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Research Article

Use of Dexmedetomidine for the Prevention of Bleeding During Functional Endoscopic Sinus Surgery

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Abstract

Background: Functional endoscopic sinus surgery (FESS) is one of the most common surgeries in the field of otolaryngology. Intraoperative bleeding is the most common factor impairing visibility, leading to an increased incidence of complications.

Purpose of the Study: To study the efficacy of dexmedetomidine in preventing bleeding in functional endoscopic sinus surgery (FESS).

Materials and Methods of Research: The study was conducted at the surgical clinic of the Azerbaijan Medical University. The study included 50 patients aged 15 - 65 years who underwent planned functional endoscopic sinus surgery (FESS). Depending on the method of anesthesia used, patients were divided into two groups. In the main group, dexmedetomidine was added to the general anesthesia regimen.

Research Results: It was found that the mean arterial pressure in the main group (with dexmedetomidine) both at the stage of surgical intervention and after awakening was significantly lower than in the control group ($p < 0.05$). The heart rate was also lower in the main group than in the control group ($p < 0.05$), both at the stage of surgery 68.6 ± 2.20 and 78.9 ± 1.22, and after the end of the surgery 74.6 ± 1.26 and 82.3 ± 1.52, respectively ($p < 0.05$).

Conclusion: Dexmedetomidine infusion during FESS procedures significantly reduced the volume of bleeding, decreased the need for anesthetics and opioids, improved visualization of the surgical field and significantly reduced the duration of the operation.

Keywords: *Dexmedetomidine; Functional Endoscopic Sinus Surgery*

Background

Functional endoscopic sinus surgery (FESS) is one of the most common surgeries in the field of otolaryngology. Functional endoscopic sinus surgery is a well-established method for the treatment of intractable SIRS and other indications. Functional endoscopic sinus surgery is a minimally invasive procedure and is usually performed under controlled hypotensive anesthesia. Severe bleeding increases the risk of complications such as meningitis, blindness, intracranial injury, cerebrospinal fluid leakage, and prolongs the duration of the operation. Intraoperative bleeding is the most common factor that impairs visibility, leading to increased complication rates. And to prevent this complication, controlled hypotension is used, which is an important necessary component of anesthesia in functional endoscopic surgery of the nasal sinuses. Based on this, we will consider in detail the studies that studied the effect of different anesthetics used in the anesthetic support of otorhinolaryngological operations on the possibility of reducing blood pressure. Controlled hypotension is a drug-controlled reduction in blood pressure during anesthesia to a systolic blood pressure of 70 - 80 mm Hg, mean blood pressure to 50 - 65 mm Hg,

but not more than 30% of the initial level. The use of controlled arterial hypotension to reduce blood loss during surgery and improve visibility of the surgical field has a long history. This technique was first described in 1917 by the outstanding American neurosurgeon H. Cushing in his book "Tumors of the auditory nerve and the cerebellopontine syndrome". According to his conclusion, controlled reduction of blood pressure allows to reduce blood loss and improve visualization of the surgical field during intracranial operations. Unfortunately, the imperfection of anesthetic techniques and the insufficient development of pharmacology did not allow this method to be widely implemented at that time. In 1948, H. Griffiths and J. Gillies published a paper on spinal anesthesia leading to a decrease in blood pressure. In 1950, G. Enderby reported achieving target blood pressure using ganglionic blockade with pentamethonium. Both methods had a similar mechanism of action - blockade of the sympathetic nervous system at the level of the spinal cord or paravertebral nodes. Advances in surgical techniques (electrocoagulation), pharmacology (new effective hemostatic drugs) and transfusiology (reduced risk of transfusion complications, introduction of Celsavers) have reduced interest in the method of controlled hypotension. One of the main problems was the impossibility of objective monitoring of tissue perfusion, particularly in the brain, with a decrease in systemic BP. The consequences of disorders not detected in time were disturbances of cerebral blood flow with the development of cerebral damage. The development of monitoring technology allows at the present stage to assess the depth and safety of anesthesia with controlled arterial hypotension using a number of methods: invasive blood pressure, precerebral oximetry rSO_2, monitoring of the bispectral index (BIS). In this regard, in recent years, the number of studies devoted to the effectiveness and safety of various methods of controlled hypotension has increased. Controlled hypotension can be achieved by using a number of drugs: inhalation anesthetics, direct vasodilators (nitroglycerin, sodium nitroprusside), β1-blockers, calcium channel blockers, central α2-adrenomimetics and local anesthetics. In recent years, the most frequently used drug for controlled hypotension is dexmedetomidine. Dexmedetomidine is a highly selective α2-adrenergic receptor agonist with a higher affinity for α2-adrenergic receptors than clonidine, making dexmedetomidine primarily a sedative-anxiolytic agent. The half-life of dexmedetomidine (t1/2b) is 2 hours and the half-life - half-life (t1/2a) is 6 minutes, and this short half-life makes it an ideal drug for intravenous titration. However, there are conflicting opinions in the literature regarding the use of dexmedetomidine for controlled hypotension.

Purpose of the Study

To study the efficacy of dexmedetomidine in preventing bleeding in functional endoscopic sinus surgery (FESS).

Materials and Methods of Research

The study was conducted at the surgical clinic of the Azerbaijan Medical University. The study included 50 patients aged 15 - 65 years who underwent planned functional endoscopic sinus surgery (FESS).

Inclusion criteria were:

- Patients undergoing functional endoscopic sinus surgery.
- American Society of Anesthesiologists (ASA) physical status classification I or II.

Exclusion criteria were:

- History of serious illnesses or presence of serious risk factors for cardiovascular disease
- Diabetes mellitus
- Bleeding disorders
- Significant ischemic heart disease or any known genetic predisposition
- History of any type of drug allergy

- Drug abuse
- Psychological or other emotional problems
- Clinically significant abnormalities in physical examination, electrocardiography (ECG)
- Liver and kidney dysfunction
- Cerebrovascular disease
- Known systemic disease requiring anticoagulants, patients with a history of functional endoscopic sinus surgery.

Depending on the method of anesthesia used, the patients were divided into two groups. In the first control group, general anesthesia was performed according to the following scheme: induction of anesthesia - propofol 3 mg/kg, fentanyl - 2 mcg/kg, orotracheal intubation after the introduction of 0.6 mg/kg rocuronium bromide. The basis of anesthesia - sevoflurane 1.3 MAC, fentanyl according to the scheme 8-5-2 mcg/kg/h. Ketorolact 100 mg was administered 20 minutes before the operation. In the second main group, all patients received dexmedetomidine infusion, which began 10 minutes before the induction of anesthesia at a dose of 0.5 mcg/kg/h and ended 10 minutes before the end of the operation. Further in this group, induction was carried out by introducing propofol at a rate of 2 mg/kg, fentanyl 2 mcg/kg, rocuronium bromide 0.6 mg/kg. Dexmedetomidine 0.1 - 0.3 mcg/kg/h, fentanyl 2 mcg/kg/h, sevoflurane 1.3 MAC were used to maintain anesthesia. The mean arterial pressure was maintained within 70 - 80 mm Hg. When the heart rate was less than 50 beats per minute, 0.5 mg of atropine was administered intravenously. The duration of awakening time was calculated from the moment of cessation of neuromuscular blockade until opening of the eyes. The hemodynamic parameters, the volume of bleeding, the surgeon's subjective assessment of the visualization of the surgical field, the duration of the operation, the time of awakening of the patient, the consumption of opioids and anesthetics, the presence of nausea and vomiting in the postoperative period were studied.

Research Results

It was found that the mean arterial pressure in the main group (with dexmedetomidine) both at the stage of surgical intervention and after awakening was significantly lower than in the control group ($p < 0.05$). The heart rate was also lower in the main group than in the control group ($p < 0.05$), both at the stage of surgery 68.6 ± 2.20 and 78.9 ± 1.22, and after the end of the surgery 74.6 ± 1.26 and 82.3 ± 1.52, respectively ($p < 0.05$). Total peripheral vascular resistance before anesthesia, during and after surgery was higher in the control group than in the dexmedetomidine group. The most important effect of dexmedetomidine is a decrease in intraoperative bleeding, which is associated with both the prevention of hypertension and possibly with an increase in platelet aggregation by acting on α2-adrenergic receptors, so the average level of intraoperative bleeding in patients receiving dexmedetomidine was significantly lower than in patients in the control group ($p < 0.001$). The incidence of postoperative nausea and vomiting in the dexmedetomidine group differed from the control group. 90% of patients in the main group did not complain of nausea, and 20% had moderate nausea. Vomiting was not observed in any patient in either group.

Discussion

Controlled hypotension using various drug regimens is widely used to control bleeding during FESS surgery and to improve overall surgical outcomes. In our randomized prospective study, 50 patients were divided into 2 equal groups. During induction and maintenance of anesthesia, dexmedetomidine was added to the usual drug in the main group, unlike the control group. Both groups were compared in terms of the duration of surgery, the dose of anesthetics and opioids, the occurrence of postoperative nausea and vomiting, and the time of awakening. The number of bleedings in the dexmedetomidine group was significantly reduced. Many studies on the use of dexmedetomidine have proven the important effect of this drug on hemodynamic stability compared with other methods of controlled hypotension.

D. Dal., *et al*. (2004) investigated the effectiveness of different inhalation anesthetics in achieving target mean arterial pressure, compared the effects of isoflurane, sevoflurane and desflurane during tympanoplasty. K. Kaygusuz., *et al*. [1] compared the effects of

combined anesthesia with desflurane and isoflurane in combination with remifentanil in the same operations on the eardrum. Both studies showed a comparable effect in achieving target arterial pressure. However, the side effects of isoflurane (longer recovery, higher risk of postoperative nausea and vomiting) led to the conclusion that desflurane and sevoflurane are preferable during long middle ear surgeries. The safety and efficacy of general anesthesia with controlled hypotension using both propofol and the inhalation anesthetic sevoflurane are demonstrated by studies by T. Toi., *et al*. (2000). When using propofol, higher doses of direct vasodilators are required, but at the same time the negative side effects of inhalation anesthetics are eliminated. K. Jung., *et al*. (2014) believe that the use of inhalation anesthetics to achieve target blood pressure creates a risk of hypothermia and hypothermia compared to those with total intravenous anesthesia (TIA) using propofol. It should be noted that a greater temperature reduction with desflurane than with TVA (propofol + remifentanil) cannot fully reflect the clinical situation when, in addition to TVA, direct vasodilators are used, which also increase heat loss. From this, it can be concluded that any anesthesia regimen using controlled hypotension prevents protective vasoconstriction of skin vessels and increases heat loss. This requires adequate protection methods from the anesthesiologist, namely the use of warming mattresses, convection heating systems for patients, and ensuring normal temperature in the operating room. F. Yoshikawa., *et al*. (2009) demonstrated a comparable effect of using nitroglycerin and sodium nitroprusside. Anesthesia was compared in 36 patients undergoing mandibular osteotomy using sevoflurane under normal BP and in 2 groups of patients in whom controlled hypotension was achieved using nitrates. The safety of the methods was determined by the fact that no significant difference was obtained in the hormonal response to the operation (the level of cortisol, adrenocorticotropic hormone, vasopressin, norepinephrine, dopamine), no gas exchange disorders were detected during the operation and early postoperative period. Sodium nitroprusside was more effective, however, with balanced combined anesthesia, the target mean BP was achieved by titrating the drug doses in both study groups. U. Srivastava., *et al*. (2013) showed a similar effect in achieving target BP values in Functional Endoscopic Sinus Surgery (FESS) operations, comparing esmolol and nitroglycerin. The study included patients aged 18-55 years without comorbidities with an assessment according to the American Association of Anesthesiologists scale (ASAI-II), divided into nitroglycerin and esmolol groups. During the operation, the visibility of the surgical field was assessed according to the Fromme and Boezaart scale. Currently, the greatest attention is paid to central α2-adrenergic receptor stimulants (dexmedetomidine, clonidine) and a large number of scientific papers are devoted to them. A. Das., *et al*. [2] conducted a double-blind prospective randomized study in which they compared the effect of clonidine and dexmedetomidine in adults in endoscopic surgery of the UR. In both groups, the drug was administered 15 minutes before the onset of anesthesia in 100 ml of physiological solution. In group C (clonidine), the drug was administered at a dose of 1.5 mcg/kg, in group D (dexmedetomidine) - at a dose of 1.0 mcg/kg. Before the operation, the surgical field was anemized with a mixture of lidocaine and epinephrine. During the operation, the bleeding of the surgical field was taken into account according to the 5-point Boezaart scale, the dosages of anesthetics and opioid analgesics, the need for the introduction and dosage of nitroglycerin to achieve the target blood pressure level were compared. Both drugs showed their effectiveness for controlled hypotension. Patients who received clonidine required higher doses of anesthetics, analgesics and nitrates. Patients who received dexmedetomidine were transferred from the postoperative wards to the general department faster, but no difference in the duration of hospitalization was found. A. Das., *et al*. [3] in another study compared dexmedetomidine and esmolol for controlled hypotension during FESS in adults. For the study, 60 patients aged 20 - 45 years with an ASAI II score were selected and divided into 2 equal groups. Group D (dexmedetomidine) received 1 μg/kg of the drug as a jet stream 15 minutes before surgery and 0.5 μg/kg/h as a microjet, group E received esmolol in the same doses. All patients underwent anemization of the nasal passages with a mixture of lidocaine and epinephrine solutions. Hemodynamic parameters and the frequency of postoperative complications in the groups were comparable. These results allowed the authors to suggest that dexmedetomidine is more effective than esmolol for controlled arterial hypotension. However, other studies have shown conflicting results. Thus, S. Karabayirli., *et al*. [4] obtained opposite results, which cast doubt on the value of dexmedetomidine as a drug for controlled hypotension and pain relief. They compared the effect of dexmedetomidine and remifentanil during FESS in adults; 50 patients were randomly divided into 2 equal groups. Induction and maintenance of anesthesia were performed with sevoflurane. Standard doses of dexmedetomidine were administered during the operation: 1.0 mcg/kg by jet stream, 0.7 mcg/kg/h by microjet stream. The authors did not reveal any differences in the volume of blood

loss, visualization of the surgical field as assessed by the surgeon, or the need for sevoflurane. The frequency and severity of postoperative nausea and vomiting, muscle weakness, and pain syndrome were comparable. In the group of patients receiving dexmedetomidine, the awakening time was longer. Thus, no advantages of dexmedetomidine over remifentanil were revealed. Analyzing the work of many researchers regarding the use of this drug in controlled hypotension, it can be said that dexmedetomidine is the choice for the prevention of bleeding in FESS operations [5-10].

Conclusion

Dexmedetomidine infusion during FESS procedures significantly reduced the volume of bleeding, decreased the need for anesthetics and opioids, improved visualization of the surgical field and significantly reduced the duration of the operation.

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