Case Report

A novel approach to spinal anaesthesia to avoid aerosol-generating procedures in a patient with COVID-19 presenting for laser prostate surgery

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Summary

General anaesthesia involves aerosol-generating procedures which, in the context of the coronavirus 2019 (COVID-19) pandemic, increases the risk of severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) transmission from patients to staff. This risk can be minimised by performing spinal or regional anaesthesia instead of general anaesthesia where possible. We report the successful management of a patient utilising spinal anaesthesia in a patient with COVID-19 undergoing urgent holmium laser enucleation of prostate for symptomatic benign prostatic hyperplasia. A combination of bupivacaine, diamorphine and midazolam was administered intrathecally which provided adequate anaesthesia despite the prolonged surgical duration. Nebulised lidocaine was also given to prevent coughing during the procedure. This report demonstrates that it is possible and safe to use spinal anaesthesia to perform prolonged surgical procedures that are normally conducted under general anaesthesia using a combination of intrathecal adjuncts to facilitate effective block duration. In addition, the novel use of nebulised lidocaine for its antitussive effects in a patient with COVID-19 is highlighted.

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Introduction

The course of a routine general anaesthetic potentially involves a number of aerosol-generating procedures including manual ventilation; tracheal intubation; extubation; and the suctioning of secretions [1]. Performing aerosol-generating procedures in patients with coronavirus disease 2019 (COVID-19) places staff at increased risk of exposure to the severe acute respiratory syndrome-coronavirus-2 (SARS-CoV-2) virus with potentially tragic consequences. In the UK as of 22 April 2020, over 100 healthcare workers have sadly died from COVID-19 [2]. While it is currently unknown if these deaths are directly attributable to workplace transmission or other factors, it is prudent to minimise the risk to staff health by refraining from aerosol-generating procedures whenever possible.

We present the management of a patient where we avoided giving general anaesthesia to an elderly man with COVID-19 who presented for urgent laser prostate surgery. Instead, spinal anaesthesia was performed using a combination of adjuncts to prolong the effective duration of the block, and lidocaine was nebulised to prevent coughing during the procedure. These strategies, we suggest, may be useful in reducing the reliance on aerosol-generating procedures in providing anaesthesia during the COVID-19 pandemic.

Report

An 88-year-old Afro-Caribbean man presented for urgent holmium laser enucleation of prostate (HoLEP) surgery. He had a history of recurrent hospital admissions for a blocked urinary catheter and haematuria secondary to benign prostatic hyperplasia (prostate size 180 cm^3). On prior attendances, a new urinary catheter had been inserted and a bladder washout was performed. However, on this presentation, he was also severely anaemic which necessitated a blood transfusion. As his hospital admissions were becoming more frequent, he was listed for urgent surgical intervention.

He was not prescribed any medication and had no comorbidities apart from mild hypertension. A throat swab, taken on admission, was positive for SARS-CoV-2. Apart from a sporadic cough, however, he had no other symptoms of COVID-19.

It is standard practice at our hospital to perform HoLEP surgery under general anaesthesia due to the duration of procedure (up to 3 h) and to minimise patient movement or coughing which could present risks for the patient and technical difficulties for the surgeon.

We decided to perform spinal anaesthesia in this patient for several reasons. Firstly, the patient was SARS-CoV-2 positive and subjecting him to 3 h of invasive positive pressure ventilation could have potentially increased his risk of developing COVID-19 pneumonia. Secondly, tracheal intubation and extubation are aerosol-generating procedures which would put staff at risk of viral transmission. Thirdly, he was at an increased risk of post operative cognitive dysfunction as a consequence of his advanced age.

The operating surgeon was agreeable to spinal anaesthesia providing that the block would last for the duration of the surgery and that the patient would not cough during morcellation, the part of the procedure during which the prostate tissue is divided into small pieces using the laser.

An 18G intravenous cannula was inserted in the patient's hand and he was positioned sitting upright in preparation for the spinal anaesthetic. Ephedrine 30 mg was administered intramuscularly. The following mixture was then prepared in a single syringe: 3.5-ml hyperbaric bupivacaine 0.5%; diamorphine 500 μg; preservative-free midazolam 1.5 mg. The total volume of the injectate was 5.5 ml.

Following standard aseptic precautions and local anaesthesia to the skin, a 25G 90-mm spinal needle was inserted at the L3/L4 interlaminar interspace using a paramedian approach. Once free-flowing cerebrospinal fluid was observed, the mixture was injected and the patient immediately placed in the Trendelenburg position. Block height immediately before surgery when checked with an ethyl chloride spray was T6 bilaterally. The patient was then placed in the lithotomy position for surgery. Intravenous medications administered intra-operatively comprised gentamicin 320 mg; co-amoxiclav 1.2 g; paracetamol 1 g; and magnesium sulphate 2.5 g.

To minimise the risk of coughing, 10 ml of lidocaine 2% was administered through an oxygen-driven nebuliser at 5 $l.min^{-1}$, about 10 min before morcellation. The morcellation process took a total of 70 min and the patient did not cough in this period. The duration of the entire surgical procedure was 190 min. One hundred and twenty-eight grams of enucleated prostate tissue was retrieved. Upon completion of the procedure, the patient had a residual sensory block higher than T10. When questioned, he commented that he was comfortable throughout the entire operation. The remainder of his hospital stay was uneventful and he was discharged 4 days later.

Discussion

Aerosol-generating procedures generate minute airborne particles (<5 μm diameter) which may contain viral material. These particles can penetrate standard surgical masks, contaminate a wider dispersal radius than droplets and remain suspended for several hours in stagnant air [1]. While personal protective equipment (PPE) reduces the risk of virus transmission, it is important to remember that no PPE is 100% effective and that every aerosol-generating procedure places healthcare staff at risk.

As SARS-CoV-2 is contagious, a strategy to minimise aerosol generation in an infected patient would be to completely refrain from performing aerosol-generating procedures. This might be possible in the operating theatre context by shunning general anaesthesia, hence avoiding four aerosol-generating procedures: tracheal intubation; extubation; suctioning; and manual ventilation.

A range of surgical procedures typically performed under general anaesthesia for reasons of patient, surgical or anaesthetic preference can be safely performed solely under regional anaesthesia (Table 1). Upper limb surgery could be carried out under brachial plexus block, distal lower limb surgery under combined femoral and sciatic nerve block and more proximal lower limb surgery under spinal anaesthesia. Mastectomies can be performed under thoracic epidural or with a combination of fascial plane blocks [3]. Laparoscopic surgery on the bowel and gallbladder has been safely carried out under spinal anaesthesia [4, 5].

Table 1 Examples of surgical procedures and suitable regional anaesthetic techniques.

Surgical procedures	Suggested non-general anaesthetic alternatives
Hand, wrist, forearm, elbow surgery (e.g. orthopaedics/plastics/fistula formation)	• Supraclavicular brachial plexus block • Infraclavicular brachial plexus block • Axillary brachial plexus block
Shoulder surgery	• Interscalene brachial plexus block
Foot and ankle surgery	• Sciatic +/− femoral nerve block • Neuraxial anaesthesia
Hip and knee surgery	• Neuraxial anaesthesia
Abdominal and pelvic surgery, including: • Urological surgery (e.g. testicular torsion, nephrectomy) • Laparoscopic surgery (e.g. cholecystectomy, bowel resection) • Open abdominal surgery (e.g. appendicectomy, laparotomy) • Gynaecological surgery (e.g. hysterectomy, ovarian procedures)	• Neuraxial anaesthesia
Breast surgery	• T4 epidural • Paravertebral blocks at T2/T3 and T3/T4, and pecs-2 block
Anorectal surgery	• Neuraxial anaesthesia

The first author's personal experience in the developing world substantiates that, with an appropriately selected patient and experienced surgeon, the majority of surgery below the level of the diaphragm can be safely conducted solely with neuraxial anaesthesia. This includes open appendicectomies, laparotomies for bowel obstruction and cholecystectomies. This technique is particularly beneficial in low-resource settings where a lack of adequate intra-operative monitoring, post operative care and trained staff mean that the use of general anaesthesia could represent an unacceptably high risk.

The abdominal and pelvic viscera are innervated predominantly by the thoracic (T5–T12), lumbar (L1–L2) and pelvic (S2–S4) splanchnic nerves. Therefore, a block height of T4 or higher would usually be sufficient to facilitate most abdominal surgery even on the bowel and other visceral organs. However, diaphragmatic irritation from surgical manipulation can result in shoulder-tip pain via the phrenic nerve which would not be adequately covered with safe neuraxial anaesthesia. Fortunately, this pain is usually short-lived and is normally amenable to boluses of a rapid-acting analgesic such as alfentanil.

Intrathecal adjuvants have properties not conferred by local anaesthetics alone. Useful attributes include improved block quality; prolongation of sensory block; and increased duration and quality of post operative analgesia. Undesired side-effects include hypotension; delayed respiratory depression; nausea and vomiting; and pruritis. Common intrathecal adjuvants used in include fentanyl and diamorphine; other adjuvants include morphine; pethidine; tramadol; adrenaline; clonidine; dexmedetomidine; dexamethasone; magnesium sulphate; ketamine; midazolam and neostigmine [6].

The combination of intrathecal midazolam and diamorphine contributed to the prolonged sensory block in our patient. It is thought that intrathecal midazolam exerts its anti-nociceptive effects by binding to the GABA-A receptors in the spinal cord; it has been used in the management of acute peri-operative pain; chronic pain; and cancer pain [6, 7].

A meta-analysis on the use of intrathecal midazolam in surgical patients concluded that it reduced the incidence of nausea and vomiting, delayed the time to first rescue analgesia, had no effect on duration of motor block and did not increase the incidence of neurological symptoms in relation to placebo [7]. Shandangi et al. performed a double-blind randomised controlled trial in which 100 patients presenting for elective surgery received 3 ml hyperbaric bupivacaine 0.5% with either 2 mg midazolam in 0.4 ml saline or 0.4 ml of saline only [8]. They noted that whereas there was no difference in the duration of motor block, there was a statistically and clinically significant prolongation of the sensory block duration and time to first rescue analgesia.

Studies in small animals where very large doses of intrathecal midazolam (up to 0.5 $mg.kg^{-1}$) were administered have raised concerns about the potential for neurotoxicity [6, 7], though these findings have not been replicated in larger animals or humans; a cohort study of 547 patients did not demonstrate an increased risk of neurological events [7]. Furthermore, it is unclear if the authors in the small animal studies used preservative-free midazolam.

Nebulised lidocaine is frequently used for topical anaesthesia before awake airway instrumentation. It has also been used to manage refractory post operative laryngospasm and to suppress intractable cough in patients with upper airway disease,

respiratory tract infection or malignancy [9]. In our case, nebulised lidocaine was used to suppress the cough reflex in order to facilitate safe surgery. While the antitussive mechanism of lidocaine is not completely understood, it is thought that it relates to its local anaesthetic properties. Lidocaine inhibits conduction of afferent nerve impulses resulting in improved tolerance to respiratory irritants [9], hence a reduced urge to cough.

Drug delivery by nebulisation is not considered to be an aerosol-generating procedure in the UK; the new and emerging respiratory virus threats advisory group states '*if a particle in the aerosol coalesces with a contaminated mucous membrane, it will cease to be airborne and therefore will not be part of an aerosol*' [1]. Whereas nebulisation generates aerosols from the fluid in the nebuliser chamber, this aerosol is not derived from patient secretions and hence does not transmit patient-derived virus particles. Furthermore, as nebulised lidocaine has antitussive properties, it should reduce the risk of cough-related virus transmission.

While regional techniques are advocated in the context of COVID-19, it is paramount that neuraxial blocks are of sufficient quality and longevity to prevent an unwanted and potentially hazardous conversion to general anaesthesia [10]. We suggest that a combination of intrathecal adjuncts, namely preservative-free midazolam 1–2.5 mg and diamorphine 0.3–1 mg with 15–20 mg of racemic bupivacaine depending on the desired block height, may be useful in this regard for the non-obstetric population. Other precautions to consider when performing neuraxial anaesthesia include donning appropriate PPE; ensuring that patients wear a surgical facemask when able; and using minimal supplemental oxygen [10]. As with any other patient undergoing neuraxial anaesthesia, one should be vigilant for hypotension and a high block level. The former can be treated with preloading or co-loading with fluids, or the prophylactic administration of vasopressors, while the latter can be managed with vigilance and adjusting the position of the operating table accordingly.

The above procedure could also have been carried out under combined spinal epidural anaesthesia and indeed this would have been the technique of choice if a significantly longer procedure was anticipated. However, with the first author's previous experience with using intrathecal adjuncts to provide spinal anaesthesia of an appropriate duration it was felt that a single-shot spinal with a small gauge needle was preferable to a larger epidural needle with its associated risks in this case.

With the COVID-19 pandemic, a 'quick easy general anaesthetic' no longer exists as it involves several aerosol-generating procedures which carry a risk of viral transmission, morbidity and mortality to healthcare workers. We have a duty of care not only to the patient but also to our fellow colleagues. Where possible, we should strongly consider regional and neuraxial anaesthesia over general anaesthesia in cases where we would not normally consider them, providing that it is safe to do so.

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