Comparative Study between Dexmedetomidine, Magnesium Sulphate and Fentanyl as Sedatives in Awake Fiberoptic Intubation for Patients Undergoing Cervical Spine Surgeries

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Abstract

Background: Various drugs are used for providing favorable intubation conditions during awake fiberoptic intubation (AFOI). However, most of them have various side effects.

Aim: The aim of this study was to compare the effects of dexmedetomedine, magnesium sulphate and fentanyl as regards sedative effects, intubation time and intubation attempts during awake fiberoptic intubation.

Material and Methods: A randomized double-blind prospective study was conducted on a total of 60 patients scheduled for elective cervical spine surgeries who were randomly allocated into three equal groups (n 20): Group A patients received a bolus dose of dexmedetomidine of 1mcg/kg over 10min followed by a continuous infusion of dexmedetomidine at 0.5mcg/kg/h., Magnesium sulphate group (Group B) received dose of 30mg/kg over 10min followed by 10mg/kg/hr. and fentanyl group (Group C) received dose of 1µg/kg over 10min followed by 0.5µg/kg/hr. Ramsy Sedation score (RSS), oxygen saturation, intubation time and intubation attempts were noted and compared between three groups.

Results: RSS was significantly favorable (p<0.001) in group A in comparison to group B and C, moreover less intubation attempts was observed in group A in comparison to the other two groups.

Conclusion: Dexmedetomidine provides optimum sedation without compromising airway with favorable intubation time and less intubation attempts during AFOI in comparison to both Magnesium sulphate and fentanyl patients.

Key Words: Awake intubation – Dexmedetomidine – Fentanyl – Magnesium sulphate – Sedation.

Introduction

MANAGEMENT of difficult airway is one of the most challenging tasks for the anesthesiologist, mostly when maneuvers of head tilt and jaw thrust are risky to implement as in cervical spine injuries [1]. Fiberoptic intubation is an effective technique for the management of patients with difficult airways. Both optimal intubating conditions and patient comfort are of paramount importance while preparing the patient for fiberoptic intubation.

One challenge associated with this procedure is to provide adequate sedation while maintaining a patent airway and ensuring good oxygenation. An ideal sedation regimen would provide patient comfort, patient cooperation, haemodynamic stability, amnesia and the maintenance of a patent airway with spontaneous ventilation.

Many agents have been reported to achieve conscious sedation for awake intubation including fentanyl, midazolam, ketamine, propofol and remifentanil [2,3,4].

Another, more recent addition has been dexmedetomidine, which is a selective α2 adrenergic agonist that has been used clinically for its sympatholytic, analgesic and sedative effects [5]. It provides a level of sedation similar to previously mentioned agents but lacks respiratory depression, emergence delirium and major cardiac depression that may occur with other agents [6] thus it can be of great benefit during awake fiberoptic intubation for patients with cervical spine fractures.

On the other hand, the uses of Magnesium sulphate in anaesthesia have been increased over the years. It is an antagonist of NMDA glutamate receptor which is responsible for central sensitization. Binding of this receptor has analgesic, anticonvulsant and sedative properties. Furthermore, it has been postulated to have potential neuro- and cardioprotective effects [7,8].

So this study hypothesize that the anaesthetic and analgesic potency of dexmedetomidine and...
magnesium sulphate might be beneficial in sedation and attenuation of stress response to intubation during awake fiberoptic intubation.

**Patients and Methods**

After approval of the Ethical Committee of the Anesthesia Department, Cairo University, and obtaining written informed consents from all patients participating in the study, sixty patients presented for elective cervical spine surgeries through awake fiberoptic intubation were randomly allocated to one of three groups, group A received dexmedetomidine, group B received magnesium sulphate and group C received fentanyl as sedative agents.

The study was carried out in kasr al ainy hospital in the period between April 2014 and December 2015.

**Inclusion criteria:**
- Age between 18 and 50 years.
- American Society of Anesthesiologist (ASA) physical status class I-II.
- Elective cervical spine fracture surgery.

**Exclusion criteria:**
- Emergency surgery.
- Patients with coagulation defects.
- Known allergy to any of the used medications.
- Patients with other associated facial, skull base and/or mandibular fractures.

Pre-operative visit was conducted on the previous day of surgery and a detailed history was taken. General and systemic examinations of the cardiovascular, respiratory, and central nervous systems were carried out. In addition, airway was assessed and the technique of awake fiberoptic intubation under sedation was explained to the patients, as well as their needed cooperation.

**Preparation of patients:**

Patients were monitored with electrocardiogram (ECG), non-invasive BP, and oxygen saturation in the operating theatre, afterwards bispectral index (BIS) was placed on the forehead of the patients. capnogram was applied after tracheal intubation.

Peripheral venous access was established in the non dominant arm and patients were premedicated with intravenous atropine 0.4mg 15min prior to the procedure. oxygen (3L/min) via nasal oxygen cannula was administered. Topical nasal vasoconstriction was achieved with xylometazoline hydrochloride 0.1% nasal drops and cotton swabs soaked in 2% lidocaine with adrenaline placed in both nostrils to reduce the bleeding and to anaesthetize nasal mucosa. The nostril with least resistance during nasal packing was used for nasal intubation while the other nostril used to deliver oxygen while the patient breathing spontaneously.

Recurrent laryngeal nerve block was carried out with transtracheal injection of 4ml of 2% lidocaine without adrenaline, through 22 guage needle on 10ml syringe to block sensory innervation to the vocal cords and trachea [9].

**Study groups:** Patients were randomly allocated into three equal groups:

- **Dexmedetomidine group (group A):** 20 patients received Dexmedetomidine in dose of 1 g/kg followed by 0.5 g/kg/hr.
- **Magnesium sulphate group (group B):** 20 patients received Magnesium sulphate in dose of 30mg/kg followed by 10mg/kg/hr.
- **Fentanyl group (group C):** 20 patients received Fentanyl in dose of 1 g/kg followed by 0.5 g/kg/hr.

The loading volume adjusted to be 50ml infused intravenously over 10 minutes followed by maintenance infusion rate of 20ml/hr to ensure operator blindness of the study medication. The infusion was prepared by clinical pharmacist not involved in data collection.

Following infusion of study drug, the patient’s conscious level was evaluated using and Ramsay sedation scale (RSS) as (1 = Anxious, agitated or restless, 2 = Cooperative, oriented and tranquil, 3 = Sedated but responds to command, 4 = Asleep with brisk response to stimulus, 5 = Asleep with sluggish response to stimulus and 6 = Asleep with no response) [10]. If the RSS was <2, rescue doses up to 50mg of propofol were administered.

In addition to Ramsay sedation scale (RSS) , conscious level was also evaluated using bispectral index (BIS COVIDIEN_VISTA Monitoring System using unilateral disposable sensors) [11]. A score of 90 to 100 correlates with an awake state, scores in the 70s to 80s with conscious sedation, scores in the 60s to 70s with deep sedation, and scores from the 40s to 60s with general anesthesia [12].

**Procedure of fiberoptic intubation:**

Before starting the procedure, the light source was checked and the bronchoscope was refocused on the printed material and on the gauze piece. The tip of the bronchoscope was defogged with 70% isopropyl alcohol. It was lightly lubricated
along its entire length with a water-soluble agent, lidocaine jelly to facilitate passage through appropriate-sized cuffed endotracheal tube.

Fiberoptic nasal intubation was started once the Ramsay scale ≥2 through topical anesthesia of the airway by spray as you go technique using lidocaine 2% via the working channel of the fiberscope until the epiglottis was visualized. If the posterior pharyngeal wall was encountered, the tip of the fiberscope was turned down to visualize the glottis. If the epiglottis obstructs vision, the fiberscope was manipulated under the epiglottis to see the vocal cords.

Fiberoptic bronchoscope was then advanced closer to the larynx and 2mL lidocaine 2% was sprayed onto the glottis between the vocal cords. External laryngeal and neck manipulation was done whenever required. Excessive force on the bronchoscope was avoided to minimize laryngeal trauma. Once the bronchoscope entered the trachea, the endotracheal tube was advanced over it.

After securing the endotracheal tube, Capnogram was added and general anesthesia was administered.

Data collection:
1- Level of sedation was evaluated by Ramsay sedation score (RSS) and bispectral index (BIS) just after completion of infusion of study drug.
3- Intubation time: From insertion of fiberoptic into the nose till confirmation of tracheal intubation with capnograph.
4- Number of intubation attempts.

Results
I- Demographic data:
Demographic characteristics like age, sex, weight and height were comparable between three groups (Table 1) and showed that there were no statistically significant differences between the study groups.

<table>
<thead>
<tr>
<th></th>
<th>DEX. group</th>
<th>Fentanyl group</th>
<th>Magnesium Sulphate group</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>32.25±6.07</td>
<td>32.45±5.84</td>
<td>32.05±5.79</td>
<td>0.977</td>
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<tr>
<td>Weight</td>
<td>78.80±4.44</td>
<td>79.00±4.48</td>
<td>79.00±4.71</td>
<td>0.987</td>
</tr>
<tr>
<td>Height</td>
<td>175.50±5.7</td>
<td>175.30±5.53</td>
<td>175.25±5.61</td>
<td>0.989</td>
</tr>
<tr>
<td>Gender:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Female\Male)</td>
<td>9/11 (45%/55%)</td>
<td>8/12 (40%/60%)</td>
<td>(40%/60%)</td>
<td>0.190</td>
</tr>
</tbody>
</table>

II- Operative data:
Patients sedation score: At the end of study drug infusion, there was statistically significant (p<0.001) lower BIS values in dex. Group compared to fentanyl group and magnesium sulphate group and also for fentanyl group compared to magnesium sulphate group. In addition, there was statistically significant (p<0.001) higher Ramsay scale scores in dex. Group compared to fentanyl group and magnesium sulphate group and also for fentanyl group compared to magnesium sulphate group (Table 2). There were twelve patients in magnesium group (60% of patients) failed to achieve RSS of two and were given rescue dose of propofol (50mg).

Intubation time and intubation attempts:
There were no significant differences in intubation time between three groups (Table 3) with lower intubation time in dex. group compared to fentanyl group and magnesium sulphate group. there were also less intubation attempts in in dex. group compared to fentanyl group and magnesium sulphate group (Fig. 1).

Table (2): Comparison between the three groups as regard sedative effects: Values were expressed as mean ± standard deviation.

<table>
<thead>
<tr>
<th></th>
<th>DEX. group</th>
<th>Fentanyl group</th>
<th>Magnesium Sulphate group</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIS</td>
<td>69.95±3.87</td>
<td>76.20±3.33*</td>
<td>82.80±4.80*#</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Ramsay score</td>
<td>3.60±0.50</td>
<td>2.65±0.49*</td>
<td>1.40±0.50*#</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

BIS = Bispectral index.
* Statistically significant compared to corresponding value in DEX group (p<0.05).
# Statistically significant compared to corresponding value in Fentanyl group (p<0.05).
Dexmedetomidine is a highly selective, centrally acting α-2 agonist. It acts on presynaptic α-2 receptors to provide negative feedback causing less neurotransmitter (norepinephrine, epinephrine) available at post-synaptic α-1 receptors. It produces hypnosis, amnesia, analgesia, anxiolysis, sympathetic and antisialagogue effects all of which are desirable during AFOI [18]. The major advantages of dexmedetomidine infusion during AFOI are a unique form of sedation where patients remain sleepy, but are easily aroused, cooperative with minimum respiratory impairment. The feasibility of dexmedetomidine has been recently studied either as a sole sedative agent or as an adjuvant during AFOI [16].

Also magnesium sulfate being an N-methyl-D-aspartate receptor antagonist has both analgesic and sedative properties and has been extensively used in anesthesia [17].

Abdelmalak et al. [18] reported a series of successful awake fibreoptic intubations using dexmedetomidine for sedation in patients with difficult airways caused by a subglottic mass, a thyroid tumour causing tracheal compression, a nasopharyngeal tumour causing obstructive sleep apnoea, and morbid obesity with sleep apnoea which is in agreement with results of our study.

Moreover, Sudeshna et al. [19] compared dexmedetomidine with fentanyl for conscious sedation during awake fiberoptic bronchoscopy, patients were allocated to receive either dexmedetomidine 1mcg/kg over 10 minutes (n30) or fentanyl 2mcg/kg over 10 minutes (n30) in double-blind design and they found that all patients achieved RSS ≥2, but patients of dexmedetomidine group achieved a higher score than in fentanyl group which is consistent with results of the our study, however this study had larger sample size and larger fentanyl dose.

Furthermore Hui-Hui [20], compared dexmedetomidine with remifentanil for conscious sedation during modified awake fiberoptic orotracheal intubation for patients with anticipated difficult airways, patients were allocated to receive loading dose of 1 µg/kg over 10min, followed by a lower infusion rate of 0.3 µg/kg/hr. (n45) or ramifentanil 0.15mcg/kg/min over 5 minutes followed by a lower infusion rate of 0.1 µg/kg/min. (n45) in double-blind design, they found that dexmedetomidine provided a good sedation with RSS ≥2 in most of the patients except three. The difference in the findings may be due to the larger sample size of the study in comparison to our study.
Moreover Davide et al. [21], compared between remifentanil and dexmedetomidine for awake fiberoptic intubation (AFOI), thirty-four patients were enrolled in a double-blinded randomized study to receive remifentanil (REM) or dexmedetomidine (DEX). The REM group received a loading dose of 0.75mcg/kg followed by an infusion of 0.075mcg/kg/min. The DEX group received a loading dose of 0.4mcg/kg followed by an infusion of 0.7mcg/kg/hr. They found that the DEX group had a lower RSS mean score compared to the REM group predicted RSS mean score which comes against our results, this may be due to small loading dose of dexmedetomidine group.

Few studies have been done regarding role of magnesium sulphate as sole agent for sedation. Attygalle, [22] investigate the ability of magnesium sulphate to control the spasms of severe tetanus without the need for sedation and artificial ventilation, they found that all patients (n8) were controlled without the need for benzodiazepines, opiates, muscle relaxants or ventilatory support.

Also, magnesium sulphate have been used in combination other agents to modulates anaesthetic depth, Sumanta, [23] conducted a double blind prospective randomized controlled study on 80 patients randomly allocated into two equal groups (n=40) to receive either bupivacaine heavy intrathecally (group B) or bupivacaine heavy intrathecally along with i.v magnesium sulfate (group BM). Magnesium sulfate 40mg/kg diluted in 100ml of normal saline was administered over 15min about 30min prior to surgery followed by continuous infusion at the rate of 10mg/kg/h for the next 24h while the other group received similar volume of normal saline in the same manner, they found that patients in group BM were significantly more sedated as compared to group B patients. This comes in contrast to our study as magnesium sulfate didn’t achieve a good sedation in most of our patients. This may be due to the shorter duration of application of magnesium sulfate in our study and the difference in the study population.

Lee and Kwon [24], investigated whether i.v. magnesium sulphate modulates anaesthetic depth and analgesic efficacy during caesarean section under general anaesthesia where seventy-two patients were randomly assigned to receive i.v. saline (control group) or magnesium sulphate 30mg/kg bolus followed by 10mg/kg/h continuous infusion (Mg 30 group) or 45mg/kg bolus followed by 15mg/kg/h continuous infusion (Mg 45 group) after induction. Lee found that preoperative i.v. magnesium sulphate attenuated BIS in both groups which is in contrast with our results. It may be due to the different timing of Mg.

There was limitation in this study as regards usage of magnesium sulphate as sole agent for sedation, larger doses may be needed to induce sedation, future studies may focus on its use as an adjuvant, or in different doses. Furthermore, the effect of those drugs on air way reflexes wasn’t studied as we used local anesthetics to blunt them.

References


Comparative Study between Dexmedetomidine, Magnesium Sulphate & Fentanyl as Sedatives


دراسة مقارنة بين عقار الدكسوميد يتريميدين وسلفات الماغنيسيوم والفنتانيل كمواد مهدئة أثناء وضع الأنبوبية الحنجورية باستخدام منظار الألياف الضوئية للمرضى الخاضعين لعمليات الفقارات العنقية

يتيح وضع الأنبوبية الحنجورية باستخدام منظار الألياف الضوئية في وضع البقاء وسيلة فعالة للتعامل مع مرضى المراة الوجهية الصعبة. مع مرضى الفقارات العنقية. ويتطلب استخدام المواد المهدئة مع الاحتفاظ بالمراة الوجهية مفتاحية لأحد التحديات خلال هذه الطرق.

ولذا تم استخدام العديد من المواد لهذا الغرض مثل الميدازولام، البروبوفول، الكيتامين، والفنتانيل.

في هذا البحث تم تقدير عقار الدكسوميد يتريميدين، الماغنيسيوم سلفات والفنتانيل كمواد مهدئة أثناء وضع الأنبوبية الحنجورية باستخدام منظار الألياف الضوئية في المرضى الخاضعين لعمليات الفقارات العنقية عن طريق تقسيم المرضى إلى ثلاث مجموعات عشوائياً، كل مجموعة مكونة من عشرة مريض. في المجموعة الأولى تم استخدام الدكسوميد يتريميدين. في المجموعة الثانية تم استخدام الماغنيسيوم سلفات. وفي المجموعة الثالثة تم استخدام الفنتانيل.

وتم قياس مستوى التهدئة بواسطة مقاس رامسي، قياس العلامات الحيوية. قياس الوقت الملازم لوضع الأنبوبية الحنجورية وقياس عدد محاولات وضع الأنبوبية الحنجورية في جميع الحالات.

وأظهرت نتائج البحث أن عقار الدكسوميد يتريميدين يوفر مستوى أفضل من التهدئة والحفاظ على العلامات الحيوية بالإضافة إلى الاحتفاظ بالمراة الوجهية مفتاحية.