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COMPARATIVE STUDY OF RECOVERY PARAMETERS OF DESFLURANE AND SEVOFLURANE IN FUNCTIONAL ENDOSCOPIC SINUS SURGERY

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Numerous inhalant anaesthetics are often utilised to provide the optimal operating field required for successful endoscopic sinus surgery (ESS). Modern inhaled anaesthetics such as Sevoflurane and Desflurane enable rapid induction and recovery because to their low blood-gas partition coefficients.

***The aim**: The goal of this study is to compare desflurane with sevoflurane's recovery qualities after functional endoscopic sinus surgery.*

***Materials and methods:** The present study was a prospective, randomised, comparative clinical trial that included participants scheduled to have functional endoscopic sinus surgery. The study included 60 ASA I and II patients scheduled for FESS under general anaesthesia and divided them into two groups of 30 each: group D (Desflurane) and group S (Sevoflurane).*

***Results**: There was no statistically significant difference in the age, gender, ASA grade, or mean weight distributions between the two groups (p>0.05). There was no statistically significant difference in the mean length of operation or anaesthesia between the two groups. Hemodynamic variables did not alter much. Time in minutes for eye opening (p<0.001) was significantly shorter in group D (Desflurane) than in group S (Sevoflurane). Time in minutes for extubation (p<0.001) was significantly shorter in group D (Desflurane) 6.53±1.14 than in group S (Sevoflurane) 9.37±1.30. Time in minutes for obeying commands (p<0.001) was significantly shorter in group D (Desflurane) 7.87±1.11 than in group S (Sevoflurane) 11.33±1.51.*

***Conclusion:** In patients receiving FESS time taken for eye opening, extubation and time taken for obeying commands from termination of anesthetic is significantly shorter with desflurane (group D) when compared with sevoflurane (group S). So desflurane was linked to a quicker early recovery than sevoflurane.*

***Keywords:** functional endoscopic sinus surgeries, desflurane, sevoflurane,* general anaesthesia*, early recovery, Hemodynamic variables*

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1. Introduction

The procedure known as FESS (functional endoscopic sinus surgery) is gaining popularity. Its debut, along with improved illumination and eyesight, led in a considerable improvement in surgical dissection. FESS is a treatment that restores the sinuses' function and health by reopening their natural drainage pathways. FESS is one of the most challenging ENT procedures for a variety of reasons, including the need for immobilisation, haemostasis, and a very mild and rapid recovery. Rapid anaesthetic recovery enables speedier recovering of reflexes and avoidance of the adverse effects of blood aspiration and laryngospasm [1–3].

A more rapid recovery from general anaesthesia is encouraged using volatile anaesthetics that are rapidly metabolised. Sevoflurane and desflurane have pharmacokinetic properties that favour rapid waking from anaesthesia. This is owing to differences in the blood-gas partition coefficients of desflurane and sevoflurane (0.45 vs 0.65 and 27 vs 48, respectively). Desflurane's lower partition coefficients enable it to be excreted from the body more rapidly and with a shorter emergence time. Therefore, the use of shorter-acting anaesthetics and analgesics may expedite the process of emergence [4–6]. This study compares the effects of desflurane and sevoflurane as inhalation agents on patients recuperating from functional endoscopic sinus surgery.

The aim of this study is to compare desflurane with sevoflurane's recovery qualities after functional endoscopic sinus surgery.

2. Materials and methods

The current research was a prospective, randomised, comparative clinical evaluation of patients scheduled for elective functional endoscopic sinus surgery at the Govt ENT facility at Osmania Medical College in Koti, Hyderabad for a period of one year – from May 2017 to April 2019.

Inclusion criteria: ASA grades I and II, ages 18 to 60. Patients who have been scheduled for elective

FESS. Anesthesia might last anywhere from 60 minutes and three hours.

Exclusion criteria: Patients who have recently had general anaesthesia. Patients with a history of neuropsychiatric disorders and alcohol use, as well as clinically significant cardiovascular, pulmonary, hepatic, renal, neurological, mental, and metabolic disease and a BMI more than 30.

Informed consent was obtained with all patients. All fundamental investigations have been completed. Following approval by the ethical committee of Osmania Medical College (IEC- 16102001026D: Date-10-11-2016),

60 ASA I and II patients scheduled for FESS under general anaesthesia were randomly assigned to one of two groups: group D (Desflurane) or group S (Sevoflurane), each with 30 patients. One day before the procedure, a pre-anesthetic check-up was performed. Patients were checked for systemic illnesses and laboratory tests were taken. The general anaesthetic technique was described to the patients, and they signed a permission form. Patients were fasted overnight as part of their preparation. At night, patients were given tab. Alprazolam 0.5 mg as a premedication. The anaesthetic machine was examined on the day of operation. Prior to the procedure, the right size endotracheal tubes, a functioning laryngoscope with medium and big blades, a stylet, bougie, and a functional suction device were all on hand. In the event of an emergency, atropine, adrenaline, mephenteramine, ephedrine, and dopamine were kept on hand. Patients were transferred to the operation room and connected to non-invasive blood pressure (NIBP), electrocardiogram (ECG), and pulse oximeter monitoring. Base vital signs were collected, and an IV cannula No 20G was utilised to get IV access on the forearm. The patients were premedicated with glycopyrrolate 0.2 mg IV, ondansetron 4 mg IV, and fentanyl 1.5 mcg/kg IV. Both study groups employed a standard anaesthetic approach with Thiopentone sodium 5 mg/kg titrated to the lack of eyelash response. Suxamethonium (1.5 mg/kg) was given to facilitate endotracheal intubation, which was performed with a cuffed tube of appropriate size. All patients were mechanically ventilated with a 33:66 O_2/N_2O mixture. To achieve normocapnia, the respiratory rate (RR) and tidal volume (TV) were adjusted to the subject's body weight. After intubation, a throat pack is placed using Mac-gills forceps. During the maintenance phase, ventilation was handled using a closed circle system with a total fresh gas flow rate of 5 L/min, a mixture of 66 percent N_2O and 33 percent O_2, and desflurane (MAC 2–4 %) or sevoflurane (MAV 0.5–1 %) to maintain normocarbia. Vecuronium is used to maintain anaesthesia. To enhance venous drainage, patients were given 3 ml/kg dextrose normal saline and put in a 15° reverse Trendelenburg posture. Bilateral polypectomy, middle meatal antrostomy, full ethmoidectomy, and sphenoidotomy were the endoscopic sinus procedures performed on all patients. To reduce bleeding, hypotensive anaesthesia is maintained using nitroglycerine drip titration. The throat pack is removed when the procedure is completed. To ensure that no clots or oral packs are left behind, the oral cavity and postnasal region are thoroughly examined and suctioned. Desflurane/sevoflurane and N_2O are turned off concurrently after oral suctioning. Following the termination of anaesthesia, residual neuromuscular blockade was re-established with glycopyrrolate (0.01 mg/kg IV) and neostigmine (0.05 mg/kg IV). The time interval between the cessation of N_2O and desflurane/sevoflurane and eye opening, tracheal extubation, and reacting to instructions was monitored at 30–60 second intervals. Additionally, the durations of anaesthesia (from induction to N_2O termination) and surgery (from surgical incision to skin closure) were recorded. Blood pressure, heart rate, and oxygen saturation were all measured non-invasively. Haemodynamics were monitored preoperatively (baseline), intraoperatively every 15 minutes, and postoperatively for 15 minutes (every 5 mins). After extubation and full recovery, patients were moved to the post-anesthesia care unit (PACU).

Statistical methods:

SPSS statistics was used to conduct descriptive statistical analysis in this investigation. Continuous measurement data are displayed as Mean±SD (Min-Max), whereas categorical measurement results are presented as Number (percent). The significance is determined at a 5 % level of significance.

We make the following data assumptions.

1. Dependent variables should be regularly distributed;

2. Population samples should be collected randomly; and

3. Sample cases should be independent.

The Students' t-test was used to examine the significance of research parameters on a continuous scale comparing two groups (inter group analysis) on metric parameters (two tailed, independent). The Students' t-test was used to analyse the data statistically, and the p value was determined p>0.05 is not significant; p<0.05 is significant; p<0.01 is highly significant.

3. Results

Sixty participants undergoing FESS surgery were involved in the study. At random, the patients were divided into two groups of 30 each.

Both groups had a range of ages between 18 and 60 years. Between the two groups, there was no statistically significant difference (p>0.05) in age distributions between the two groups. There were 15 males and 15 females in group D, and 14 males and 16 females in group S. Between the two groups, there was no statistically significant difference (p>0.05) in gender distributions between the two groups. There was no statistically significant difference in the ASA grade distributions between the two groups p>0.05.

There was no statistically significant difference in mean weight distributions between the two groups (p > 0.05) (Table 1).

There was no statistically significant difference in mean length of operation between the two groups (p>0.05) (Fig. 1).

There was no statistically significant difference in mean duration of anaesthesia between the two groups (p>0.05) (Fig. 2).

There was no statistically significant difference (p > 0.05) in any hemodynamic measure between the two groups (Table 2).

Table 1

Comparison of demographic distribution

Age in years	Group D		Group S	
	NO	%	NO	%
18–20	3	10	4	13.33
21–30	14	46.66	7	23.33
31–40	6	20	10	33.33
41–50	5	16.66	5	16.66
51–60	2	6.66	4	13.33
Total	30	100	30	
Mean	32.87		35.37	
SD	11.32		11.95	
Gender				
Male	15	50	14	46.66
Female	15	50	16	53.33
ASA grade				
I	18	60	21	70
II	12	40	9	30
Weight in kgs				
41–50	2	6.66	4	13.33
51–60	10	33.33	11	36.66
61–70	9	30	11	36.66
71–80	9	30	4	13.33
Mean±SD	64.80±9.2	100	61.07±8.48	100

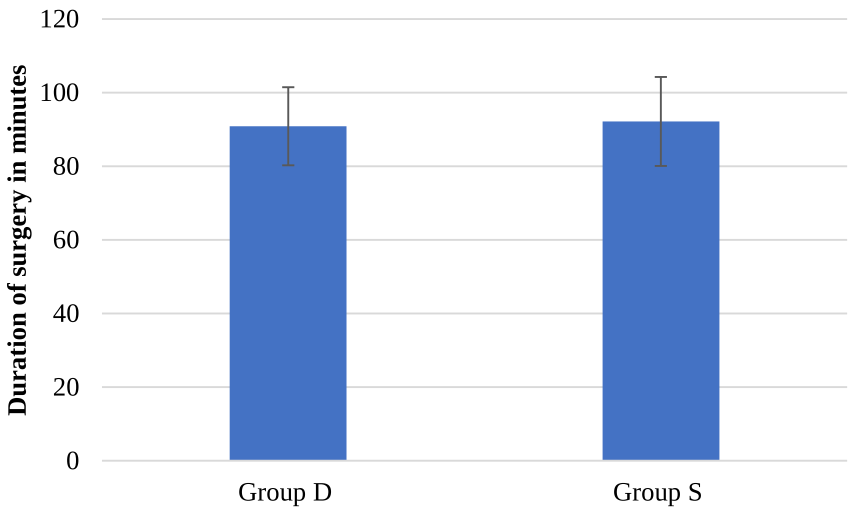

Fig. 1. Comparison of mean duration of surgery

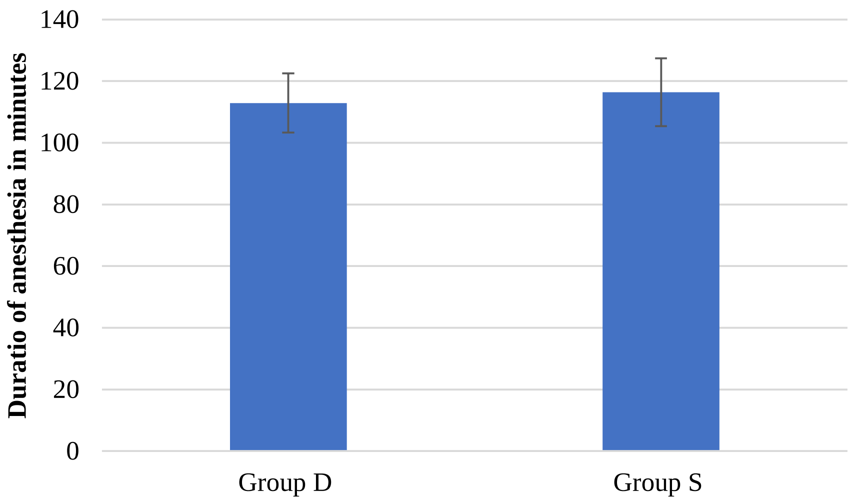

Fig. 2. Comparison of mean duration of anesthesia

Table 2

Comparison of hemodynamic variables

SBP (mm Hg)	Group D	Group S	P value
Pre op	116.60±7.74	118.67±7.78	0.3058
At time of recovery			
0 mins	124.27±4.83	124.40±6.57	0.9307
5 mins	116.53±5.87	116.13±5.70	0.7898
10 mins	115.53±5.86	115.20±5.52	0.8231
15 mins	115.33±5.42	114.80±4.72	0.6878
DBP (mm Hg)			
Pre op	79.33±7.47	81.67±5.61	0.2802
At time of recovery			
0 mins	82.73±4.22	83.67±4.07	0.3835
5 mins	78.27±3.99	78.20±4.01	0.9462
10 mins	76.60±3.86	76.13±3.96	0.6433
15 mins	75.67±3.53	75.33±3.17	0.6961
Heart rate (bpm)			
Pre op	78.93±5.14	79.80±6.67	0.5737
At the time recovery			
0 mins	93.07±5.48	92.60±4.70	0.7227
5 mins	79.53±4.09	79.40±4.17	0.9034
10 mins	77.80±4.34	78.73±3.50	0.3647
15 mins	76.20±4.50	75.53±4.06	0.5472

Time required to open the eyes in minutes p<0.001 substantially less in group D (Desflurane) than in group S (Sevoflurane). Extubation time in minutes was substantially less in group D (Desflurane) (6.53±1.14) than in group S (Sevoflurane) (9.37±1.30). The time required to accept directions in minutes was substantially less in group D (Desflurane) (7.87±1.11) than in group S (Sevoflurane) (11.33±1.51) (Table 3, Fig. 3).

Table 3

Comparison of mean time in minutes for recovery parameters

Variables	Group D	Group S	P value
Eye opening (mins)	5.30±1.09	7.67±1.32	<0.001
Extubation (mins)	6.53±1.14	9.37±1.30	<0.001
Obeying commands (mins)	7.87±1.11	11.33±1.51	<0.001

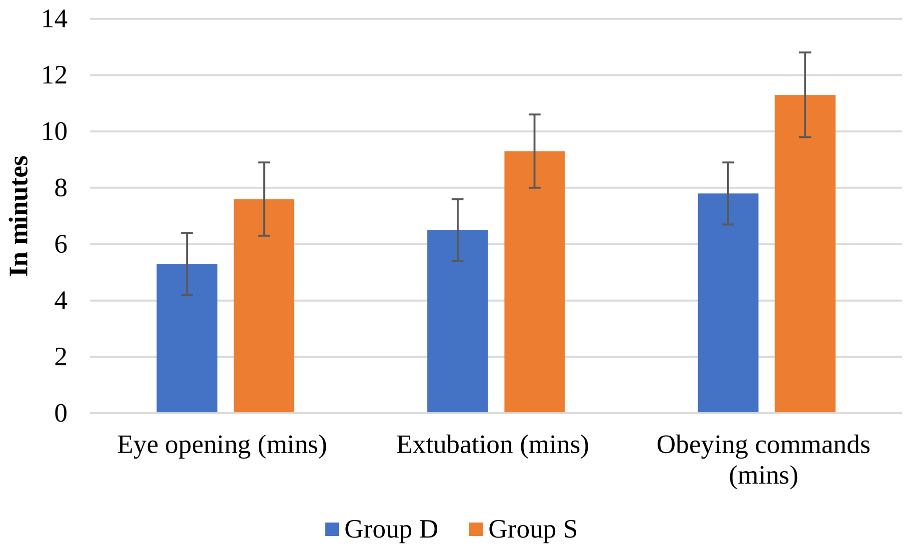

Fig. 3. Bar diagram showing Comparison of recovery parameters in both groups

4. Discussion

FESS is one of the most challenging ENT procedures for a variety of reasons, including the need for immobilisation, haemostasis, and a very mild and rapid recovery. A more rapid recovery from general anaesthesia is encouraged using volatile anaesthetics that are rapidly metabolised. Sevoflurane and desflurane have pharmacokinetic properties that favour rapid waking from anaesthesia. This is owing to differences in the blood-gas partition coefficients of desflurane and sevoflurane (0.45 vs 0.65 and 27 vs 48, respectively). Desflurane's lower partition coefficients enable it to be excreted from the body more rapidly and with a shorter emergence time. As a consequence, the use of shorter-acting anaesthetics and analgesics may expedite the process of emergence. This study compares the effects of desflurane and sevoflurane as inhalation agents on patients recuperating from functional endoscopic sinus surgery. The recovery features of patients undergoing FESS were evaluated in terms of time to eye opening, extubation, and obeying directions after the cessation of anaesthetic drugs (desflurane, sevoflurane) (squeezing finger).

Patients were randomly assigned to one of two groups of thirty each: Group D (desflurane) or Group S (sevoflurane). Gender, ASA grade, length of anaesthesia and operation, weight, and premedication drug doses, thiopentone induction dose, and intraoperative analgesic demand were also similar across the two anaesthetic groups.

For monitoring hemodynamic state, the pulse rate, systolic and diastolic blood pressures were monitored for 15 minutes before to induction (pre op) and during recovery from anaesthesia (every 5 mins). Nitroglycerine was used to maintain controlled hypotension during surgery and was discontinued at the conclusion of the procedure.

Desflurane (Group D) opens the eyes much faster than sevoflurane (Group S) in our investigation, $p<0.001$. Desflurane took 5.30+1.09 minutes and sevoflurane took 7.67+1.30 minutes. In our study, we found that when desflurane (Group D) was compared to sevoflurane (Group S), the time required for extubation from the end of the anaesthesia was much shorter ($p<0.001$). Desflurane took 6.53+1.14 minutes while sevoflurane took 9.37+1.30 minutes. In our study, we found that when desflurane (Group D) is compared to sevoflurane (Group S), the time necessary to obey directives (e.g., squeeze finger, lift head) after anaesthetic termination is significantly shorter with desflurane (Group D) $p=0.001$. It was 7.87+1.11 in the presence of desflurane and 11.33+1.51 in the presence of sevoflurane.

The study showed desflurane reduces the average extubation time and variability of extubation time by 20–25 % when compared to sevoflurane. In our study, desflurane had a much shorter average extubation time than sevoflurane [7].

E. Iannuzzi, M. Iannuzzi, G. Viola [8] study desflurane provided a significant advantage in terms of early recovery, as judged by the time necessary to properly answer basic questions after the cessation of anaesthetics. Desflurane required less time to administer than sevoflurane, although we did not assess pulmonary washout time. The mean time to eye opening after desflurane was 5.30+1.09 minutes, but the mean time to eye opening following sevoflurane was 7.67+1.30 minutes. For desflurane, the mean time required to accept vocal directions was 7.87+1.11, but for sevoflurane, the mean time required was 11.33+1.51.

In a study conducted by Giuseppina Magni et al [9] showed mean emergence time was similar across the two groups (12.2±4.9 min in group S vs 10.8±7.2 min in group D; P=ns), the mean eye-opening time was much shorter in our study with desflurane 5.30+1.09 and sevoflurane 7.67+1.30. Group S required more time on average for extubation and recovery (15.2 3.0 minutes vs 11.3±3.9 minutes in group D and 18.2±2.3 minutes vs 12.4±7.7 minutes in group D, respectively; $P<0.001$). Desflurane performed much better than sevoflurane in our experiment in terms of extubation time and command adherence.

Glucan Erk et al [10] observed that desflurane significantly accelerated early recovery (eye opening and extubation), but had no effect on orientation, sitting, or walking. In our investigation, desflurane had a faster initial recovery time than sevoflurane.

Mahmoud N. A. et. al [11] observed mean end-tidal desflurane concentration was 4.5 percent five and ten minutes after induction, while the mean end-tidal sevoflurane concentration was 1.7 percent. Five adverse airway events (coughing, hiccoughs) occurred in the desflurane group, while three occurred in the sevoflurane group, including one laryngospasm. After anaesthesia, the desflurane group opened their eyes and orientated themselves much faster (2.8 min/4.8 min; $p<0.0001$) than the sevoflurane group (7.0 min/9.8 min; $p<0.0001$). The time required for the desflurane group to be sent home was also much shorter (3 h compared with 3.5 h). On the first postoperative day, a telephone interview indicated that 29 of 31 desflurane patients had completely recovered, compared to just 15 of 29 sevoflurane patients ($p<0.01$). Desflurane (5.30+1.09 minutes) was much faster than sevoflurane (7.67+1.30 minutes) in our experiment, however we did not assess the time required to resume regular activities.

R. E. McKay et al [12] showed Increased body mass index and length of anaesthesia influence the recovery of protective airway reflexes after sevoflurane versus desflurane. The recovery of the airway reflex is hindered by prolonged sevoflurane administration and a greater body mass index. BMI has a larger influence in this delay after sevoflurane than it does following desflurane. Although we did not assess the effect of BMI in our trial, desflurane recovery was much faster than sevoflurane recovery.

Pensado Castiñeiras et al [13] reported desflurane facilitates early postoperative recovery, with mean times to eye opening of 7.6 and 7.8 minutes and time to extubation of 7.8 and 8.3 minutes for desflurane and sevoflurane, respectively. In our research, the time to eye opening was 5.30+1.09 and 7.67+1.30 for desflurane and sevoflurane, respectively, while the time to extubation was 6.53+1.14 and 9.37+1.30 for desflurane and sevoflurane, respectively. Desflurane provides a speedier initial recovery than sevoflurane.

S. Gergin et al [14] studied the hemodynamic, emergence, and recovery properties of sevoflurane and desflurane in nitrous oxide were examined and it was observed that the time to extubation, remembering one's name, and following directions were all quicker with desflurane. They determined that desflurane has a temporary benefit over sevoflurane in terms of early recovery, even though desflurane has a longer duration of anaesthesia. The length of anaesthesia was comparable across the two groups in our research, however desflurane had a quicker initial recovery from anaesthesia than sevoflurane.

Strums E. M. et al [15] studied desflurane vs sevoflurane emergence and recovery characteristics in morbidly obese adult surgical patients. In a prospective, randomised study, morbidly obese adult patients undergoing major abdominal surgery awakened significantly sooner after being sedated with desflurane than after being sedated with sevoflurane, and patients sedated with desflurane had a higher oxygen saturation upon admission to the PACU. Although they excluded patients who were severely obese from experiment, recovery was much faster with desflurane than with sevoflurane.

Valentina Caverni et al [16] D group recovered more rapidly and fully in the early and late phases; hypotensive anaesthesia was maintained similarly in our experiment, however the impact of hypotensive anaesthesia on recovery was not compared. When compared to sevoflurane, individuals on desflurane recovered more rapidly.

Study limitations are rotational error was not included; study period was less; sample size was small. Our patient population did not include geriatric patients or obese patients, who are more likely to benefit from a faster recovery from anesthesia.

Prospects for further research. Future studies are needed to validate for post-operative assessment of cognitive dysfunction in elderly patients (over 65 years) and compare its usefulness with other relevant neuropsychological tests. Our study design needs to have follow-up to see if the benefits of early recovery from anesthesia extended in to the intermediate and late recovery period.

5. Conclusion

In our study time taken for eye opening from termination of anesthetic is significantly shorter with desflurane (Group D) when compared with sevoflurane (Group S) ($p<0.001$). With desflurane it was 5.30+1.09 min whereas with sevoflurane it was 7.67+1.30min. In our study time taken for extubation from termination of anesthetic is significantly shorter with desflurane (Group D) when compared with sevoflurane (Group S) ($p<0.001$). With desflurane it was 6.53+1.14 min whereas with sevoflurane it was 9.37+1.30 min. Time taken for obeying commands (e.g., squeeze finger, head lift) from termination of anesthetic is significantly shorter with desflurane (Group D) when compared with sevoflurane (Group S) ($p<0.001$). With desflurane it was 7.87+1.11 whereas with sevoflurane it was 11.33+1.51.

We conclude that when parameters such as time to eye opening, time to extubation, and time to follow directions (squeezing finger, head lift) in patients undergoing FESS, desflurane was associated with a faster early recovery than sevoflurane.

Conflict of interests

The authors declare that they have no conflicts of interest.

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