



Robotic Surgery, Hypertrophic Cardiomyopathy and Difficult Airway – A Challenging Combination for the Anesthesiologist! : A Case Report

Uma Hariharan*, Shagun Bhatia Shah and Binod Kumar Naithani

Rajiv Gandhi Cancer Institute and Research Centre (RGCI&RC), Delhi, India

*Corresponding author: Uma Hariharan, Fellow- Oncoanesthesia, RGCI&RC, Rohini, BH-41, East Shalimar Bagh, Delhi 110088, India, Tel: +91-98112710931, E-mail: uma1708@gmail.com

Abstract

The introduction of robotic surgery has heralded new challenges for the anesthesiologists. The daVinci™ robotic system provides a three-dimensional view and better work ergonomics for the surgeon, especially in complex and radical cancer surgeries. Innovation of robotic surgery has opened the doors for newer concerns in patient safety for the anesthesia team. This is of greater importance in patients with concurrent serious conditions like hypertrophic cardiomyopathy. The challenge becomes greater when difficult airway compounds the situation.

Keyword

Robotic, Hypertrophic cardiomyopathy, Anesthesia, Difficult airway

Introduction

Robotic surgery has revolutionized the field of minimal access surgery. It is considered superior, as it provides a three-dimensional view of the operative area, seven degrees of freedom, movement dexterity similar to the human hand, minimal blood loss and lesser postoperative pain. Robotic nephron-sparing partial nephrectomy (NSS) is done to preserve the function of diseased kidney in well-localised upper or lower pole renal tumors, with no metastasis. Hypertrophic cardiomyopathy is a serious, familial cardiac disease causing asymmetric hypertrophy of the inter-ventricular septum, leading to dynamic left ventricular outflow tract obstruction and sometimes, even sudden death. Previous history of carcinoma of the larynx and radiotherapy to the neck can lead to difficult airway, which needs to be anticipated and managed appropriately.

Case Report

A 72 years old, 70 Kg, ASA grade 3, male patient was posted for elective robotic right nephron sparing surgery (NSS) under general anesthesia. He had a renal mass, measuring 50*20*27mm in the anterior aspect of the upper pole of right kidney with no perinephric extension and no metastasis. On preoperative evaluation, he had difficult airway in view of past history of carcinoma larynx treated with radiotherapy (35 cycles of radiation, completed 9 years back). On airway examination, his Mallampatti class was 3, edentulous and he also had a short, firm neck. Renal tumor was detected during

routine follow up for carcinoma larynx on PET-CT scan (Positron Emission Tomography), as he was asymptomatic otherwise. He was a known case of hypertension, on regular treatment since 12 years. He was also diagnosed to have hypothyroidism after radiotherapy to the neck and was on regular thyroxine replacement therapy since then. Most importantly, he was a diagnosed case of hypertrophic cardiomyopathy, which presented with history of 2 consecutive episodes of stable angina 12 years back. His angiographic study showed normal coronaries. His current echocardiographic findings revealed asymmetric septal hypertrophy with left ventricular ejection fraction (LVEF) of 67%, concentric left ventricular hypertrophy and no regional wall motion abnormalities. He was on thyroxine supplementation (Thyronorm 100mcg daily), aspirin 75mg daily and betablocker therapy (Tab Metoprolol 25 mg once daily). ECG showed sinus bradycardia with T wave inversion in all chest leads. On functional cardiac assessment, his effort tolerance was good (Metabolic equivalents >4). He was a reformed chronic smoker and tobacco chewer, which he quit after diagnosis of carcinoma larynx. During routine pre-anesthetic evaluation, all his blood investigation results were normal, including serum electrolytes, thyroid function tests, renal function tests and coagulation profile. Chest X-ray was also within normal limits. All his medications were continued till morning of the surgery.

In view of anticipated difficult airway, CMAC™ video laryngoscope-guided intubation with preservation of spontaneous respiration was planned. Difficult airway cart, including fiberoptic bronchoscope was kept ready in case of a change in plan. Preinduction invasive monitoring lines with ultrasound-guidance (left radial arterial & right internal jugular central venous catheters) were inserted under local anesthesia and mild intravenous (I.V) sedation. Other standard monitors were placed, including neuromuscular monitoring, bispectral index (BIS) monitor, continuous 12-lead ECG, pulse oximeter, temperature probe, end-tidal carbon-dioxide, airway pressure and cuff pressure monitor. A large bore intravenous cannula (16G) was taken and slow I. V induction started with Midazolam (1.5mg), Fentanyl (100mcg) and Etomidate (10mg), after preoxygenation. Phenylephrine hydrochloride infusion was started prophylactically along with intravenous induction at an initial dose of 100 microgram/min, followed by 50 microgram/min, to prevent

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hypotension on induction and stopped immediately on intubation. CMAC™ blade (Karl-Storz, Tuttingen, Germany) was inserted, after oral 10% lignocaine spray and I.V Esmolol hydrochloride bolus dose injection of 35mg over 1 minute (500 mcg/kg/min), to prevent laryngoscopic response to airway management. Trachea was intubated under vision with 8mm cuffed orotracheal tube (Portex). After confirming bilateral air entry and capnographic trace, neuromuscular blocker (slow I.V Vecuronium bromide 8mg) was given for surgical relaxation and opioid (60 micrograms I.V Fentanyl) repeated for analgesia. Positioning for robotic Surgery was done with extreme caution. During initial pneumoperitoneum before final positioning, carbon-dioxide (CO₂) insufflation was done slowly with pressures kept below 12mmHg. After adequate padding, cushioning and shoulder supports, docking of robotic arms and instruments were done. Head down position for robotic surgery was given slowly. I. V fluids were restricted, as a routine for robotic surgeries in extreme head-down position to decrease venous congestion and surgical oozing. As his airway pressures started to increase in this position, ventilator mode was changed to pressure control ventilation to limit the peak and plateau airway pressures attained (to prevent barotrauma). To avoid tachycardia and hypertension associated with CO₂ pneumoperitoneum and positioning, I.V esmolol hydrochloride infusion was started at an initial dose of 35 mg/min over 1 minute, followed by 3.5mg/min for 4 minutes. After docking for inserting robotic arms and instruments, good muscle relaxation was ensured with neuromuscular monitoring and continuous I.V vecuronium infusion. Maintenance of anesthesia was done with oxygen + air + Desflurane coupled with intravenous propofol infusion, guided by the BIS monitor and other parameters. In order to prevent hypotension during clamping of right renal vessels for bloodless tumor resection, phenylephrine infusion was restarted at a maintenance dose of 50 micrograms/min. Warm ischemia time was 15 minutes. Total estimated blood loss was 200ml and the procedure lasted for 2 hours. The entire perioperative course was uneventful, as the patient tolerated steep trendelenberg position well. After surgery, de-docking of the robot was done & patient returned to supine position slowly, taking care to avoid displacement of airway, intravenous and monitoring lines. During reversal, hemodynamic stability was ensured with esmolol infusion (@50mcg/Kg/Min) and diltiazem hydrochloride boluses (IV 6 + 6mg). Trachea was extubated over a tube exchanger device, after return of train-of-four responses on neuro-muscular monitor, adequate muscle power with good respiratory effort and clear consciousness. Multi-modal analgesia was instituted with intravenous Paracetamol infusion (1 gram), port site local anesthetic infiltration and I.V Fentanyl infusion (30 - 40 micrograms/hour). Postoperatively, patient was observed in an onco-surgical intensive care unit with continuation of invasive monitoring for 24 hours. His entire postoperative course was uneventful and patient was shifted to the ward after 48 hours. His ECG, renal function tests, serum electrolytes, urine output and other routine investigations were unremarkable. He was later discharged home after 5 days, with advice for regular follow-up with the onco-surgeons and the cardiologist and continuing the same preoperative medications, as cited before.

Discussion

Hypertrophic cardiomyopathy [1] is a serious cardiac condition due to asymmetric hypertrophy of the interventricular septum. It is a hereditary disorder, with autosomal dominant character. Clinical features are due to heart failure, myocardial ischemia and decreased cerebral perfusion (syncope). Hypertrophy is more common in the upper interventricular septum, below the aortic valve leading to left ventricular outflow obstruction (LVOT) and accentuated by anterior motion of the septal leaflet of the mitral valve (SAM). It can even cause sudden death [2] due to sudden LVOT obstruction or severe arrhythmia. Anesthetic goals [3] include: maintaining adequate preload, avoiding increases in after load, preventing both myocardial depression and increase in myocardial contractility. Particular attention must be paid to avoid sympathetic stimulation during intubation, incision, pneumoperitoneum and extubation. In HCM patients, it is recommended to give adequate intravenous fluids to

maintain preload. But in robotic Surgery, intravenous fluids are usually restricted during head down position to avoid venous congestion and improve surgical access. Hence, we used Phenylephrine [4] infusion during induction and during the period of renal vessel clamping, to maintain adequate mean arterial pressure. Other agents like norepinephrine, doapamine, dihydropyridine calcium channel blockers, ACE inhibitors and Digoxin are contraindicated in HCM. Phenylephrine hydrochloride is a direct alpha₁-adrenergic receptor agonist used to maintain the mean arterial pressure, without causing tachycardia or increase in myocardial contractility. Hence, it can be used safely in HCM patients. The main thrust was on maintenance of sinus rhythm, prevention of hypotension and tachycardia. Our case highlights that robotic surgery can be safely performed in HCM patients, provided preload and afterload are maintained and sympathetic nervous system stimulation is prevented. Steep trendelenberg position (40 degrees) leads to increase in preload [5], which may be beneficial in preventing hypotension. In robotic surgery, blood loss is usually minimal and transfusion is usually not required. Intra-abdominal pressures must be limited to prevent cardiovascular changes associated with pneumoperitoneum. Robotic surgery is advantageous in such cardiac patients by decreasing the perioperative morbidity and mortality. Even though steep trendelenberg position has several disadvantages like increase in intracranial pressure, intra-thoracic pressure and intra-ocular pressure, it was well tolerated by our patient, as the increase in preload is beneficial in HCM patients. Videolaryngoscopic intubation [6] and induction under spontaneous respiration was carried out in view of anticipated difficult airway in our case, along with an ultra-short acting betablocker (Esmolol bolus) for suppressing sympathetic response. There are several difficult airway management tools, which must be made available in all such situations, with alternate plans for securing the airway. Fiberoptic bronchoscope was kept ready in our case, if video laryngoscope was unsuccessful. Muscle relaxant was given only after confirming correct tube placement. Vecuronium was used as the patients' renal functions were within normal limits and it does not cause histamine release or hypotension on injection. Etomidate was used for induction in view of its cardiovascular stability. Invasive monitoring was carried out before induction for beat-to-beat blood pressure and central venous pressure measurement. Diltiazem hydrochloride is a non-dihydropyridine calcium channel blocker [7], which can be used for hemodynamic control in HCM patients, as they do not cause reflex tachycardia and also reduce myocardial oxygen demand. During extubation as well, sympathetic stimulation was avoided by I.V Esmolol infusion [8] and Diltiazem bolus. Videolaryngoscope is an excellent tool in the armamentarium of difficult airway management, both anticipated and unanticipated. We were cautious during extubation as well, by using tube exchanger device, in view of pre-existing difficult airway.

Conclusions

Robotic surgery can be safely performed in patients with hypertrophic cardiomyopathy, provided the anesthetic principles are adhered-to strictly. Steep trendelenberg position causes increases in preload, which may be beneficial in patients with HCM. Its advantages in radical cancer surgery in cardiac patients may outweigh the disadvantages of robotic surgery. The change in position needs to be done slowly and gently, to minimize hemodynamic disturbances. Sympathetic stimulation during pneumoperitoneum also needs to be guarded against. Careful selection of anesthetic agents and drugs need to be emphasized to prevent left-ventricular outflow tract obstruction and sympathetic stimulation. With advances in surgical techniques, anesthesiologists need to be prepared to face such challenges. Difficult airway cart needs to be kept ready, with ready alternate plans for securing the airway, both during intubation and extubation (as per the ASA- American Society of Anesthesiologists Difficult Airway protocol [9]). HCM patients need to be watched diligently for arrhythmias, cardiac failure or sudden cardiac death in the postoperative period, preferably under complete cardiac monitoring in an intensive care unit.

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