

Spinal Anesthesia for Lumbar Surgery in the Elderly Patient

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ABSTRACT

A 22 year old primi diagnosed as Eisenmengers syndrome with severe pulmonary hypertension with bidirectional shunt and room air saturation of 78% was taken up for emergency caesarian section under thoracic segmental spinal anaesthesia with low volume isobaric 0.5% levobupivacaine and fentanyl. Patient was haemodynamically stable during the intraoperative and postoperative period and was discharged safely on the 10th postoperative day. Thoracic segmental spinal anaesthesia with isobaric levobupivacaine is a good alternative to epidural and general anaesthesia in patients with cardiac and respiratory diseases.

Keywords : Spinal anesthesia; Surgeries; Neuromonitoring; Elderly patients

INTRODUCTION

By the year 2054, the US population is projected to mature to where 1 in 5 citizens are over age 65 [1]. Given their increased prevalence of degenerative conditions, the elderly comprise an outsized proportion of surgical patients [2]. It has been reported that 45% of neurosurgery cases are performed on the elderly (>65 years old) [2]. Meanwhile, cognitive impairment and dementia are predicted to become the leading health issue in this demographic given continued advances in oncologic and cardiovascular outcomes [3]. Therefore, there is much current interest in utilizing regional anesthetic techniques whenever possible in elderly patients. This is because the elderly patient has decreased functional and cognitive reserve, and general anesthesia confers a significant risk of Postoperative Cognitive Dysfunction (POCD) and other complications associated with polypharmacy [4,5]. POCD is a common occurrence with up to 41% of patients over age 60 developing POCD after use of general anesthesia in major non-cardiac surgery [6]. There are numerous adverse sequelae from POCD including increased mortality, decreased quality of life, and exacerbation of underlying disease [7,8]. There is much data suggesting a reduction in POCD and polypharmacy with the use of regional anesthesia thus the anesthetic modality may have serious implications on the overall postoperative outcome in elderly patients.

General Endotracheal Anesthesia (GEA) is by far the most commonly used anesthetic in spine surgery. Despite the

concerns for POCD with general anesthesia, there are several reasons that spine surgeons have been reticent to consider regional anesthetic options, such as spinal anesthesia, for lumbar surgeries. Most important is the concern for airway loss given that patients are generally positioned prone during the procedures. Additionally, potential for patient movement, loss of effect due to intraoperative durotomy, and incompatibility with neuromonitoring and image-guidance technology are other potential roadblocks. In this review we share our experience with spinal anesthesia, our regional technique of choice, in simple and complex lumbar surgery and conclude it is a safe modality with numerous advantages compared to GEA. Although frequently used in orthopedic hip and knee surgeries, its use in lumbar spinal surgery has heretofore been limited. Spinal anesthesia provides various clinical benefits when compared to general anesthesia including increased perioperative hemodynamic stability, decreased post-operative nausea, urinary retention, opioid requirements, POCD etc., [4,9,10]. Thus, unless otherwise contraindicated, spinal anesthesia may be routinely considered for elderly patients having lumbar surgery and may in time emerge as the anesthetic modality of choice.

SPINAL ANESTHESIA IN LUMBAR SURGE

Despite the common nature of lumbar surgeries in the elderly patient and the risks of GEA, use of regional anesthesia in lumbar surgery has not been significant. The first use of spinal

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anesthesia in spine surgery dates back to 1898 in which German surgeon August Bier performed a lumbar puncture to inject cocaine intended to promote anesthesia [11]. In the 1960's, use of spinal anesthesia for spine surgery was a common occurrence but with the evolution of more complex surgeries and longer operative times, general anesthesia grew in popularity and usage [11]. Overall, spinal anesthesia has been infrequently used for simple spine surgeries like laminectomies, discectomies, and foraminotomies with shorter operative times compared to complex surgeries. Over the last 30 years, the use of spinal instrumentation has exploded along with evidence indicating the clinical superiority of adding fixation and fusion in common conditions such as lumbar spondylolisthesis [12,13]. Studies reports that the number of lumbar fusions performed doubled in the 1980's, tripled in the 1990's and are still on the rise [14]. Spinal anesthesia for complex spine surgery has generally been avoided in all age groups, including the elderly, due to a lack of supporting literature on its safety. Risk of conversion to general anesthesia, difficulty in the prone position for the duration of surgery, and increased medical complexity are barriers responsible for the hesitancy of spinal anesthesia use. Given the outsized benefits of spinal anesthesia there is need for increased acceptance of the modality in elderly patients undergoing complex spine surgeries.

SAFETY AND EFFICACY OF SPINAL ANESTHESIA

Recent studies have shown that spinal anesthesia is safe and effective in complex as well as simple lumbar surgeries. Our group conducted a study of 345 consecutive patients who had undergone simple and complex spine surgery with spinal anesthesia [11]. We found minimal intraoperative and postoperative complications in both groups. Most importantly, spinal anesthesia was highly effective and no patients required conversion to GEA intraoperatively. In patients undergoing complex lumbar procedures specifically, 0% of patients experienced a CSF leak, DVT, or wound infection. A small proportion of fusion patients experienced postoperative hypotension (6.1%), urinary retention (6.1%), pneumonia (1.1%), UTI (0.6%), and AFib during hospitalization (5.5%). Patients who underwent simple spine surgeries experienced similar rates of the previously listed post-op complications. Although this study was not conducted exclusively on elderly patients, other studies have yielded similar results. These findings also apply to the extreme elderly (>80 years old), an even more vulnerable population [15]. We reported our experience using spinal anesthesia in 46 patients over 80 years of age that had undergone simple and complex lumbar spine surgery. There were also no cases of intraoperative conversion to GEA in this cohort and surgical morbidity was low. We reported a 0% incidence of the following postoperative complications: Spinal headache, deep vein thrombosis, pneumonia, and urinary tract infection. 8.7% of patients developed urinary retention, 6.5% had intraoperative visualization of dural puncture, and 2.2% received an acute pain services consult. Another study by Lessing et al. was conducted on 56 elderly patients who had received spinal anesthesia for lumbar spine surgery [9]. The researchers found no instances of permanent

loss of function, mortality, stroke, or pulmonary embolism. 5% of their cohort (3 patients) experienced major complications including myocardial infarction, wound infection, and bradycardia leading to the placement of a pacemaker. With such low rates of intra and postoperative complications, these studies show that spinal anesthesia is a viable anesthetic modality in elderly patients undergoing spine surgery.

In addition to being safe and effective in the elderly, spinal anesthesia also provides cognitive benefits, a decreased carbon footprint, decreased length of stay, and lower costs. A study by Brown et al., reported that Post-Operative Delirium (POD) may be as high as 40% in elderly spinal surgery patients undergoing GEA [16]. Reducing polypharmacy has been established as a significant preventative measure against POD and is of particular importance in the elderly population [17]. Spinal anesthesia reduces the number of perioperative medications and is therefore likely effective in the prevention of POD. We have also investigated the carbon footprint of spinal and general anesthesia in single level Transforaminal Lumbar Interbody Fusions (TLIF) [18]. We found that on average, general anesthesia produces 22,707 g of carbon dioxide equivalents (CO₂e) in one TLIF procedure versus 63 g produced by spinal anesthesia. This reduction in CO₂e is due to the elimination of volatile gases used in general anesthesia and meaningfully decreases the carbon footprint during these procedures. This is the first known report to investigate the effect of general vs spinal anesthesia on carbon footprint in the neurosurgical literature. The length of hospital stay and cost are significant factors in the healthcare that can be reduced by *Via* use of spinal anesthesia. A study by Agarwal et al. Reported shorter length of stay for patients undergoing simple lumbar surgery under spinal anesthesia when compared to general anesthesia. This, among other factors, allowed for an overall reduction in total cost of 39.6% [19].

Some spinal surgeons have been reluctant to use spinal anesthesia due to potential problems with intraoperative navigation or neuromonitoring. Fortunately, we have shown that awake and natively respiring patients do not appear to degrade intraoperative Computed Tomography (CT) images [20]. We have reported the use of spinal anesthesia with concurrent CT for navigated instrumentation placement in elderly patients undergoing TLIF procedures. We found that intraoperative CT increased operative time by an average of 6.3 minutes and had no impact on completion of the case within the time allotted by one spinal anesthesia dose, and image quality remained unaffected. Similarly, Triggered Electromyography (tEMG) is often used for intraoperative neuromonitoring in spine surgeries done under general anesthesia, but its effectiveness in spinal anesthesia cases has been unclear. We have shown that tEMG is safe and effective in lumbar surgery accomplished with spinal anesthesia (Matthew Kanter, M.S., unpublished data, 2022). Thus, use of intraoperative tEMG neuromonitoring should not contraindicate the use of spinal anesthesia.

Not all patients are candidates for spinal anesthesia, however. In our practice, we use spinal anesthesia in approximately 70% of eligible procedures (lasting < 3 hours) and the remainder is done

under general. We avoid spinal anesthesia in patients with extreme obesity (BMI \geq 40) due to the difficulty of performing a dural puncture and discomfort while prone.

Similarly, patients with severe scoliosis are typically done under general anesthesia given the difficulty of dural puncture. Lastly, spinal anesthesia is avoided in patients who have a strong preference for general anesthesia, usually related to anxiety.

Spine anatomy shows that the space between durameter and the spinal cord in the thoracic region is greater when compared to the space in the lumbar area. MRI shows a distance of 4.8-5.6 mm between the cord and the durameter at thoracic levels, so the risk of spinal cord injury is very rare if done by expert. Now with ultrasound guided thoracic spinal the risk of injury is almost nil [4,5].

FUTURE DIRECTIONS

Although spinal anesthesia has been shown to be safe in the elderly, more studies are needed to support its use in spine surgeries. Elderly patients often seek other anesthetic modalities when presented with the option of general anesthesia due to the known associated risks [16]. With increased support and visibility, elderly patients stand to benefit the most from the use of spinal anesthesia. Similarly, studies directly evaluating the rates of pre-operative and intraoperative conversion to general anesthesia in the elderly are warranted. Lastly, studies reporting risk factors for failed spinal anesthesia, when induction fails to achieve the required anesthetic effect, are of clinical significance considering no studies currently report reasons for failure. Lastly, POCD in the elderly patient has a complex causality where anesthesia and polypharmacy play a partial role. Further studies are necessary to elucidate the contributions of other factors such as pain, frailty, and inflammation.

DISCUSSION AND CONCLUSION

Spinal anesthesia is a safe and effective modality in elderly patients undergoing simple and complex lumbar surgeries. Numerous advantages have been reported including reduced postoperative cognitive issues, shorter length of stay, reduced cost, and reduced carbon footprint. More studies are needed to garner widespread acceptance of spinal anesthesia in this population. It is reasonable to conclude presently that spinal anesthesia is a valid alternative to general anesthesia and it is very possible that in the future spinal anesthesia will be the preferred modality in elderly patients.

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