue damage[2]. Moreover, there is increased risk of renal injury and pulmonary complications post-operatively. Fluid and hemodynamic management for this procedure is not well-established, most specifically in patients with heart failure, hence proving to be a challenge for the anesthesiologist [4].

The physiologic consequences of CRS-HIPEC pose a challenge to a patient with heart failure. Patients with heart failure are at risk for cardiac compromise. Heart failure patients are dependent on sympathetic tone to maintain cardiac output[7]; hence any drastic hemodynamic changes may be deleterious to the patient. The need for vasopressors is highlighted as anesthetic induction agents are myocardial depressants which may result in further derangements to cardiac function[5].

The primary rationale for the management of heart failure includes preload preservation and afterload reduction. Hence, maintaining an optimum fluid balance that preserves cardiac output is paramount. However, implementing a restrictive fluid therapy regimen increases the risk for renal injury. The existing

derangement entails that fluid loading be carefully done to maintain adequate blood flow, vascular tone and perfusion.

A patient with heart failure for CRS-HIPEC entails a difficult balancing act. The anesthesiologist needs to closely monitor fluid losses, hemodynamic status, temperature changes, and urine output. These and more make the conduct of anesthesia in this case worth investigating.

Case Description

The patient is a 71- year-old male, known hypertensive, with ischemic heart disease, previous 50-pack-year smoker. Pertinent previous medical history includes a chronic Hepatitis B infection, dyslipidemia, thrombocytopenia (likely chemotherapy-induced), and consideration of Chronic Obstructive Pulmonary Disease. The patient presents with exertional dyspnea on more than ordinary activities and is classified as Heart Failure, Functional Class II. A 2D Echocardiography shows eccentric left ventricular hypertrophy with moderately diminished systolic function and mild diastolic dysfunction, ejection fraction at 35%.

The patient presents with a two-year history of decrease in stool caliber, abdominal pain, bloatedness, vomiting and anorexia. Eight months prior, he underwent exploratory laparotomy, right hemicolectomy with histopathologic findings of ascending colon mucinous adenocarcinoma. The patient had 5 cycles of systemic chemotherapy (Bevacizumab, Folinic Acid, Fluorouracil and Oxaliplatin). On Computed Tomography Scan, there were noted mesenteric nodularities, increasing in size located adjacent to the right common/external iliac artery. Hypodense foci were also seen in both hepatic lobes. The patient was diagnosed with Stage IV Colon adnocarcinoma and advised CRS-HIPEC.

Preoperatively, the patient has an intermediate risk of developing cardiac events while undergoing an intermediate risk procedure. The patient has a high clinical bleeding risk in an intermediate to high-risk bleeding procedure and an intermediate risk for post-operative pulmonary complications.

Monitors in use for the procedure include pulse oximetry, noninvasive BP monitoring, electrocardiography, and capnography. A temperature probe was placed to closely monitor body temperature and an arterial line was inserted. Two patent large-bore intravenous accesses were placed for possible use during resuscitation.

The planned anesthetic technique is a combination of General Endotracheal Anesthesia and Continuous Lumbar Epidural Anesthesia. An epidural catheter was placed at the L3-L4 level uneventfully, a negative test dose was noted.

On induction, agents used include Midazolam (1.5mg), Fentanyl (200mcg) and Atracurium (40mg). Premixed Norepinephrine and Dobutamine were prepared ahead of time and placed on standby. The pressors (Norepinephrine at 0.6 mkm and Dobutamine at 3 mkm) were in use on induction. The patient was intubated with an endotracheal tube size 7.5, using video laryngoscopy with a Dblade and secured at level 19.

Normal saline solution was used for maintenance fluid. Plain Lactated Ringer's solution was utilized as resuscitation fluid. Rate was increased according to the phase of the surgery and current losses. Relaxation of abdominal muscles is essential for the current procedure, hence hourly top-ups of the muscle relaxant was done. Anesthesia was maintained with Sevoflurane at 1-2.5 %. The lumbar epidural was not used intraoperatively.

For this procedure, a forced air warmer was prepared, along with refrigerated fluids. Vasopressors placed on standby to be used as needed. Blood pressure was maintained, with a mean arterial pressure of 65 as target. The pressors were maintained during the cytoreductive surgery phase of the procedure. One

hypotensive episode occurred, this was managed by increasing the rate of Norepinephrine from 0.6 mkm to 0.8 mkm. No further recurrence of hypotensive episodes noted. Vasopressors were discontinued during the HIPEC portion of the procedure.

Hourly monitoring of input and output was done: blood losses, insensible losses and urinary output was noted. Normal saline solution was used for maintenance fluid. Plain Lactated Ringer's solution was utilized as resuscitation fluid. Fluid resuscitation was performed by careful titration of the hourly rate from 130ml/hr to 150ml/hr, and maintained all throughout the procedure. One unit of packed red blood cells was transfused on the sixth hour of the surgery. Capillary blood glucose was taken at hourly intervals post-cytoreductive surgery. Normal blood glucose levels were observed.

An hourly output of 0.5-1ml/kg/hr is considered adequate. Inadequate output was measured on the 7th hour, hence furosemide was administered. Otherwise, adequate output was maintained. On emergence, neuromuscular blockade was reversed with Atropine (0.5mg) and Neostigmine (2mg). The patient was extubated fully awake.

On transfer to Post-Anesthetic Care Unit, patient was awake, responsive, and carefully weaned off pressors. He was able to tolerate room air with no episodes of desaturations. Patient then underwent Magnesium correction. The rest of the patient's hospital course was unremarkable and patient was discharged stable.

Discussion

Heart Failure is an ailment that presents challenges to the anesthesiologist. Aside from increasing the risk of perioperative morbidity and mortality, functional changes in circulation occur due to the morphologic changes in heart failure. A heart failure patient will already have difficulty tolerating anesthetics[3]. This coupled with the unique anesthetic requirements of the procedure (CRS-HIPEC) make it a difficulty.

The cytoreductive surgery phase of the procedure will have fluid losses, fluid shifts and blood loss[2]. These losses require replacement in the form of crystalloids, colloids or blood products. However, given that the patient is a heart failure patient. He is unable to tolerate massive transfusions or fluid loading[3]. Hence, the goal for this procedure is a zero fluid balance with deficits adequately replaced. This was performed with careful monitoring of hourly losses during the entire procedure and carefully matching the output with the input. Fluids were titrated to sufficiently replace losses. Blood loss was carefully accounted for and replaced with blood products.

Monitors in place for the procedure include ASA standard monitors. In addition, an arterial line was placed to guide goal-directed fluid resuscitation. Pulse pressure variation dictates fluid responsiveness. A value greater than thirteen is indicative of fluid responsiveness[8], hence it is at this time when resuscitation should be performed.

Due to massive fluid losses and shifts, hemodynamic changes will occur. Moreover, in the hyperthermic application of the chemotherapeutic drug, a hypermetabolic state exists[2]. This hypermetabolic state leads to vasodilation and hyperdynamic circulation with consequent decrease in SVR and MAP and increase in HR and CO. Hence, hemodynamic instability occurs in both phases. A heart failure patient's cardiac output is heavily dependent on the sympathetic tone, hence minor hemodynamic derangements may prove to be fatal for the patient. These instances are countered with the use of vasopressors. Norepinephrine (a sympathomimetic) and Dobutamine (beta-1-agonist) mixtures were prepared ahead of time in anticipation of hemodynamic changes throughout the procedure. Norepinephrine, a synthetic form of the endogenous hormone functions as a vasopressor by activating alpha-1 receptors[6], resulting in peripheral

vasoconstriction and thereby elevating blood pressure. Dobutamine is a sympathomimetic amine that serves as an inotrope, it augments cardiac output by increasing stroke volume and decreasing peripheral vascular resistance[7]. These agents were in use throughout the cytoreductive surgery section of the procedure as massive fluid and blood losses occurred. The patient was responsive to the prepared agents, hence hemodynamic stability was maintained throughout the procedure.

Conclusion

The anesthetic management for patients with decreased functional reserves for CRS-HIPEC is not yet established. Hence, further studies need to be done on this topic. Changes in physiology occurring during the procedure may lead to cardiac compromise, thus, both the patient profile and the planned procedure need to be taken into consideration when forming an anesthetic plan. Cases of CRS-HIPEC on Heart Failure patients are increasing in number, hence, more data will be available in the near future.

References

1. Gupta, N., Kumar, V., Garg, R., Bharti, S. J., Mishra, S., & Bhatnagar, S. (2019). Anesthetic implications in hyperthermic intraperitoneal chemotherapy. *Journal of anaesthesiology, clinical pharmacology*, *35*(1), 3–11.
2. Gupta, R., Gupta, N., Sirohiya, P., Pandit, A., Ratre, B., Vig, S., Bhan, S., Singh, R., Kumar, B., Bhopale, S., Mishra, S., Garg, R., Bharati, S., Kumar, V., Deo, S. & Bhatnagar, S. (2022). Perioperative anaesthetic management in cytoreductive surgery (CRS) with hyperthermic intraperitoneal chemotherapy (HIPEC): a retrospective analysis in a single tertiary care cancer centre. *Pleura and Peritoneum*, *7*(3), 127-134. https://doi.org/10.1515/pp-2022-0001
3. R. Pirracchio, B. Cholley, S. De Hert, A. Cohen Solal, A. Mebazaa, Diastolic heart failure in anaesthesia and critical care, *BJA: British Journal of Anaesthesia*, Volume 98, Issue 6, June 2007, Pages 707–721, https://doi.org/10.1093/bja/aem098
4. Aldawoodi, N. N., Escher, A. R., Jr, Ninan, D., & Patel, S. Y. (2019). Transesophageal Echocardiography During Cytoreductive Surgery with Hyperthermic Intraperitoneal Chemotherapy: A Novel Approach. *Cureus*, *11*(7), e5062. https://doi.org/10.7759/cureus.5062
5. Ryu, J. & Koo, C. (2021). Anesthetic concerns during cytoreductive surgery with hyperthermic intraperitoneal chemotherapy. *Korean Journal of Anesthesiology*.74(2):89-90. https://doi.org/10.4097/kja.21099
6. Smith MD, Maani CV. Norepinephrine. [Updated 2022 May 15]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK537259/
7. Ruffolo R. R., Jr (1987). The pharmacology of dobutamine. *The American journal of the medical sciences*, *294*(4), 244–248. https://doi.org/10.1097/00000441-198710000-00005
8. Grassi, P., Lo Nigro, L., Battaglia, K., Barone, M., Testa, F., & Berlot, G. (2013). Pulse pressure variation as a predictor of fluid responsiveness in mechanically ventilated patients with spontaneous breathing activity: a pragmatic observational study. *HSR proceedings in intensive care & cardiovascular anesthesia*, *5*(2), 98–109.