Case report

Hemiarthroplasty performed under transversus abdominis plane block in a patient with severe cardiorespiratory disease

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Summary

This report describes the use of a transversus abdominis plane block as the main anaesthetic technique for the performance of a hemiarthroplasty in a patient with severe cardiac and respiratory dysfunction, for whom both general and spinal anaesthesia carried considerable risks. The block was performed in the triangle of Petit posterior to the mid-axillary line, using a landmark technique. A combination of lidocaine 1% (20 ml) and bupivacaine 0.5% (20 ml) was administered. A low-dose propofol infusion was used intra-operatively to relieve anxiety, although the patient breathed spontaneously throughout the procedure and responded to voice commands. The surgery was completed successfully without the need for further analgesia. The patient was alert and comfortable in recovery. First opioid administration was 12 h after surgery. The patient was subsequently discharged to a nursing home, where he succumbed to his primary respiratory disease six months later.

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The majority of patients presenting with a fractured neck of femur are classed as ASA physical status 3 or 4 [1]. The safest type of anaesthesia for these patients is widely debated. They often present with a complex mix of cardiac, renal and respiratory disabilities, each of which on their own represents a hazard for anaesthesia of all types. This probably explains why general and regional anaesthesia are associated with similar outcomes in this patient group [2]. Perhaps for these reasons, a significant number of patients do not receive surgical management [1]. Nevertheless, fixation of the fracture vastly improves patient comfort and ease of nursing, so formal repair, rather than conservative measures, should be considered even in very high-risk patients. Novel anaesthetic strategies are required to manage this challenging group.

The transversus abdominis plane (TAP) block has been described as a method for intra- and postoperative analgesia in a wide variety of settings [3]. As originally described, local anaesthetic injected into the triangle of Petit anaesthetises a significant portion of the thoracolumbar plexus, from approximately T10 to L1 [4]. However, successful use of this block for analgesia in pelvic procedures suggests that the TAP block may extend well below L1 [5, 6]. If this is so, there is a possibility that orthopaedic procedures involving the hip joint, which is innervated by the lumbosacral plexus, can benefit from this technique.

Case report

A 76-year-old male patient presented with a fractured neck of femur. He was scheduled for a right hemiarthroplasty. The patient had been living in his own
home before his fall, although he was dependant on home oxygen (2 l.min⁻¹) and rarely ventured outdoors. His past medical history included severe chronic obstructive pulmonary disease (COPD), and he had had a number of admissions for management of acute exacerbations dating back over the previous 20 years. At his most recent respiratory outpatient appointment before this admission, the patient reported breathlessness during conversation and while eating. However, it was considered that no further improvements could be made to his respiratory care. He had been declined elective repair of an epigastric hernia 12 years before this admission because the risk inherent in a general anaesthetic was considered too high. He had stopped smoking 10 years ago. In addition to these problems, the patient’s past medical history included paroxysmal atrial fibrillation and angina. Medications at the time of his trauma admission included amiodarone, tiotropium, theophylline, co-amilofruse, salmeterol/fluticasone and salbutamol inhalers, omeprazole and oral morphine sulphate solution.

At pre-operative examination the patient was cachectic (weight 63 kg, BMI 21 kg.m⁻²). He was dyspnoeic at rest with a respiratory rate of 20 breaths.min⁻¹. Although he was fully oriented, he was not able to give many details about his health. His peripheral blood oxygen saturation was 91–93% on 2 L.min⁻¹ of oxygen via nasal speculae, his pulse was 81 beats.min⁻¹ and his BP was 140/68 mmHg. An ECG showed sinus rhythm and an echocardiogram demonstrated a hypokinetic left ventricle, but the view was too poor to determine the ejection fraction or whether pulmonary hypertension was present. Urea and electrolyte results were normal, the haemoglobin concentration was 14.5 g.dl⁻¹ and the white cell count was elevated at 18.3 × 10⁹.l⁻¹. A peak expiratory flow measurement conducted at the bedside was 198 L.min⁻¹ (< 50% of predicted value).

Without a full understanding of the patient’s cardiovascular status, and in the setting of severe COPD, it was decided that the patient was not suitable for general anaesthesia and that spinal anaesthesia might result in dangerous levels of hypotension. After careful consideration of the innervation of the hip joint and likely spread of local anaesthesia, it was decided to offer the patient a hemiarthroplasty under a TAP block, on the understanding that this was a novel anaesthetic technique for this operation.

The procedure and its novel aspect were explained to the patient. It was agreed that the operation would not proceed if surface anaesthesia could not be demonstrated pre-operatively. If that were the case, a spinal anaesthetic would be used, accepting the greater risk that this would involve. Oxygen at 2 L.min⁻¹ was administered via a Hudson mask, and midazolam 2 mg and ketamine 20 mg were given for relaxation and analgesia during performance of the block. The right side of the abdomen was exposed and a landmark technique was used to identify the triangle of Petit. A 50-mm Polymedic needle (Blue Box Medical Ltd., Southampton, UK) was placed posterior to the mid-axillary line, directly above the iliac crest, so that the needle lay on the base of the triangle of Petit. The needle was directed perpendicular to the skin, and the TAP was detected using the 'double pop' technique [7]. Twenty millilitres of lidocaine 1% (200 mg; 3.2 mg.kg⁻¹) and 20 ml bupivacaine 0.5% (100 mg; 1.6 mg.kg⁻¹) were injected. After 30 min, loss of sensation to pain and cold could be demonstrated over the approximate range of the T11-L3 dermatomes covering the surgical site. The hip joint could be flexed and extended by the surgeon without patient discomfort. Formal motor block was not tested, but the patient could move his toes. The patient was placed in a lateral position. Light propofol sedation was commenced at 40 ml.h⁻¹ (6.4 mg.kg⁻¹.h⁻¹) and the patient breathed spontaneously throughout the procedure and was arousable by speech. A right uncemented bipolar hemiarthroplasty was performed. The procedure took approximately 45 min to complete ‘skin-to-skin’. No further local anaesthesia was required.

In recovery, the patient was alert and comfortable and vital signs were stable. Salbutamol was given to control continuing wheeze. The visual analogue score for pain was 1 out of 10. The first opioid administration was 10 mg oral morphine solution 12 h postoperatively. Paracetamol 1 g and dihydrocodeine 30 mg four times daily were given routinely for the first week postoperatively. Postoperative recovery was slow because of poor mobility secondary to his respiratory problems, and he was ultimately transferred to a care
home where he died from respiratory complications of his COPD six months after surgery.

**Discussion**

This case report describes the successful use of a TAP block and light intravenous sedation to perform a hemiarthroplasty on an elderly male with severe cardiorespiratory morbidities for whom standard anaesthetic management, both regional and general, presented considerable risks. The patient had severe respiratory dysfunction, which precluded general anaesthesia, coupled with an indeterminate degree of left ventricular dysfunction, which also placed him at risk of severe hypotension if spinal anaesthesia was attempted. A lumbar plexus block was considered, but the patient was unable to co-operate with positioning, and the risks associated with this technique were considered to outweigh the benefits. Although conservative management was a possibility, it was decided that if a satisfactory regional blockade could be achieved, repair of the fractured neck of femur would vastly improve patient comfort and aid nursing care. The TAP block was employed after consideration of the anatomy of the nerve supply to the hip and the potential likely spread of local anaesthetic. Spinal anaesthesia was agreed beforehand as the appropriate rescue technique in the event of failure of the TAP block. A low-dose propofol infusion was used intra-operatively to relieve patient anxiety.

The sensory innervation of the hip joint arises from multiple sources. It includes branches from the femoral, sciatic and superior gluteal nerves, with a variable contribution from the obturator nerve [8]. Therefore, to achieve a sensory block of the hip joint, a significant proportion of the lumbosacral plexus, from L2 to S2, has to be anaesthetised. In the case reported here, formal testing of the full extent of the sensory block was difficult, but certainly extended to L3. Studies of the spread of local anaesthesia injected into the triangle of Petit suggest that the principal area covered is T10-L1, although the degree of spread appears to be dependent on injection technique and is still a matter of considerable controversy [3, 9]. The fact that the TAP block has been used to provide effective postoperative analgesia in radical prostatectomy implies that sacral spread of local anaesthetic can occur, as the prostate has a significant sacral sensory innervation [5, 10, 11]. The block was placed at the base of the triangle of Petit, directly above the iliac crest. In this position, cephalad spread of local anaesthetic is unlikely [12]. For TAP blocks placed posterior to the mid-axillary line, as in this case, local anaesthetic spreads in a posterior direction towards the paravertebral region [13]. The high total volume of local anaesthetic infused (total 40 ml) may have resulted in a greater paravertebral spread than has been reported previously. Therefore, the success of the TAP block described here probably relates to a large volume of local anaesthetic being directed in a caudad and paravertebral direction, covering a significant number of dermatomes and providing analgesia to the lumbosacral plexus.

The high volume of local anaesthetic used raises the possibility of toxicity. Adrenaline was not used because of the risk of tachycardia in a patient with ischaemic heart disease. Information on the potential cumulative toxic effects of combined agents is limited. However, combinations of short- and long-acting agents are commonly used in orthopaedic procedures, especially for daycase surgery, and toxicity is rarely reported in spite of the high volumes used [14]. In this patient, the total dose of each individual agent was significantly below the toxic dose for each agent, and no signs or symptoms of local anaesthetic toxicity were detected. Nevertheless, in performing this technique, very close attention should be paid to the amount of local anaesthetic given and the surgeon prevented from giving further doses intra-operatively. In this case, if the degree of analgesia had been insufficient for surgery, the plan was to halt the procedure temporarily and administer a spinal anaesthetic, which would have required only a small volume of bupivacaine.

Analgesia provided by single-shot local anaesthesia will recede, so appropriate oral analgesia should be prescribed for the postoperative period. In this patient, the first opioid requirement was 12 h after surgery, and oral analgesia was required for several days during the rehabilitation period. A future development for TAP blocks in these patients might include continuous infusion techniques for postoperative analgesia to facilitate mobilisation.

The patient was very anxious before surgery and a propofol infusion was commenced to enhance patient...
comfort. Although the patient breathed spontaneously throughout the procedure and responded to verbal commands, it should be considered whether the propofol infusion induced a degree of anaesthesia, which contributed to the efficacy of the block. In patients with fractured neck of femur, the mean dose of propofol required to induce anaesthesia depends specifically on BMI and cognitive function [15]. In patients with a BMI < 23 kg.m$^{-2}$, the mean propofol infusion rate to induce anaesthesia sufficiently deep to allow intubation is approximately 4 mg.min$^{-1}$, although the variation is wide and very dependent on cognitive status [15]. Although a formal assessment of mental status was not carried out in this patient, he was fully oriented and aware pre-operatively and able to provide his own consent for operation. The rate of propofol infusion used in this case was 6.7 mg.min$^{-1}$, which is greater than the mean anaesthetic infusion rate for a patient with a BMI of 21 kg.m$^{-2}$.

However, this patient had good cognitive function and was somewhat anxious pre-operatively. Although he appeared to doze throughout the procedure, he was easily arousable. On balance, while the propofol infusion induced a degree of light hypnosis, it is unlikely that this would have been sufficient to provide anaesthesia for the operation without the addition of the TAP block.

In summary, this report suggests that a TAP block placed in the base of the triangle of Petit posterior to the mid-axillary line may be employed in the anaesthetic management of high-risk patients presenting for hemiarthroplasty. The technique may also be of value for postoperative pain relief even in patients who have a general or spinal anaesthetic for their surgical procedure.

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Competing interests
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References
14. Jafari S, Kalstein AI, Nasrullah HM, Hedayatnia M, Yarmush JM, SchianodiCola J. A randomized, double-blind trial comparing 3% chloroprocaine followed by 0.5% bupivacaine to 2% lidocaine followed by 0.5% bupivacaine for interscalene brachial plexus block. Anesthesia and Analgesia 2008; 107: 1746–50.