Dexmedetomidine for anesthetic management of anterior mediastinal mass

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Abstract Anesthetic management of anterior mediastinal masses (AMM) is challenging. We describe the successful anesthetic management of two patients with AMM in which dexmedetomidine was used at supra-sedative doses. Our first case was a 41-year-old man who presented with a 10 × 9 × 11 cm AMM, a pericardial effusion, compression of the right atrium, and superior vena cava syndrome. He had severe obstruction of the right mainstem bronchus, distal trachea with tumor compression, and endobronchial tumor invasion. Our second case was a 62-year-old man with tracheal and bronchial obstruction secondary to a recurrent non-small-cell lung cancer mediastinal mass. Both patients were scheduled for laser tumor debulking and treatment of the tracheal compression with a Y-stent placed through a rigid bronchoscope. Both patients were fiberoptically intubated awake under sedation using a dexmedetomidine infusion, followed by general anesthesia (mainly using higher doses of dexmedetomidine), thus maintaining spontaneous ventilation and avoiding muscle relaxation during a very stimulating procedure. The amnestic and analgesic properties of dexmedetomidine were particularly helpful. Maintaining spontaneous ventilation with dexmedetomidine as almost the sole anesthetic could be very advantageous and may reduce the risk of complete airway obstruction in the anesthetic management of AMMs.

Keywords Mediastinal mass · Dexmedetomidine · Airway management

Introduction

The anatomical position of an anterior mediastinal mass within the thorax can predispose patients to severe respiratory and/or cardiovascular complications during anesthesia. These may include airway obstruction, compression of cardiac chambers, and/or compression of the pulmonary artery. We describe the successful anesthetic management of two patients with anterior mediastinal masses (AMMs) in which spontaneous ventilation was achieved with minimum respiratory depression by using dexmedetomidine at supra-sedative doses.

Case 1

The patient was a 41-year-old man with synovial cell carcinoma of the left lower leg complicated by pulmonary
metastasis. He had previously undergone a right upper lobe (RUL) resection, a left lower lobectomy, and chemotherapy. As his disease progressed he developed a 10 × 9 × 11 cm AMM (Fig. 1a, b), a pericardial effusion, multiple deep venous thromboses, pulmonary emboli, chronic airway obstruction, compression of the right atrium, and superior vena cava syndrome. He had severe obstruction of the right mainstem bronchus with tumor compression from the residual RUL. There was also extrinsic compression of the distal trachea and endobronchial tumor invasion of the remaining right lung, so he was ventilating from the left upper lobe and lingula only. The patient was very symptomatic, being short of breath with minimum activity, and his functionality was severely affected.

The plan was laser debulking of the tumor of the right lower and middle lobes and treatment of the compression with a Y-stent with a short left-sided limb.

Case 2

This patient was a 62-year-old man who initially presented a year before this procedure with shortness of breath and cough and was diagnosed with T4 N0 M0 tracheal cancer. He underwent initial laser debulking followed by chemotherapy (carbo-taxol), external beam radiation (5,940 cGy in 33 fractions), and brachytherapy application, with further brachytherapy 4 months later.

He remained well for two months when he noted progressively worsening shortness of breath, cough, hemoptysis, and wheezing. This led to a repeat CT scan (Fig. 2a, b), which demonstrated recurrence of the tracheal cancer with paratracheal mediastinal adenopathy. The tumor was judged to be unresectable locally and he was transferred to our tertiary care facility for further treatment. He was scheduled for bronchoscopic debulking and stenting.

Anesthetic management

Both patients were premedicated with 2 mg IV midazolam, followed by dexmedetomidine 1 mcg/kg IV infusion over 10 min as a loading dose and 0.6 mcg/kg/h to maintain sedation. The airway was topicalized with atomized lidocaine 4%. Following awake fiberoptic intubation with an 8.0 endotracheal tube (ETT), the dexmedetomidine infusion was gradually increased towards anesthetic levels (up to five times the maximum recommended dose for sedation; 0.2–0.7 mcg/kg/h). Small amounts of isoflurane (0.3%) for patient #1 and approximately 1.0% sevoflurane for patient #2 were also added. Adequate surgical anesthesia was assured by monitoring the patient’s movements in response to surgical stimulation and by using a BIS® monitor (Aspect Medical, Newton, MA, USA) where the BIS index was maintained between 40 and 60. Both patients maintained spontaneous ventilation throughout, sustaining adequate oxygenation. No muscle relaxant was used. Intraoperative arterial blood gas analysis for the second patient during the early phase of his surgery while on 100% FiO2 showed pH of 7.42, PaCO2 of 44.3 mmHg, PaO2 of 199 mmHg, BE of 4 mmol/L, sodium bicarbonate of 28.5 mmol/L, and O2 saturation of 97%. The tumor was lasered via a flexible bronchoscope with the FiO2 kept at approximately 30%. The ETT was then removed and a rigid bronchoscope was used for placement of the Y-stent and, in patient #2, further tumor debulking in a coring fashion using the barrel. Following successful stent placement, a tube exchanger was then introduced through the rigid bronchoscope and a 7.5 Parker ETT was railroaded over it after removal of the rigid bronchoscope. Our second patient had three episodes when his blood pressure fell from starting values of 120/60 mmHg to 80 s/50 s mmHg that was treated successfully with a bolus of 100 mcg of phenylephrine administered intravenously. On conclusion

Fig. 1 Patient # 1: a A volume-rendered 3D CT image in which the black space represents the mediastinal mass showing the effect on the airway. b CT showing the size of the calcified anterior mediastinal mass with lateral displacement and tracheal compression
of the procedure, the patients were transported to the post-
anesthesia care unit (PACU) on a T-piece circuit supplied
with 15 L/min of oxygen while breathing spontaneously.
Both were extubated about 30 min after arriving in the
PACU and reported no recall.

Discussion

We report the first successful use of dexmedetomidine as
almost sole anesthetic without muscle relaxation in the
management of a massive anterior mediastinal mass.

It has long been established that AMMs can precipitate
serious, life-threatening respiratory and cardiovascular
events [1]. The incidence of such complications in a
pediatric population is approximately 7–20% intraopera-
tively and approximately 18% postoperatively [2–6].
Because these were observations made in a pediatric pop-
ulation, it is difficult to project this into the adult popula-
tion [7]. However, extreme caution is advised in similar
adult scenarios.

Airway obstruction is a very real and dangerous com-
pliation of general anesthesia in patients with an AMM.
Three reasons have been given for this [8]. First, lung
volumes can be reduced to 0.5–1.0 L, reducing oxygen
stores. Second, general anesthesia relaxes airway smooth
muscle leading to increased compliance, thus making it
more likely to collapse under the pressure of the tumor.
Finally, loss of spontaneous diaphragm movement precip-
itates a decrease in transpulmonary pressure gradient leading to
a decrease in airway diameter. These factors all facilitate
tumor compression of the airway. If use of muscle relax-
ants is avoided, spontaneous ventilation counteracts these
mechanisms and maintains the negative intra-pleural
pressure. This has been highly recommended in the anes-
thetic management of AMM patients [9].

Intraoperative management can be extremely difficult in
patients with an AMM; a number of different conservative
anesthetic management plans have been suggested [10].
The patient should be intubated via awake fiberoptic
techniques with sedation while in the least symptomatic
position. Topical anesthesia and inhalational agents are
both good adjunctive courses of action.

Sedation, as an anesthetic technique, was not an option
in this case because of the need to use a rigid bronchoscope
to insert the plastic Y-shaped stent for tracheobronchial
support at the carinal level. We decided to proceed with
awake intubation followed by general anesthesia using
dexmedetomidine which, even at higher doses, allowed
spontaneous ventilation.

Dexmedetomidine is a selective a2 agonist with seda-
tive, analgesic, amnestic [11], and antialagalogue proper-
ties [12] that maintain spontaneous respiration with
minimum respiratory depression, making it quite suitable
for such cases. It is administered intravenously, the pre-
ferred route for anesthetic delivery in bronchoscopic sur-
gery. Patients under dexmedetomidine sedation are usually
ey easy to arouse [13], a property we exploited during awake
fiberoptic-assisted intubation [14].

To maintain adequate anesthesia during a very stimu-
lating procedure we used a relatively large dose of dex-
medetomidine (compared with the sedation dose range of
0.2–0.7 mcg/kg/h); this is considered to be an off-label use.
Such a large dose, or even larger, up to ten times the
maximum recommended sedation dose, has been reported
by Ramsay et al. as sole anesthetic agent in the anesthetic
management of complicated clinical challenges [15], albeit
in different circumstances in less stimulating procedures,
and mainly to avoid the use of supplemental oxygen that
could have increased surgical risk. In addition, low con-
centrations of isoflurane in the first case and sevoflurane in
the second case were used to complement the limited

Fig. 2  Patient # 2: a A
volume-rendered 3D CT image
showing the same (note what is
left of the tracheal lumen after
removal of the mediastinal mass
from the image). b CT showing
the size of the anterior
mediastinal mass with tracheal
compression (note the very
small flattened tracheal lumen)
and right main stem bronchus
intrusion

amnestic properties of dexmedetomidine [11]. At this dose neither isoflurane nor sevoflurane induced sufficient muscle relaxation to adversely affect respiratory function. It should be noted that many authorities recommend the use of sevoflurane in preference to isoflurane in similar situations, because it is claimed to cause less airway irritation.

The same line of thinking appealed to Ramsay et al. [16] when they used an anesthetic composed of 5 mg midazolam, dexmedetomidine infusion (up to 10 mcg/kg/h), and 1.0% sevoflurane in the anesthetic management of tracheal stenosis. Similarly, Nafiu et al. [17] used dexmedetomidine infusion as a sedative for a patient with a mediastinal mass undergoing Chamberlin’s procedure.

Clinicians intending to use dexmedetomidine must be aware of its side effects. Those few side effects which are an extension of its pharmacological actions have been reported to be increases in systemic and pulmonary vascular resistance and hypertension (induced by peripheral α-2B receptors) when high doses are infused rapidly. Also, hypotension, bradycardia, and decreased cardiac output are evident at concentrations twofold greater than the therapeutic level. We encountered some hypotension with our second patient that was successfully treated with a small dose of phenylephrine. Thus, vigilant monitoring is essential when high doses of dexmedetomidine are used.

It has been suggested that cardiopulmonary bypass be available on stand-by and that femoral vessel cannulation should be achieved prior to induction for cases with patients having a >50% reduction in airway diameter, as seen on a computed tomography scan [2, 10]. However, some have noted that even having bypass equipment on stand-by will not always ensure a good outcome [9]. Even with a bypass team on standby, it may take from 5 to 10 min for adequate oxygenation to be achieved after complete airway obstruction [18]. Although the patient is most likely to be resuscitated, there is a good chance of hypoxic neurological injury. This emphasizes the importance of utilizing an anesthetic plan that lessens the chances of the need for such a very invasive intervention.

We conclude that maintaining spontaneous ventilation with dexmedetomidine as almost the sole anesthetic could be very helpful and may reduce the risk of complete airway obstruction in the anesthetic management of an AMM.

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