Dexmedetomidine VS. Propofol: haemodynamic changes in conscious sedation in arthroscopic shoulder surgery in the beach chair position: A randomized control trial.

Minura Hapugoda\textsuperscript{1,*}, Lewan P Kariyawasam\textsuperscript{1}

\textsuperscript{1}Department of Anaesthesiology, Intensive Care & Pain Medicine, Teaching Hospital Anuradhapura, Sri Lanka.

*Corresponding author. E-mail: minura1988@gmail.com

Abstract

Background: Interscalene brachial plexus block (ISB) combined with conscious sedation is a viable alternative to general anaesthesia for arthroscopic shoulder surgery in the beach chair position. The purpose of the trial was to compare the haemodynamic instability and safety of Dexmedetomidine vs Propofol for conscious sedation in arthroscopic shoulder surgery in the beach chair position.

Method: A single-blinded prospective randomized trial was conducted in 56 patients randomly allocated into Dexmedetomidine and Propofol groups for conscious sedation following ISB placement. The primary outcome was to measure intraoperative haemodynamic variations (systolic blood pressure, mean arterial pressure, heart rate) in the two groups maintaining adequate conscious sedation during arthroscopic shoulder surgery in the beach chair position.

Results: In the dexmedetomidine group a significantly higher percentage of systolic blood pressure (21.86 vs 10.81%, $p = 0.001$, $d = 1.05$) and a higher percentage heart rate (18.52 vs 9.02%, $p = 0.002$, $d = .98$) drop from baseline measurements was noted. A large ($d$
Cohen’s effect size suggested the high practical significance of the finding. Perioperative hypotensive \((f=19, p<0.001)\) and bradycardic \((f=21, p=0.003)\) episodes were significantly more frequent in the dexmedetomidine group. The propofol group had a greater incidence of airway complications requiring intervention \((f=6 \text{ vs } f=0, p=.023)\).

**Conclusion:** Dexmedetomidine leads to significant blood pressure and heart rate reductions from baseline values in the beach chair position providing controlled hypotension and has minimal airway complications in patients undergoing arthroscopic shoulder surgery in the beach chair position under ISB and conscious sedation compared to Propofol.

**Keywords:** Arthroscopic shoulder surgery, Beach chair position, Conscious sedation, Dexmedetomidine, Haemodynamic instability, Propofol

**Introduction**

Arthroscopic shoulder surgery is used in the treatment of a wide range of intra- and extra-articular conditions, and regional anaesthesia in the form of interscalene brachial plexus block (ISB) combined with sedation is considered a viable alternative to general anaesthesia (GA)\(^1\), as it improves patient experience, reduces postoperative complications, and reduces postoperative opioid use \(^2\) leading to successful day-case surgery. The beach chair position is used in arthroscopic surgeries because it has many advantages\(^3\) however maintaining haemodynamic stability during surgery is a challenge. Profound blood pressure reductions and the occurrence of cerebral desaturation events (CDE) are lessened in ISB with conscious sedation compared with GA\(^4\).

Propofol, a short-acting non-opioid sedative, is commonly used in patients undergoing ambulatory shoulder arthroscopy under regional anaesthesia; however, data on its use in arthroscopic shoulder surgery in the beach chair position are sparse.
Dexmedetomidine is a selective α₂-adrenoceptor agonist, that can produce analgesia, sedation, and anxiolysis, with minimal respiratory depression. Only one prior study compared the use of dexmedetomidine and propofol in the beach chair position and found no statistically significant differences between the two groups with regard to intraoperative hypotension and bradycardia; however, dexmedetomidine was associated with a prolonged post-anaesthesia care unit (PACU) stay, and propofol led to a higher incidence of airway obstruction. The pilot study conducted prior to the clinical trial noted haemodynamic differences between propofol and dexmedetomidine used for conscious sedation in arthroscopic shoulder surgery under interscalene block in the beach chair position, and was deemed necessary of further analysis.

The primary objective of this study was to compare haemodynamic changes in heart rate and blood pressure with the use of dexmedetomidine and propofol for conscious sedation in arthroscopic shoulder surgery under interscalene block in the beach chair position.

Methods
A parallel randomised single blinded study was conducted in accordance with the ethical standards of the Declaration of Helsinki, and the trial was registered in the WHO approved Clinical Trials Registry following ethical clearance. Patients aged 18-80 years with the American Society Anaesthesiologist (ASA) physical status of I or II, planned for shoulder arthroscopic surgeries in beach chair position under ISB with conscious sedation at Teaching Hospital Anuradhapura Sri Lanka were included. Patients with ASA physical status III and above having significant organ dysfunction (cardiac- patients with heart block, bradycardia, severe ventricular dysfunction, hypovolemia, or chronic uncontrolled hypertension, pulmonary, renal,
hepatic impairment and uncontrolled diabetes mellitus), significant coagulopathy (INR >1.5, platelets <100,000 mm\(^{-3}\)), age <18 years or >80 years, body mass index (BMI) more than 35 Kg/m\(^2\), allergy to local anaesthetics and sedative drugs, pregnant patients, infection at the injection site, and block failure (Surgical anesthesia not present at 45 minutes or, need for block supplementation after 45 minutes or conversion to GA during surgery) were excluded from the study.

A Microsoft Excel 2019 generated randomisation list was created with 1:1 allocation into two groups (D and P) using block sizes 2 and 4 by an independent doctor who placed the questionnaires marked D or P into corresponding numbered sealed envelopes. The allocation sequence was concealed, consenting patients were numbered consecutively, and a matching envelope was assigned. Patients were blinded to the sedatives used. Demographic data were collected using an interviewer-administered questionnaire.

A pilot study of 16 patients undergoing arthroscopic shoulder surgery in the beach chair position under ISB showed an average BP drop of 16.6 mmHg and 9.14 mmHg from baseline in the dexmedetomidine and propofol groups, respectively. Assuming a power of 80% and an alpha of 0.05, the calculated minimum sample size was 19 patients for each group. Data were analysed using SPSS version 25. Continuous data were analysed using an independent-sample t-test. Categorical variables were presented as numbers and percentages (%) and analysed using contingency tables with a two-tailed Fisher’s exact test or chi-squared test for association. Pearson’s and Spearman’s rho correlation coefficients were used to determine the strength of the association between the variables. A 95% confidence interval was used for calculations. P<0.05 was considered statistically significant for all
comparisons. An effect size (d) of >0.8 was considered large.

Patients fasted according to the GA guidelines. Standard monitoring, including electrocardiography (ECG), non-invasive blood pressure (NIBP), and pulse oximetry, was applied, and baseline systolic blood pressure (SBP), mean arterial pressure (MAP), heart rate (HR), peripheral oxygen saturation (SpO₂), and respiratory rate (RR) were measured in the beach chair position.

ISB was performed by the investigators, while adhering to the standard guidelines, and following universal precautions, using 50 mm, 22-gauge insulated needles under strict aseptic conditions. Under ultrasonographic guidance, 10 mL of 0.5% plain bupivacaine was injected. Patients who did not achieve surgical anaesthesia after 45 min were considered to have block failure. Patient vitals systolic blood pressure (SBP), mean arterial pressure (MAP), heart rate (HR), and respiratory rate (RR) were monitored every 5 min in the beach chair position and documented by an anaesthetist and were retrospectively reviewed and data collected by the investigators. Patients were monitored for hypotension (SBP <90 mmHg, MAP <65 mmHg, and >20% reduction in SBP from baseline measured in the beach chair position) and bradycardia (HR decreased by 20% from baseline measured in the beach chair position or <60 bpm). Severe symptomatic hypotension was treated with 5–10 mg of intravenous ephedrine or a fluid bolus (30 mL/kg of 0.9% saline), and severe bradycardia with 0.5 mg of intravenous atropine by the anaesthetist. Patients were observed for apnoea, the need for airway manoeuvres (chin lift, jaw thrust, and head extension), and the need for oropharyngeal/nasopharyngeal airway insertions in case of airway obstruction. The patients in group D received intravenous dexmedetomidine. Infusion was initiated after successful ISB and continued until
wound closure was achieved in the beach chair position. Infusion began with a 1 mcg/kg loading dose over 10 min, followed by 0.1–0.7 mcg/kg/hr titrated to achieve a Modified Observer Assessment of Alertness/Sedation (MOAA/S) score of 3 or 4 (the MOAA/S ranges from 0–5, with a score of 5 defined as awake or minimally sedated, and a score of 0 defined as general anaesthesia with 4 being “lethargic response to name spoken” and 3 being “responds after name called loudly/repeatedly”). Group P received intravenous propofol infusion following successful ISB and continued until wound closure in the beach chair position. Infusion commenced at 1–4 mg/kg/h and was titrated to achieve a MOAA/S score of 3 or 4. Following surgery, patients with a modified Aldrete score >9 were discharged from Phase I of the PACU to the orthopaedic surgical ward.

Results

Sixty-nine patients were contacted, 13 did not meet the inclusion criteria, and the remaining 56 were randomly divided into two groups (Fig 1).

Demographic characteristics, patients’ baseline vital signs in the beach chair position, and MOAA/S scores did not differ significantly between the two groups [Table 1 & Table 2]. The average percentage of SBP reduction from baseline were significant, with the dexmedetomidine group having a higher percentage of SBP reduction (M=20.96, SD=10.03) than the propofol group (M=11.95, SD=6.77) \( (t(42)=3.48, P=0.001) \). Cohen’s effect size \( (d=1.05) \) suggested high practical significance. The dexmedetomidine group had a higher percentage of HR reduction from baseline (M=18.58, SD=7.50) than the propofol group \( (r(42) =3.25, p=0.002) \). The Cohen’s effect size \( (d=0.98) \) suggested high practical significance [Table 2]. Perioperative hypotensive episodes were significantly more frequent \( (f=19, p<0.001) \)
in the dexmedetomidine group so were perioperative bradycardic episodes ($f=21$, $p=0.003$). The need for airway manoeuvres were more common ($f=6$, $p=0.023$) in the propofol group than in the dexmedetomidine group [Table 2].

**Discussion**

ISB combined with a sedative has made arthroscopic shoulder surgery in the beach chair position more patient-friendly and improved the surgical conditions for the surgeon. Identifying sedatives with minimal side effects and improved outcomes has been challenging. Haemodynamic changes in both dexmedetomidine and propofol under general anaesthesia have been covered extensively in the literature, nevertheless their use in the beach chair position for conscious sedation has been minimal.
Dexmedetomidine vs. Propofol: Haemodynamic Changes

Dexmedetomidine is a selective $\alpha_2$ adrenoceptor agonist with the adverse haemodynamic effects of hypotension and bradycardia due to pre-synaptic activation of $\alpha_2$ adrenoceptors in the central nervous system (CNS) inhibiting the release of norepinephrine, terminating the propagation of pain signals, and their post-synaptic activation inhibiting sympathetic activity. Dexmedetomidine led to a significantly higher percentage drop in SBP from baseline in the beach chair position than propofol did when used in arthroscopic shoulder surgery, in the beach chair position. Previous studies using a loading dose and infusion of dexmedetomidine documented a 16.5% decrease in supine SBP.

### Table 1 Demographic characteristics of study population

<table>
<thead>
<tr>
<th></th>
<th>Propofol group</th>
<th>Dexmedetomidine group</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>44.07 ± 13.58</td>
<td>46.14 ± 14.84</td>
<td>.58</td>
</tr>
<tr>
<td>BMI (kgm$^{-2}$)</td>
<td>21.99 ± 3.62</td>
<td>22.79 ± 3.36</td>
<td>.39</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>22 (78.5%)</td>
<td>21 (75%)</td>
<td>1.0</td>
</tr>
<tr>
<td>Female</td>
<td>6 (21.5%)</td>
<td>7 (25%)</td>
<td></td>
</tr>
<tr>
<td>Side of surgery</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>17 (60.7%)</td>
<td>17 (60.7%)</td>
<td>1.0</td>
</tr>
<tr>
<td>Left</td>
<td>11 (39.3%)</td>
<td>11 (39.3%)</td>
<td></td>
</tr>
<tr>
<td>ASA physical status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASA I</td>
<td>21 (75%)</td>
<td>20 (71.4%)</td>
<td>1.0</td>
</tr>
<tr>
<td>ASA II</td>
<td>7 (25%)</td>
<td>8 (28.6%)</td>
<td></td>
</tr>
</tbody>
</table>

Data are entered as mean ± SD and numbers as percentages. BMI- Body Mass Index, ASA status- American Society of Anesthesiologists (ASA) physical status.

* Significance was noted to be $p > 0.05$. 
from baseline values intraoperatively. In contrast to previous studies, hypotensive episodes were significantly more frequent in the dexmedetomidine group in the beach chair position than in the supine position.

The biphasic effect of dexmedetomidine where at low concentrations, it leads to hypotension, and at higher doses, it leads to hypertension, could be a contributing factor in the frequent hypotensive episodes.

Hypotensive episodes noted during arthroscopic shoulder surgery in the beach chair position under GA occurred owing to positioning following the induction of anaesthesia. Under conscious sedation, the patient was kept in the beach chair position.
from the point of ISB placement throughout the surgery which mitigated changes in BP.

Controlled hypotension (CH) which is defined as a reduction in MAP to 50–65 mmHg, an SBP of 80–90 mmHg, or a 30% reduction in MAP\(^\text{12}\), has been in use for >40 years. CH reduces bleeding and provides a bloodless field for the surgeon\(^\text{12}\). It is used in orthopaedic surgeries, its safety in shoulder surgeries in the beach chair position has been documented\(^\text{13}\), and it provides a clear surgical view.

Following the examination of 4169 day-case shoulder surgeries in the beach chair position by Yadeau et al.\(^\text{14}\), they found that 95.7% of patients underwent interscalene block with sedation, of which 47% recorded having hypotensive episodes however none had adverse neurological events, as cerebral desaturation was uncommon despite frequent hypotension in patients under regional anaesthesia and sedation\(^\text{15}\). Previous studies have shown that patients can safely tolerate a reduction in SBP greater than is recommended\(^\text{13}\). A significant heart rate reduction from baseline in the dexmedetomidine group was noted in our study and was similar to the 17.71% heart rate drop noted in a previous study examining the haemodynamic advantages of intravenous dexmedetomidine\(^\text{8}\). Bradycardic episodes were more common in the dexmedetomidine group than in the propofol group, which was corroborated by prior literature and was common in studies in which the initial loading dose was infused over a short duration (5 or 10 min)\(^\text{16}\). By omitting the loading dose and maintaining the infusion at <0.7 mcg/kg/h, undesirable haemodynamic effects can be mitigated without compromising the sedative and analgesic effects of dexmedetomidine\(^\text{17}\).

In future studies, invasive blood pressure monitoring could be employed for accurate BP measurements, however this was not considered in the current study because of the invasive nature of the procedure in conscious, sedated patients. When we compared the
standard procedures used for sedation in many developing countries, set infusion values were used for dexmedetomidine and propofol infusions in the present study. In future studies, target-controlled infusions could be used to maintain the desired concentration more accurately.

**Conclusion**

Dexmedetomidine leads to higher intraoperative heart rate and systolic blood pressure reductions from baseline values in the beach chair position than propofol, providing controlled hypotension effectively. Based on these findings, intravenous dexmedetomidine is a valuable sedative for use in patients undergoing arthroscopic shoulder surgery in the beach chair position with ISB.

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doi:10.1007/s12630-011-9574-7
