Case Report

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Imaging Guided Thoracic Epidural Catheter Insertion In A Morbidly Obese Patient Undergoing Elective Thoracotomy.

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ABSTRACT

A 26-year old morbidly obese male with body mass index of 39 kg/m^2 was scheduled for an elective left thoracotomy for large loculated empyema. During pre-anaesthetic assessment, he had predictors of a difficult regional anaesthesia upon back examination such as indistinct thoracic spinous processes and intervertebral spaces. We planned for a combination of radiological imaging-assisted regional anaesthesia (mid-thoracic epidural catheterisation) and general anaesthesia for him. Prior to the procedure, the skin-epidural space distance at level T5 was measured as 8.32 cm from his transverse computed-tomography. A pre-induction ultrasound localisation of mid-thoracic spinous process and interspinous space (T5-6) was done. Epidural space was identified at the needle length of 8.5 cm (0.18 cm more than the CT-scan derived skin-epidural space estimation) and catheterised successfully, general anaesthesia with one-lung ventilation ensued. Pre-emptive thoracic epidural analgesia instituted and surgery was uneventful. Multi-modal analgesia applied and he was discharged from Intensive Care Unit four days later.

Keywords: thoracic epidural, morbid obesity, computed tomography, ultrasound.

INTRODUCTION

The prevalence of obesity in Malaysia is approximately 20% and many of them will require anaesthesia at any point of their life.[1] Generally, an epidural catheterisation provides perioperative analgesia, reduction of postoperative respiratory and sympathetic-related complications associated with pain.[2] These beneficial profiles promotes a more steady and enhanced systemic recovery in comparison of administering a conventional intravenous opioid. However, localising the epidural space correctly in a morbidly obese patient can be technically challenging for the anaesthesiologist in ensuring effective analgesia and avoiding potentially catastrophic morbidity such as spinal cord injury. More so when it is done at the thoracic region, hence the usage of radiological imaging may improve the success rate of performing it. We report our experience of a successful mid-thoracic epidural catheterisation in a young

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morbidly obese patient undergoing an elective thoracotomy after a preoperative assessment of the skin-epidural space depth from thoracic CT-scan and pre-puncture ultrasound localisation of the thoracic spinous process and interspinous space.

CASE REPORT

A 26-year old morbidly obese male (BMI: 39 kg/m^2), scheduled for an elective left thoracotomy for large loculated empyema. The patient was evaluated two days prior to surgery. He suffered prior community acquired pneumonia complicated with left lung empyema, previous transient ischaemic attack and hypercholesterolaemia.

Preoperatively, he denied any symptoms of obstructive sleep apnoea but claimed had snoring. Pre-anaesthetic assessment of his vital signs were: heart rate of 80 beats/min, non-invasive blood pressure of 130/84 mmHg, pulse oximetry oxygen saturation level (SpO_2) of 98%. He was clinically comfortable and respiratory assessment was consistent with left lung empyema. Bedside airway test revealed predictors of difficult bag-valve-mask (BVM) ventilation such as excess adipose tissues on the cheeks and neck circumference of 42 cm but otherwise he had Mallampati Class II with unrestricted neck flexion and extension. Thoracic spinous processes and intervertebral spaces were not appreciated on back examination due to excessive subcutaneous fat. Lung function tests revealed restrictive lung disease and a fair arterial blood gas. Other blood investigations such as full blood count, coagulation and renal profile were within normal limits. We opted for radiological imaging assisted mid-thoracic epidural catheterisation and analgesia (TEA) with general anaesthesia (GA) and one lung ventilation (OLV) for this patient. Despite having a difficult thoracic epidural anatomy, this method was chosen for its known post-operative pain relief, respiratory and circulatory benefits in an obese patient. The patient was also counselled for patient controlled analgesia morphine in view of an unsuccessful attempt of thoracic epidural catheterisation and he consented to this. The radiologist assisted us by measuring the distance from skin to epidural space at level T5 from his transverse computed tomography (CT-scan) and it measured as 8.32 cm (Figure 1). Anti-aspiration prophylaxis consisted of tablet ranitidine 150 mg and tablet metoclopramide 10 mg were given the night and one hour prior to the surgery. A written and informed consent for anaesthesia was taken after explaining the anaesthetic modes and their perioperative implications.

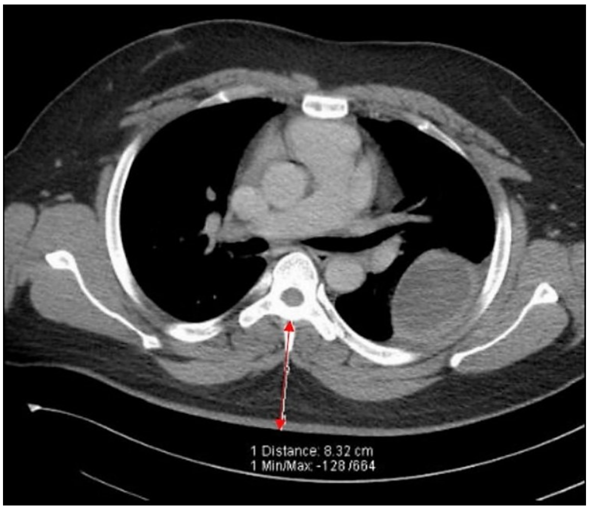

Figure 1**:** Transverse computed tomography of the mid-thoracic plane at level T5. Red arrow represents the perpendicular distance from skin to epidural space measuring at 8.32 cm.

On the day of the surgery, pre-induction monitoring were applied, these included five lead ECG, invasive blood pressure (inserted under aseptic technique at the left radial artery), pulse oximetry and capnography. Baseline vital signs were recorded: heart rate 85 beats/min, invasive blood pressure 134/82 mmHg and room air saturation was 98%. An 18-G intravenous cannula was in situ and Hartmann's solution was administered. On sitting up position, the mid-thoracic spinous process and interspinous spaces were visualised during pre-induction with ultrasound using a curvilinear probe (2-5 mHz) orientated transversely by tracking from the cervical (caudad direction) and lumbar region (cephalad direction) on the median plane. Level T5-T6 interspinous space was localised and marked at the midline. A paramedian sagittal oblique view was attempted but fail to visualize and identify the ligamentum flavum-dura matter unit. Under aseptic technique, the epidural space was located at the midline using 18-G Touhy needle of 8.8 cm length (from combined spinal-epidural set kit). The needle depth was 8.5 cm when the 'loss of resistance' to air was appreciated. Negative aspiration for blood and cerebrospinal fluid was confirmed, epidural catheter was inserted and placement was further confirmed with the 'hanging drop technique'. The epidural catheter was anchored to the skin at 13 cm with 4.5 cm of the distal end left in the epidural space.

He was placed on a troop elevation pillow and pre-oxygenated with 100% oxygen for five minutes. Induction, paralysis, two-handed BVM ventilation performed. Direct laryngoscopy showed Cormack and Lehane Grade I, a left-sided double lumen tube (DLT) inserted with confirmation by auscultation and fiberoptic bronchoscopy. He was positioned to the right lateral with adequate manpower and DLT placement was re-checked again with fiberoptic bronchoscopy. All pressure points were protected with silicone gel pads. Ropivacaine 0.37% of 3 ml aliquots were administered epidurally 10 minutes prior to surgical incision and every 10 minutes after surgery started with a total of 9 ml. General anaesthesia was maintained with sevoflurane and OLV commenced on the right lung.

No haemodynamic instability encountered, a cocktail of ropivacaine 0.1% and fentanyl 2 µg/ml infusion at 8 to 10 ml/hour was initiated at one hour after surgery started. Surgery was uneventful and lasted for two hours. He was reversed and extubated in a reversed Trendelenburg position and shifted to Intensive Care Unit (ICU) for observation. TEA was continued for three days with paracetamol and oral tramadol prescribed. Pain score was 0 to 2/10 with a satisfactory incentive spirometry of more than 2L achieved. He was discharged from ICU four (4) days later.

DISCUSSION

Patients planned for thoracotomy will routinely have a preoperative chest CT-scan, therefore an estimation of the CT-derived distance between skin to the epidural space can be estimated. Carnie et al described a concept to calculate the depth of needle insertion at the thoracic midline approach by using Pythagorean triangle trigonometry when perpendicular distance (measured from skin to the intended thoracic epidural space) and sin α (angle between the needle and thoracic vertebral body) are known.[3] They concluded that CT-derived depth appeared to be greater by the range of 0.03 to 0.49 cm than the actual depth. There were no correlations seen between either the CT-derived or the actual depth of the epidural space with age, weight, height or BMI. Sung et al used the same principles of trigonometry and found that there was a significant correlation between both the estimated CT-derived distance and the actual depth of the needle in performance of mid-thoracic epidural catheterisation.[4] In contrary, they demonstrated an actual depth of the needle reaching epidural space tended to have 1.25 times longer than the estimated distance on the CT-scan film. It showed a significant correlation between the actual length with both weight and BMI but not to age and height. In our case, the actual depth of the needle reaching the epidural space was 0.18 cm greater than the CT-scan derived distance between skin to the epidural space estimation. This finding is consistent with the study done by Sung et al. Practically, one would expect that the tissue of the back in a morbidly obese patient would be more compressible in supine position during CTimaging as compared to when they are sitting up during thoracic catheterisation. This potential differential compression based on the patient's position may support the fact that the actual depth of the needle reaching epidural space is longer than the estimated distance on the CT-scan film and anaesthesiologist should be aware of this.

Ultrasound imaging of the spinal region does not only identify the relevant landmarks but also able to provide an estimation of distance from skin to ligamentum flavum-dura matter unit (ultrasound depth), optimum insertion angle and insertion point of the epidural needle.[5,6] However, visualisation of the deeper structures such as ligamentum flavum-dura matter unit, epidural space and intrathecal space can be challenging in the morbidly obese patients. In our case, we used the ultrasound to facilitate the localisation of mid-thoracic spinous process and interspinous space as it was difficult to locate the deeper relevant structures. In obese patients, deeper structures are often obscured due to the beam attenuation of ultrasound waves which had to penetrate through a longer distance of soft tissues. Other reported factors that contributed to this poor imaging quality in the presence of excessive adipose tissue are: 1) the effect of phase aberration of sound field secondary to variable speed of sound in the overlying non-homogenous and irregularly-shaped fat layers and 2) the reflection of the ultrasound beam because of differing acoustic velocity at the fat-muscle interface.[7]

It is well reported that the ultrasound depth of skin to epidural space can be estimated if the ligamentum flavum-dura matter unit could be identified. Nishiyama showed a corrected shorter ultrasound depth ranging from 0.8 to 2.5 cm than the needle depth (distance from the skin to the tip of needle) for a thoracic epidural catheterisation in bariatric surgery among the morbidly obese.[8] Rasoulian et al found that the skin to epidural depth measured by an ultrasound had the tendency to underestimate the actual depth using needle among their thoracic surgery patients. This was probably secondary to probe-induced tissue compression or the intrinsic thickness of the ligamentum flavum.[9] However, Sahota et al demonstrated that ultrasound measured depth ranges from -14% to +17% of the actual needle depth, which was comparable in both sonographic transverse median and paramedian sagittal oblique plane.[10] The visualisation of the ligamentum flavum-dura matter unit and epidural space while performing a paramedian sagittal oblique view with the ultrasound was attempted in our case but to no avail, probably due to the presence of excessive adipose tissue. Applying different planes to estimate the ultrasound depth may be beneficial in those with poor sonoanatomy.

CONCLUSION

In conclusion, CT-derived distance between skin to epidural space with ultrasound localisation of the spinous process and interspinous space may be helpful as a guide and adjunct in mid-thoracic epidural catheterisation in morbidly obese patients for a better success rate and a favourable outcome.

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