Anesthetic management of robot-assisted thoracoscopic thymectomy

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Abstract

Myasthenia gravis (MG) is a rare disorder involving neuromuscular junction. In conjunction with medical therapy, thymectomy is a known modality of treatment of MG and has shown to increase the probability of remission and overall symptomatic improvement. For minimally invasive thymectomy, video-assisted thoracoscopic surgery has been the preferred surgical approach till recently. The robotic surgical procedure must necessarily bring new challenges to the anesthesiologists to effectively meet the specific requirements of the technique. At present, there is a paucity of literature regarding the anesthetic concerns of robotic assisted thymectomy, patient in question specifically posed a challenge since different maneuvers and techniques had to be tried to obtain optimum surgical conditions with stable ventilatory and hemodynamic parameters. Concerns of patient positioning and hemodynamic monitoring have also been discussed.

Key words: Minimally invasive, myasthenia gravis, robotic, thymectomy

Introduction

Myasthenia gravis (MG) is an autoimmune disease that affects neuromuscular transmission and results in chronic weakness and varying levels of fatigue in striated muscles. Since 1941, when Blalock first reported results of transternal thymectomy in patients affected by MG, thymectomy has played a significant role constituting a widely accepted therapeutic option in the integrated management of MG. Although various surgical approaches have been described for thymic resection, minimally invasive techniques have become increasingly popular as they offer low overall postoperative morbidity, faster recovery, shorter hospital stay and better cosmetic results when compared to conventional open techniques.

Case Report

A 17-year-old female, weighing 90 kg, with a diagnosis of MG was posted for robot-assisted thoracoscopic thymectomy (RATT). At admission, motor power of the limb muscles and pulmonary function tests were normal. The resting heart rate was 99/min and blood pressure was 130/90 mm Hg. Oral prednisolone 5 mg, pyridostigmine 60 mg and azathioprine 150 mg were administered on the morning of surgery. In the operating room, a 16 G venous cannula was secured in the right upper limb. 20 G cannula in left radial artery and 7 Fr double lumen catheter was inserted in right internal jugular vein under local anesthesia. An epidural catheter was also placed in left T4-T5 paravertebral space. After induction of anesthesia, trachea was intubated with a 37 Fr left sided double lumen tube (DLT) (Portex blueline endobronchial tube, smiths design Smith Medical Company, Hythe, U.K.) and lungs were ventilated with a tidal volume of 7 ml/kg and respiratory rate of 15/min. Airway pressure was 33 cm H2O when both lungs were being ventilated. Position of DLT was confirmed with the help of fiberoptic bronchoscope. On the commencement of one lung ventilation (OLV) the airway pressure reached beyond acceptable level (up to 45-50 cm of water). Bronchial lumen was unclamped, and suction of both lumens was done and position of DLT was reconfirmed by fiberoptic bronchoscope. All these measures did not help much to decrease the airway pressure. Then it was decided to change mode of ventilation from...
volume control to pressure controlled ventilation-volume
guaranteed (VCV to PCV), decrease the tidal volume to
5 ml/kg, and increase the respiratory rate to 17/min. These
changes brought down the airway pressure up to 35 cm of
water. Before the insertion of robotic arms, epidural infusion
of bupivacaine (0.25% at a rate of 5 ml/h) was started.
Patient was placed in a supine position with a 30° tilt to
the right. There was a decrease in systolic blood pressure
to 70 mm Hg after insufflation of CO₂ (15 mm of Hg) in
thoracic cavity, which responded to volume infusion and
reduction of CO₂ insufflation pressure (12 mm of Hg).
Robotic docking took 35 min, and dissection and removal
of the thymus took 55 min. Neuromuscular blockage was
reversed with neostigmine 2.5 mg and glycopyrrolate
0.4 mg and trachea was extubated after adequate
muscle strength observed on peripheral nerve stimulator
(train-of-four ratio 0.9). Urine output during surgery was
300 ml over 120 min and blood loss was about 200 ml. After
extubation, patient was shifted to the recovery room. Rest
of the postoperative period was unremarkable. Bupivacaine
(0.25%) infusion in thoracic epidural catheter was continued
for next 8 h and pain score on visual analogue scale was
satisfactory in the postoperative period. Oral prednisolone,
pyridostigmine and azathioprine were started immediately
on resumption of oral intake, and she was discharged next
evening after surgery.

Discussion

Thymectomy for thymoma has traditionally been performed
through a transternal approach because of the excellent
exposure and easy access. Over the past decade, because of
growing interest in minimally invasive surgical techniques,
video-assisted thoracic surgery has led to less frequent use
of the classic transternal approach. The RATT is the most
recent innovation in minimally invasive thymectomy, and first
RATT for the treatment of a small thymoma was performed
in 2001. [2]

Robot-assisted thoracoscopic thymectomy has brought new
challenges to the anesthesiologists, especially OLV with raised
intrathoracic pressure and patient positioning. Preoperative
preparation includes pulmonary function testing, its inference
and appropriate management. Transternal thymectomy may
compromise ventilatory mechanism and this is where robotic
technique has an advantage as the sternum is not disturbed
and minimal bleeding occurs.

Patient positioning is a great concern, RATT requires
position of the patient in such a way to allow docking of
the robot, the optimal alignment and free movement of its
arms. For left-sided procedures patient usually placed at the
left edge of the operating table in semirecumbent position
with the left side up using sand bags. The left upper limb
remains in abducted, extended and externally rotated to
accommodate the robotic arms. However, this position can
lead to neurovascular compression and nerve injury of the
left upper limb. Pandey and colleague in their case series of
17 patients undergoing RATT, suggested oximetry and
arterial blood pressure monitoring in the abducted arm
ipsilateral to the surgical approach. They observed that radial
artery cannulation ipsilateral to the surgical site gave a clue of
vascular compression by robotic arms by showing decreased
amplitude of the arterial waveform. However, authors suggest
that it is not a confirmatory method for assessing the same and
other more relievable monitoring like somatosensory evoked
potential can be used to identify neurovascular compromise
and thereby prevent injuries. The authors also suggest that
ipsilateral upper limb can be kept adducted and supported
along with patient in the beanbag or with the using of arm
sling.[3]

One lung ventilation is special concern in robotic thymectomy
and can present a challenge. Based on the critical care
literature, there does not appear to be a peak airway pressure
or plateau pressure level that is truly safe. A retrospective study
of 197 patients undergoing pneumonectomies did, however,
show that peak ventilation pressures above 40 cm H₂O were
associated with the development of post pneumonectomy
pulmonary edema.[4] Similarly, patients exposed to a plateau
pressure of 29 cm H₂O were at significantly higher risk of
developing acute lung injury after lung resection surgery than
those who had a plateau pressure of 14 cm H₂O.[5] Regarding
the mode of ventilation it has been suggested that use of PCV
reduce peak airway pressure (Ppeak) and intrapulmonary
shunt, thereby limiting the risk of barotrauma and improving
oxygenation, respectively.[6,7] On the other hand, Rozé et al.
in their study challenge the common clinical perception that
PCV offers an advantage over VCV during OLV by reducing
bronchial Ppeak. The authors concluded that during PCV
for OLV, the decrease in Ppeak is observed mainly in the
respiratory circuit and is probably not clinically relevant in the
bronchus of the dependent lung.[8] However, in the present
case changing the mode of ventilation from volume control
to pressure control helped to achieve the decrease in airway
pressure. It is a good idea to keep the peak airway pressure
levels <35-40 cm H₂O and plateau pressures <25 cm H₂O
to prevent intraoperative lung injury.

Postoperative analgesia is an important aspect for such
patients to allow full freedom of chest movements to enable
maximum respiratory dynamics and patient compliance.
Others have used local infiltration of bupivacaine (0.25%),

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supplemented with intravenous tramadol (100 mg 8 h) and diclofenac (75 mg) in the postoperative period and such patients were found to have an acceptable visual analog scale score. Although neuraxial analgesia minimizes pain and improves postoperative ventilation, the minimally invasive nature of the procedure, local infiltration with bupivacaine combined with other analgesics may suffice to give a satisfactory pain score.

Capnomediastinum increases the central venous pressure so urine output should be considered as a good criterion for adequacy of fluid status and it is suggested that a transesophageal echo to be used under such circumstances. Transient episodes of hypotension or arrhythmias may also occur during surgical dissection due to direct compression of the heart or major vessels by robotic instruments, capnomediastinum or by stretching of the pericardium. These episodes generally resolve by relieving the compression and did not require any pharmacological intervention.

Conclusion

The procedure specific concerns during anesthetic management of Robot-Assisted Thymectomy are limited to airway management and patient positioning. Continuous vigilance, monitoring of airway pressure and end tidal carbon dioxide can help avoid dislodgement of the endotracheal tube as robotic arms are manipulated. Special attention should be paid to positioning of the patient after induction of anesthesia, to not only secure airway but also to protect vulnerable pressure points to avoid injury to nerves.

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