Chances of inadvertent movements are high with these drugs especially during the femoral puncture and contrast injection. If the doses of sedatives are increased, then the incidence of airway obstruction is increased leading to high probability of airway manipulation with supra-glottic devices or endotracheal tube insertion. Recently dexmedetomidine has been used for sedation in MRI suite\cite{2,3} and cardiac angiography.\cite{4,5} It is one of the most favoured drugs for conducting awake craniotomy.\cite{6,7} As both dexmedetomidine and propofol have short half-life and lead to early awakening after stopping the infusion, early post-anaesthetic care unit (PACU) discharge was anticipated. The primary objectives of our pilot study were to measure the rate of inadvertent movement and success of sedation during the imaging procedure, haemodynamics, respiratory parameters, recovery time and Steward's recovery score were similar to propofol in our study.

**Key words:** Cerebral angiography, dexmedetomidine, non-intubated, propofol, sedation

**Original Article**

**Dexmedetomidine and propofol for cerebral angiography in non-intubated patients: A comparative study**

Sujoy Banik, Pallav Kumar¹, Hemanshu Prabhakar, Gyaninder P. Singh

**Abstract**

**Context:** Patients posted for cerebral angiography may be restless and drowsy with high chance of inadvertent movements. **Aims:** The primary objective was to compare the incidence of inadvertent movements between propofol and dexmedetomidine groups. The secondary objectives include comparison of recovery time and characteristics, Steward's score, and haemodynamic and respiratory parameters between the two groups. **Settings and Design:** Prospective, randomised, double-blind, pilot study. **Materials and Methods:** In all, 20 adult uncooperative, drowsy patients were randomised to dexmedetomidine (1 µg/kg bolus over 10 minutes followed by 0.3-0.7 µg/kg/hour infusion) or propofol (100 µg/kg/min for 10 minutes followed by 25-75 µg/kg/min infusion). Rate of movement, success of sedation, haemodynamics, respiratory parameters, Steward's recovery score and recovery time were recorded. Statistical analysis used: Repeated measures of analysis of variance, Mann-Whitney test, independent and paired t-tests, and Fisher test. **Results:** The median rate of movement was similar (1, \( P = 0.206 \)) with success of sedation achieved in 7 (70%) patients in Group D and 9 (90%) patients in Group P, which was comparable (\( P = 0.582 \)). The median recovery time in patients in Group D was 150 (37-764) seconds and in Group P was 128 (54-174) seconds (\( P = 0.519 \)) with similar Steward's scores (\( P = 0.363 \)). Haemodynamics and respiratory variables were well-maintained during loading and maintenance dose infusions in both the groups. **Conclusions:** Dexmedetomidine is a safe alternative for diagnostic cerebral angiography. Its success of sedation, median rate of movement during the imaging procedure, haemodynamics, respiratory parameters, recovery time and Steward's recovery score were similar to propofol in our study.

**INTRODUCTION**

Patients posted for cerebral angiography may be restless, drowsy and uncooperative, and pose a challenge to anaesthesiologists. Various anaesthetics such as propofol, midazolam and fentanyl have been tried earlier to sedate these patients during the procedure.\cite{1}

Chances of inadvertent movements are high with these drugs especially during the femoral puncture and contrast injection. If the doses of sedatives are increased, then the incidence of airway obstruction is increased leading to high probability of airway manipulation with supra-glottic devices or endotracheal tube insertion.

Recently dexmedetomidine has been used for sedation in MRI suite\cite{2,3} and cardiac angiography.\cite{4,5} It is one of the most favoured drugs for conducting awake craniotomy.\cite{6,7} As both dexmedetomidine and propofol have short half-life and lead to early awakening after stopping the infusion, early post-anaesthetic care unit (PACU) discharge was anticipated. The primary objectives of our pilot study were to measure the rate of inadvertent movement and success of sedation during...
diagnostic cerebral angiography, in restless, drowsy and uncooperative patients. The secondary objectives of the study were to measure the recovery time after stoppage of sedation, using Steward’s scoring system,[8] and to compare the peri-procedural haemodynamic and respiratory parameters [heart rate (HR), oxygen saturation (SpO₂), non-invasive blood pressure (NIBP), end-tidal carbon dioxide (EtCO₂) and respiratory rate (RR)].

MATERIALS AND METHODS

Twenty adult patients posted for diagnostic cerebral angiography in the neuroradiology suite were recruited for this prospective, randomised study. The study was approved by the ethics committee of the institute (IEC/NP-245/2012). Patients who were uncooperative, restless or drowsy, but responding to commands were included in the study. Patients not responding to verbal commands, age <18 years, and ASA grade IV and above were excluded from the study. Patients with anticipated difficult airway, on inotropic support, preoperative mechanical ventilation or sedative medication were also excluded from the study.

After obtaining written informed consent and pre-anesthetic check-up, including routine investigations, the patients were shifted to the neuroradiology suite. Monitors were attached (five-lead ECG, NIBP, HR, RR monitor and pulse oximeter), and baseline parameters were recorded. Supplemental oxygen was provided by nasal prongs with integrated EtCO₂ sampling line for monitoring EtCO₂. Fentanyl 1 µg/kg was administered to all the patients. Both the patient and the assessor (neuroradiologist) were blinded to the study drug. Using a computer-generated randomisation chart and opaque-sealed envelopes, patients were allocated into two groups: Group D received dexmedetomidine 1 µg/kg bolus over 10 minutes followed by 0.3–0.7 µg/kg/hour infusion; Group P received propofol 100 µg/kg/min for 10 minutes followed by 25–75 µg/kg/min infusion. Femoral puncture was allowed immediately after bolus was completed and local infiltration with lignocaine 2% was done. Time of starting study drug infusion and start of procedure were noted. Haemodynamic and respiratory parameters were recorded at 1-minute intervals during the period of bolus administration, and at every 5-minute intervals thereafter till the end of the procedure. Any movements during the procedure were noted and sedation adjusted accordingly. Rate of inadvertent movement during the imaging procedure was noted by the neuroradiologist, who was blinded to the study drug. A rescue bolus of propofol 20 mg was administered if movement occurred despite maximal sedative infusion dose in both the groups. Successful sedation for the procedure was noted as the completion of diagnostic cerebral angiography without need for maintenance of airway using laryngeal mask airway (LMA) or endotracheal intubation.

If SpO₂ continued to remain less than 90% for 30 seconds, then LMA was inserted to maintain adequate ventilation and oxygenation and the complication was noted. Bradycardia (HR decrease >20% baseline) was treated with atropine 0.6 mg and repeated if necessary. Tachycardia (HR increase >20% baseline) was treated by fluid bolus and esmolol 0.5 mg/kg bolus if required. Hypotension (mean blood pressure decrease <20% baseline) was treated by fluid bolus and mephentermine 3 mg boluses, repeated every 3 minutes till normalisation of blood pressure, up to a maximum of 15 mg. Hypertension (blood pressure increase >20% baseline) was treated by labetalol 10 mg bolus repeated after 5 minutes if necessary. Number of such events was recorded along with the treatment given. Any other adverse effects like nausea, vomiting, retching, coughing, shivering and snoring were also recorded.

Study drug infusion was stopped immediately after dressing of the femoral puncture site. Patient was awakened, and time to response to commands noted. Post-procedural recovery score was recorded according to Steward’s scoring system,[9] which includes two points each for consciousness, airway (coughing on command or crying) and purposeful movement. One point is given for some response to stimuli but not being fully awake, maintaining good airway and non-purposeful movement, respectively; no points are awarded if the patient doesn’t respond to commands, requires airway maintenance and/or no movement.

Statistical analysis

The descriptive data was expressed as mean with standard deviation, or median with range. The continuous variables were analysed by Kolmogorov-Smirnov test for normality. Repeated measures of analysis of variance were used to assess the change in continuous variables at multiple time points. Mann-Whitney test was used to analyse rate of movement and recovery time in both the groups. Fisher test was used to study success of sedation in the two groups. Paired t-tests were applied to the haemodynamic and respiratory variables, which were analysed separately during loading dose and maintenance dose infusion. Steward’s recovery score was analysed by independent sample t-test in both the groups.

RESULTS

Twenty consecutive patients undergoing diagnostic cerebral angiography were enrolled in this pilot study, and data of all patients were analysed. None of the patients were excluded from final analysis. The
demographic profile of the two groups shows that patients were well-matched for age, sex, and baseline haemodynamic and respiratory parameters [Table 1].

The median rate of movement noted was similar in both the groups (1, range = 0-3 in both the groups, \( P = 0.206 \)). Success of sedation was achieved in 7 (70%) patients in Group D and 9 (90%) patients in Group P, and were comparable (\( P = 0.582 \)). The duration of procedure was 51 ± 18 minutes in patients in Group D, and 63 ± 17 minutes in patients in Group P, which was similar in both the groups (\( P = 0.210 \).

A decrease in HR and mean arterial pressure (MAP) was noted in patients of both Group D and Group P during loading dose infusion [Figure 1]. However the decrease in HR and MAP was comparable between both the groups (\( P = 0.64; P = 0.48 \). Similarly there was a decrease in RR in patients in Group D and Group P (\( P = 0.002 \) significant for Group P) during the loading dose infusion [Figure 2]. This decrease was comparable between the two groups (\( P = 0.699 \)). During this time, EtCO\textsubscript{2} showed an increase in patients from 31.9 mm Hg to 35.8 mm Hg in patients in Group D and from 29.5 mm Hg to 30.4 mm Hg in patients in Group P (\( P = 0.048 \). This increase was higher in patients in Group D than in Group P (\( P = 0.039 \) [Figure 2].

During maintenance dose infusion, insignificant fluctuation in mean HR, MAP, RR and EtCO\textsubscript{2} were observed [Table 2]. Mean HR, MAP, RR and EtCO\textsubscript{2} were similar throughout the maintenance dose infusion in both the groups [Figures 3 and 4]. The SpO\textsubscript{2} was well-maintained in both groups at all measured time points (arterial puncture, sheath pullout, arousal) [Table 2].

The median recovery time in patients in Group D was 150 (37 – 764) seconds and in Group P was 128 (54–174) seconds (\( P = 0.519 \). The mean Steward’s recovery score was 5.6 ± 0.5 in patients in Group D and 5.8 ± 0.4 in patients in Group P (\( P = 0.363 \)).

Of the four patients who had failure of sedation, and were subsequently administered general anaesthesia, one patient in Group D did not allow arterial puncture, while 2 patients in Group D and 1 patient in Group P had continuous movement hampering the imaging. The median total dose of dexmedetomidine used in Group D was 84 µg (range = 58–137 µg), while the median total dose of propofol used in Group P was 200 mg (range = 110-350 mg).

Rescue boluses were required in our study during the maintenance dose infusion once each in 2 patients in dexmedetomidine group (20 mg propofol each) and once in 1 patient in propofol group (20 mg propofol). One patient required 1.2 mg atropine to counteract bradycardia during maintenance dose infusion of dexmedetomidine. There were no other adverse effects noted intraoperatively or in immediate postoperative

Table 1: Demographic and baseline characteristics of patients in study groups

<table>
<thead>
<tr>
<th></th>
<th>Group D</th>
<th>Group P</th>
<th>( P )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>45±13</td>
<td>38±13</td>
<td>0.221</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>64±15</td>
<td>63±16</td>
<td>0.791</td>
</tr>
<tr>
<td>Sex (M/F)</td>
<td>6/4</td>
<td>7/3</td>
<td>1.000</td>
</tr>
<tr>
<td>Heart rate (/min)</td>
<td>79±17</td>
<td>73±11</td>
<td>0.325</td>
</tr>
<tr>
<td>Respiratory rate (/min)</td>
<td>15±1</td>
<td>16±4</td>
<td>0.483</td>
</tr>
<tr>
<td>EtCO\textsubscript{2} (mm Hg)</td>
<td>32±8</td>
<td>30±5</td>
<td>0.423</td>
</tr>
<tr>
<td>MAP (mm Hg)</td>
<td>105±22</td>
<td>114±21</td>
<td>0.571</td>
</tr>
<tr>
<td>SpO\textsubscript{2} (%)</td>
<td>99±1</td>
<td>98±2</td>
<td>0.732</td>
</tr>
</tbody>
</table>

EtCO\textsubscript{2}: End-tidal carbon dioxide, MAP: Mean arterial pressure, SpO\textsubscript{2}: Oxygen saturation, Group D: Dexmedetomidine group, Group P: Propofol group

Figure 1: Graph showing changes in mean heart rate and mean arterial pressure during loading dose infusion of dexmedetomidine and propofol

HR = Heart rate; MAP = Mean arterial pressure

Figure 2: Graph showing changes in respiratory rate and EtCO\textsubscript{2} during loading dose infusion of dexmedetomidine and propofol

RR = Respiratory rate; EtCO\textsubscript{2} = End-tidal carbon dioxide
period in either group. No vasopressors were used in either group. No respiratory depression requiring active intervention occurred in either of the two groups in our study.

**DISCUSSION**

Dexmedetomidine is a highly selective $\alpha_2$-agonist with dose-dependent sedative, anxiolytic and analgesic effects without ventilation suppression. In 1999, the American Food and Drug Administration approved the use of dexmedetomidine for sedation in ICU at a dose range of 0.2-0.7 $\mu$g/kg/hr.[6] In 2001, Bekker et al. reported the first use of dexmedetomidine in awake craniotomy combined with LMA (spontaneous breathing), sevoflurane, fentanyl and nitrous oxide.[7] The sedative, haemodynamic and respiratory effects of dexmedetomidine were evaluated and compared with those of midazolam in children undergoing MRI by Heard et al.[8] Patients in dexmedetomidine group had a higher rate of imaging completion without the need to add another sedative (80% compared with 20% in the midazolam group). In our study, success of sedation, as defined by completion of imaging procedure without supra-glottic device insertion or endotracheal intubation, was 70% with dexmedetomidine group, compared with 90% in propofol group. In 2006, Tosun et al.[4] evaluated the effects of dexmedetomidine-ketamine and propofol-ketamine combinations on haemodynamics, sedation level, and the recovery period in paediatric patients undergoing cardiac catheterisation. The dexmedetomidine-ketamine combination was not better than propofol-ketamine combination because of a longer recovery time and inadequate sedation and analgesia. In a retrospective analysis by Mester et al.[5] combination of ketamine and dexmedetomidine for sedation during cardiac catheterisation in children with congenital heart disease was found to provide effective sedation without significant effects on cardiovascular or ventilatory function. Wu et al. compared propofol and dexmedetomidine in children undergoing MRI.[3] There were fewer pauses during MRI and lower failure rate of completion of MRI in propofol versus dexmedetomidine (0.22 versus 0.81, $P = 0.01$, and 1 versus 15, $P < 0.001$), less behavioural disturbances.

<table>
<thead>
<tr>
<th>parameters</th>
<th>After arterial puncture</th>
<th>After sheath pull out</th>
<th>Arousal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Group P</td>
<td>Group D</td>
<td>$P$</td>
</tr>
<tr>
<td>HR</td>
<td>72±15</td>
<td>69±14</td>
<td>0.609</td>
</tr>
<tr>
<td>MAP</td>
<td>95±11</td>
<td>95±21</td>
<td>0.968</td>
</tr>
<tr>
<td>RR</td>
<td>14±3</td>
<td>14±2</td>
<td>0.586</td>
</tr>
<tr>
<td>$\text{SpO}_2$</td>
<td>100±0</td>
<td>99±1</td>
<td>0.315</td>
</tr>
<tr>
<td>$\text{EtCO}_2$</td>
<td>35±7</td>
<td>29±6</td>
<td>0.058</td>
</tr>
</tbody>
</table>

**Table 2:** Haemodynamic and respiratory parameters in patients in the two groups at various points of time (mean±SD)

**Figure 3:** Graph showing changes in mean heart rate and mean arterial pressure during maintenance dose infusion of dexmedetomidine and propofol HR = Heart rate; MAP = Mean arterial pressure. Art. Punc. = Arterial puncture

**Figure 4:** Graph showing changes in mean respiratory rate and end-tidal carbon dioxide during maintenance dose infusion of dexmedetomidine and propofol RR = Respiratory rate; $\text{EtCO}_2$ = End-tidal carbon dioxide. Art. Punc. = Arterial puncture
Cognitive testing could have been a confounding factor for cognitive testing in this subset of patients in our study. Despite good outcome after subarachnoid haemorrhage, persistent cognitive consequences remain, limiting the patients’ psychosocial functioning. Cognitive testing could have been performed after the study, despite the problems noted above and might be an important factor in overall outcome.

CONCLUSION

Dexmedetomidine is a safe and reliable alternative for sedation for diagnostic cerebral angiography in the neuroradiology suite without need for insertion of LMA or endotracheal intubation. Its success of sedation and median rate of movement during the imaging procedure were similar to propofol in our study. Haemodynamics and respiratory parameters were well-maintained in both the groups. Recovery time and Steward’s recovery scores were similar in both the groups, demonstrating rapid and good recovery of patients from sedation for neurologic assessment.

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