Comparison between Dexmedetomidine and Glyceryl Trinitrate in Improving Quality of the Operative Field During Functional Endoscopic Sinus Surgery

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Abstract

Background: Functional endoscopic sinus surgery [FESS] is a well-established therapeutic option for intractable CRS. In case of major bleeding, risk of complications such as meningitis, blindness, intracranial injury, cerebrospinal fluid [CSF] leakage and the duration of surgery increase. **Aim of work:** The present work aims to compare between the efficacy of dexmedetomidine and glyceryl trinitrate in inducing controlled hypotension to improve the quality of the operative field during FESS under general anesthesia. **Materials and Methods**: In our study, the number of patients was 40 which were divided randomly into two groups: (a) Glyceryl trinitrate group: twenty patients received Glyceryl trinitrate (GTN group). (Dexmedetomidin group: twenty patients received Dexmedetomidine (DEX group). **Results:** It was confirmed that dexmedetomidine causes significant stable hemodynamics, excellent surgical field and significant surgeon satisfaction compared to glyceryl trinitrate. It also causes sedation effect so less extra doses of fentanyl were used. **Conclusion:** We concluded that during ambulatory FESS, dexmedetomidine is more effective than glyceryl trinitrate for providing controlled hypotension and rendering an excellent surgical field with higher surgeon's satisfaction score and lesser analgesic requirement without major hemodynamic alteration.

Keywords: Functional endoscopic sinus surgery, bleeding and hypotension.

Introduction

As chronic rhinosinusitis has a significant negative impact on quality of life, treatment is typically required **[1].**In most cases, chronic rhinosinusitis can be managed through pharmacologic means; however, some individuals do not respond to such intervention and require surgery **[2].** Functional endoscopic sinus surgery [FESS] is a well-established therapeutic

option for intractable CRS and other indications**[3].**

In case of major bleeding, risk of complications such as meningitis, blindness, intracranial injury, cerebrospinal fluid [CSF] leakage and the duration of surgery increase **[4]**.

Reduction of the bleeding and improvement of surgical conditions are essential to increase the visibility in the operation field during FESS and to avoid the complications such as orbital, skull base and internal carotid artery injury **[5].**

Dexmedetomidine, is a selective, short-acting, central α2-adrenergic agonist and is characterized by dose dependent decrease in arterial blood pressure, heart rate [HR], cardiac output and norepinephrine release **[6].**

The Glyceryl trinitrate [GTN] biotransformation pathway produces nitric oxide and contributes directly to its vasodilating effect **[7].**

Materials and Methods

This prospective study was performed from January 2017 to January 2018.

Approval of Ethics Committee in Faculty of Medicine; Benha University was taken before conduction of the study.

Informed consent was obtained from all participating patients before their inclusion at the outpatient clinic and another consent before undergoing FESS.

Patients:

This study was carried out on 40 patients that was selected from the Otorhinolaryngology outpatient clinic of Benha University Hospital .

The criteria of selection was carried on those who complain of symptoms of chronic sinusitis and nasal obstruction due to sinonasal polyposis of different grades that is refractory to medical treatment and defined by their clinical history, physical examination and radiographic findings.

Inclusion criteria:

Patients complaining of signs of bilateral chronic and/or recurrent rhinosinusitis and nasal obstruction from sinonasal polyposis of different grades that is refractory to medical management and defined by their clinical history, physical examination and radiographic findings.

Exclusion criteria

1. Patients with coagulopathies.
2. Patients with a known systemic disease requiring the use of anticoagulants.
3. Patients with a history of previous FESS.

Study design:

Patients was divided randomly in to two groups:

a) Glyceyl trinitrate group: twenty patients received Glyceryl trinitrate (GTN group).

b) Dexmedetomidine group: twenty patients received Dexmedetomidine (DEX group).

The 2 groups of patients were treated identically in all aspects.

During their intraoperative and postoperative follow up, the predefined outcome measures were recorded and the findings were compared between the two groups.

Study procedure:

All the patients were subjected to the followings:

A-Pre-operative Assessment:

All patients were assessed pre-operatively for the extent of chronic sinusitis which is resistant to medical treatment diagnosed clinically and radiologically or sinonasal polyposis with ASA I and ASA II physical status.

American Society of Anestheiologists (ASA), physical status classification*:*

I Healthy patient.

II Mild systemic disease- no functional limitations.

III severe systemic disease-difinite functional limitation .

IV Severe systemic disease that is constant threat to life.

V Moribund patient unlike to survive 24 h with or without operation.

B- Anasthetic technique:

All the patients underwent FESS using mucosal sparing technique and were divided randomely into two groups:

a) The patients of the glyceryl trinitrate group received an infusion at the level of 25-200 μg/min, according to the response diluted in 0.9% saline which will start after sterilization and positioning of the patients.

b) The patients of the dexmedetomidine group received a loading dose of 1μg/kg dexmedetomidine diluted in 100 ml 0.9% saline over 10 minutes just before induction of anesthesia, followed by continuous infusion of 0.2-0.7 μg/kg/h.

All the patients were subjected to the followings:

All the patients were pre oxygenated and premedicated with intravenous midazolam 0.05 mg/kg and Fentanyl 2μg/kg.

Induction of anesthesia was accomplished with 2 mg/kg intravenous Propofol 2%.

Endotracheal intubation was done with suitable – sized cuffed tube.

Normocapnic mechanical ventilation was performed and the anesthesia was maintained with sevoflurane 1-3% and muscle relaxation when needed was done.

After induction and intubation, all patients were laid in an approximately 30° reverse Trendlenburg position.

A standard dose of adrenaline (1:200 000 adrenaline) was packed in the nasal cavity.

The quality of the surgical field was estimated using the category scale that was described by Fromme 1986 ***(8).***

0: No bleeding.

1: Slight bleeding, no suctioning of blood required.

2: Slight bleeding occasional suctioning required. Surgical field not threatened.

3: Slight bleeding frequent suctioning required. Bleeding threatens surgical field a few seconds after suction is removed.

4: Moderate bleeding frequent suctioning required. Bleeding threatens surgical field directly after suction is removed.

5: Severe bleeding constant suctioning required. Bleeding appears faster than can be removed by suction. Surgical field severely threatened and surgery not possible.

The ideal values of category scale of surgical field were determined to be 2-3.

Monitoring of the mean arterial blood pressure (MAP) and the heart rate (H–R) was recorded at regular intervals of time.

C- Outcome measures:

a-assessment of quality of the operative field.

b-assessment of quantity of blood loss during the operation.

c- assessment of the mean arterial blood pressure (MAP).

d-assessment of the heart rate (HR).

Results

This study included a total of forty patients with chronic rhino-sinusitis (CRS) refractory to medical treatment or sinonasal polyposis presented for us in outpatient clinic and fulfilling the inclusion criteria in the absence of any of the exclusion criteria All patients underwent Functional Endoscopic Sinus Surgery (FESS) after receiving medical treatment and experienced no improvement.

Classification of cases:

a. **According to age, sex, weight and ASA score**

*The age in our study ranged from 22 till 48 years with mean value 33.10 ± 7.60 (Table 1)

Table (1):

		Total no. = 40
Age(years)	**Mean ± SD**	33.10 ± 7.60
	Range	22 – 48
Sex	**Female**	18 (45.0%)
	Male	22 (55.0%)
Weight	**Mean ± SD**	77.20 ± 12.16
	Range	57 – 95
ASA Score	**I**	26 (65.0%)
	II	14 (35.0%)

Table 2: Classification according to the quality of the surgical field.

In the analysis of the quality of surgical field during FESS surgery, their was no significant difference between both groups of drugs during all times of surgery as both groups provide the surgeon with good quality of the surgical field

Scale of surgical field (0-5)		**Group A No. = 20**	**Group B No. = 20**	**Test value•**	**P-value**	**Sig.**
15 mins of hypotension	Mean ± SD	2.2 ± 0.41	2.1 ± 0.31	0.872	0.389	NS
	Range	2 – 3	2 – 3			
30 mins of hypotension	Mean ± SD	1.9 ± 0.21	1.8 ± 0.25	1.378	0.176	NS
	Range	1.5 – 2	1.5 – 2			
45 mins of hypotension	Mean ± SD	1.85 ± 0.31	1.75 ± 0.32	1.000	0.324	NS
	Range	1.25 – 2	1.25 – 2			
60 mins of hypotension	Mean ± SD	1.8 ± 0.41	1.6 ± 0.45	1.474	0.149	NS
	Range	1 – 2	1 – 2			
75 mins of hypotension	Mean ± SD	2 ± 0	2 ± 0	–	–	–
	Range	2 – 2	2 – 2			

Baseline values of MAP were comparable in both groups. On comparison, there was a significant reduction in MAP compared with baseline values after induction of However, in the GTN group a rise in MAP was noticed before extubation, followed by a significant reduction at 5 min after extubation. The studied drugs reached the desired MAP (55–65 mmHg) with significant differences detected between anesthesia and during the hypotensive period in both groups. This reduction extended until extubation in the DEX group.

both groups during the hypotensive period from 30 up to 75 min and extended until extubation, with the lowest values observed in the DEX group followed by the GTN group in almost all times.

Table 3: Classification according to mean arterial blood pressure (MAP)

MAP		Group A No. = 20	Group B No. = 20	Test value•	P-value	Sig.
Basal	**Mean ± SD**	93.1 ± 12.57	97.4 ± 4.86	-1.427	0.162	NS
	Range	81 – 121	92 – 106			
After induction	**Mean ± SD**	89 ± 12.61	94.5 ± 7.99	-1.648	0.108	NS
	Range	75 – 112	81 – 105			
After intubation	**Mean ± SD**	100.2 ± 17.01	93.1 ± 10.77	1.577	0.123	NS
	Range	80 – 132	77 – 107			
After 15 min	**Mean ± SD**	68.9 ± 5.51	69.5 ± 7.32	-0.293	0.771	NS
	Range	61 – 78	58 – 79			
After 30 min	**Mean ± SD**	63.70 ± 4.73	60.60 ± 3.41	2.379	0.022	S
	Range	58 – 72	55 – 65			
After 45 min	**Mean ± SD**	60.90 ± 2.95	57.80 ± 4.15	2.722	0.010	S
	Range	58 – 66	52 – 64			
After 60 min	**Mean ± SD**	63.85 ± 5.22	60.30 ± 5.45	2.103	0.042	S
	Range	57 – 73	53 – 71			
After 75 min	**Mean ± SD**	66.30 ± 4.70	61.90 ± 6.41	2.474	0.018	S
	Range	59 – 74	52 – 73			
Before extubation	**Mean ± SD**	96.1 ± 8.84	88.9 ± 6.33	2.960	0.005	HS
	Range	86 – 114	81 – 101			
5 min after extubation	**Mean ± SD**	95.8 ± 8.75	91.4 ± 9.94	1.486	0.146	NS
	Range	86 – 114	79 – 107			

In the analysis of HR, significant difference was detected between the groups at 45 and 75 min of the hypotensive period, before extubation, and at 5 min after extubation (with P values 0.010, 0.039, <0.034, and <0.041, respectively), with slower and more steady rate observed in the DEX group. Intergroup comparison showed a significant reduction in HR in both groups after induction and throughout the hypotensive period in comparison with the basal HR. This significant reduction continued until extubation and 5 min after extubation in the DEX group. However, it showed significant increase in the GTN group at those two times.

Table 4: Classification according to the analysis of heart rate (HR)

Heart rate	Group A Mean ± SD	Group B Mean ± SD	Test value•	P-value	Sig.
Basal	87 ± 3.2	86 ± 2.9	-1.036	0.307	NS
After induction	76 ± 4.15	78 ± 3.17	1.713	0.095	NS
After intubation	84 ± 2.3	85 ± 2.8	1.234	0.225	NS
After 15 mins	80 ± 4.4	77 ± 5.3	-1.948	0.059	NS
After 30 mins	72 ± 2.5	70 ± 3.7	-2.003	0.052	NS
After 45 mins	74 ± 3.2	71 ± 3.8	-2.701	0.010	S
After 60 mins	71 ± 4.3	68 ± 4.6	-2.131	0.039	S
After 75 mins	72 ± 3.6	69 ± 4.9	-2.207	0.034	S
Before extubation	83 ± 4.35	80 ± 4.59	-2.122	0.041	S
5 min after extubation	90 ± 4.51	87 ± 4.37	-2.136	0.039	S

Table 5: Classification according to surgical time, anesthesia time and blood loss: There was no significant differences between the surgical time, anesthesia time and blood loss between both groups.

		Group A No. = 20	Group B No. = 20	Test value•	P-value	Sig.
Surgical Time (min)	**Mean ± SD**	90 ± 4.21	91.6 ± 4.24	-1.199	0.238	NS
	Range	85 – 97	86 – 98			
Anesthesia time (min)	**Mean ± SD**	99.5 ± 3.87	100.6 ± 4.06	-0.877	0.386	NS
	Range	95 – 106	95 – 107			
Blood Loss (min)	**Mean ± SD**	209 ± 26.14	212 ± 38.61	-0.288	0.775	NS
	Range	170 – 250	150 – 270			
Time to restore basal MAP (min)	**Mean ± SD**	7.6 ± 2.01	8.3 ± 1.84	-1.149	0.258	NS
	Range	4 – 10	5 – 11			

Table 6: Classification according to using other drugs: Significant difference was noticed in the using fentanyl in the GTN group more than the DEX group. There was no significant difference between the two groups in using other drugs.

	Group A No. (%)	Group B No. (%)	Test value	P-value	Sig.
Fentanyl	11 (55.0%)	3 (15.0%)	7.033	0.008	HS
Atropine	3 (15.0%)	2 (10.0%)	0.229	0.632	NS
Ephedrine	6 (30.0%)	6 (30.0%)	0.000	1.000	NS

Discussion

In this prospective study, dexmedetomidine or GTN was used to induce controlled hypotension to provide a good surgical field. The results revealed that the two drugs reached the desired MAP (55–65 mmHg) with significant differences detected during the hypotensive period from 30 up to 75 min and extended until extubation with the lowest values in the DEX group and lastly the GTN group in almost all times.

For HR, significant reduction in both groups was detected during the hypotensive period; this reduction continued until extubation and 5 min after extubation in the DEX group only.

However, it showed a significant increase in the GTN group at those two times and slower and steadier rate in the DEX group.

Intraoperative blood loss and quality of the surgical field during the hypotensive period were comparable in both groups with no significant differences.

The target cMAP between 55 and 65 mmHg was decided after revising previous studies in which metabolic and hormonal responses were investigated in patients who were subjected to induced

hypotension to provide bloodless field without the hazard of tissue ischemia.

Although the two drugs were effective in achieving the target MAP, lowering the HR, and ensuring good surgical condition during the procedure, the hemodynamic profile of dexmedetomidine was steadier, which can be attributed to the known sympatholytic effect of α-2 agonists.

The α-2 receptors are involved in regulating the autonomic and cardiovascular systems; thus, the receptors on sympathetic terminal inhibit norepinephrine release and those located on blood vessels mediate vasoconstriction **[9].**

At lower doses, DEX is predominantly sympatholytic. DEX, on binding to α-2 receptors, reduces the sympathetic outflow and augments cardiac vagal activity, thus resulting in a decreased HR and cardiac output **[10]**

It causes analgesia and sympatholysis and has sedative, anxiolytic, and hypnotic effects **[11].**

As regards GTN, it has shown that it reduced bleeding and improved surgical view quality with MAP 50–60 mmHg during endoscopic nasal surgery **[12].**

However**,** it was found that a continuous infusion of DEX is effective in minimizing blood loss and maintaining superior hemodynamics as compared with GTN in posterior fixation spine surgeries **[13]**. GTN produces its hypotensive action by liberating nitric oxide, which has a half-life of 0.1 s **[14].** Whereas DEX acts by selectively binding to α-2 receptors with great affinity **[15].**

This could explain our findings, which is in agreement with those of in which longer time to restore the baseline MAP and more hemodynamic stability were observed during extubation in the DEX group compared with the GTN group even after the hypotensive drugs were stopped **[16]** .

On evaluating the intraoperative fentanyl and first postoperative analgesic request, this study showed that fentanyl was significantly lower, together with longer time to require postoperative analgesia, in the DEX group compared with the GTN group.

In accordance with our results, several studies have demonstrated the analgesic properties of both drugs as in **[17].** Whereas, others showed that perioperative use of dexmedetomidine was associated with a significant reduction in the consumption of fentanyl in a dose-dependent manner as in these studies **[18]** and **[19].**

This can be explained by the sedative and analgesic sparing effects of dexmedetomidine through central actions in the locus coeruleus and in the dorsal horn of the spinal cord **[20].**

Conclusion

In conclusion, dexmedetomidine provided more stable hemodynamics, greater visual quality of the surgical field and superior recovery profile with less post-operative complications compared to glyceryl trinitrate when used in patients underwent Functional endoscopic sinus surgery (FESS) under general anesthesia.

As a result, we believe that in Functional endoscopic sinus surgeries, dexmedetomidine is a good alternative to glyceryl trinitrate.

The effect of the studied drugs on the release of catecholamine and other stress hormones either intraoperatively or postoperatively was not investigated.

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