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COMBINED REGIONAL NASAL BLOCK AND GENERAL ANESTHESIA VERSUS GENERAL ANESTHESIA WITH INDUCED HYPOTENSION TECHNIQUE DURING ENDOSCOPIC SINUS SURGERY

By

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ABSTRACT

Background: Since the early development of functional endoscopic sinus surgery (FESS) in the 1970s, this technique has gained increasing popularity.

Objective: To compare the efficacy of combined regional nasal anesthesia and general anesthesia -in a group of patients undergoing FESS versus the efficacy of general anesthesia.

Patients and Methods: A double blinded study was carried out, in Al-Azhar University Hospitals on 40 adult patients undergoing endoscopic sinus surgery, Physical status (ASA I&II), after approval of the ethical committee of Al-Azhar University. Written consent was obtained from all patients. Every patient received an explanation to the purpose of the study and given a code number. The SPSS program was used for data handling.

Results: After analysis of the data, the results have shown that the regional anesthesia in Group B could achieve better surgical fields, less blood loss, a stable hemodynamic profile with no need for the use of risky multimodal drugs, less anesthesia time, and better postoperative analgesia.

Conclusion: Regional anesthesia of the nose after induction of general anesthesia in patients undergoing FESS is an effective method that can provide better surgical field visualization with fewer bleeding, more stable hemodynamic profile without the use of multimodal drugs, less anesthesia time, and better postoperative analgesia when compared to the induced hypotension technique.

Keywords: Regional Nasal Block – Induced Hypotension - Surgical Field Visualization – FESS.

INTRODUCTION

Since the early development of functional endoscopic sinus surgery (FESS) in the early 1970s, this minimally invasive technique has gained increasing popularity. The aim of this surgery is to clear the diseased air cells and improve ventilation of the paranasal sinuses, thereby reducing the severity and frequency of infections *(Park et al., 2010)*.

One of the major limiting factors for endoscopic approaches to paranasal sinuses is its high vascularity. Often, a slight hemorrhage is sufficient to dramatically reduce visibility, creating a poor surgical field *(Kastl et al., 2009)*.

Also, procedures involving the nasal sinuses are very painful, and in most of them, patients are obligated to breathe through their mouth post-operatively *(Miłoński et al., 2013)*.

Thus, obtaining adequate hemostasis, and providing sufficient analgesia are of utmost importance during endoscopic sinus surgeries. That is why the anesthetic plan must be tailored to ensure the best possible surgical field visualization and the most adequate analgesia; while preserving the patient's hemodynamic stability and reducing complications during surgery, emergence from anesthesia and upon recovery *(Kesimci et al., 2012)*.

The aim of this study was to compare the efficacy of combined regional nasal anesthesia and general anesthesia -in a group of patients undergoing FESS versus the efficacy of general anesthesia with induced hypotension on:

- Surgical filed visualization.
- Maintaining hemodynamic stability intraoperatively.
- Reducing perioperative complications.
- Postoperative consumption of analgesics.

PATIENTS AND METHODS

A double blinded study was carried out in Al-Azhar University Hospitals on 40 adult patients undergoing elective endoscopic sinus surgery, Physical status (ASA I & II), after approval of the ethical committee of Anesthesia and Intensive Care Department in Al-Azhar University. Written informed consents were obtained from all patients. Every patient received an explanation to the purpose of the study, and had a secret code number.

Inclusion criteria:

- Patients with physical status ASA I, II scheduled for endoscopic sinus surgery.
- Patients with no history of hypersensitivity or idiosyncrasy to any drugs.

Exclusion criteria:

- Patients with physical status ASA III, IV.
- Extremes of age.
- Chronic hypertensive patients.
- Patients with history for cerebrovascular or coronary insufficiency.
- Patients with co-aggulopathy.
- Patients with liver dysfunction.
- Patients with infection at the injection sites.
- Patients known to be allergic to amide LAs.

Patients were randomly classified into two equal groups:

- **Group A:** Patients in this group received general anesthesia with the use of an induced hypotensive technique.
- **Group B:** Patients received general anesthesia, immediately followed by regional block for the nose.

• On arrival to the operation ward, IV cannula was inserted, and the patient was given the midazolam premedication. They were monitored using SPO2 pleth, ECG "lead II", NIPB, and EtCO2.

• In Both groups, GA was initiated with Fentanyl (1µg/kg), and Propofol (2mg/kg). Muscle relaxation was obtained using Cis-atracurium Besylate (0.15mg/kg) for intubation. Two puffs of 10% Lidocaine spray (one puff delivers 10 mg of lidocaine) for the laryngeal inlet and Lidocaine (1.5mg/kg IV) were used to decrease the stress response of intubation. After intubation, anesthesia was maintained using Sevoflurane (1 MAC "2%") and lungs were ventilated with 100% Oxygen.

• In group (A), an induced hypotensive technique was initiated aiming to reduce the mean arterial blood pressure and the heart rate by 20% of the basal reading. Propranolol increments (0.5 mg) and glyceryl trinitrite infusion (0.2-1µg/kg.min) were used *(Alan et al., 2001)*.

• In group (B), immediately after Induction of general anesthesia, bilateral local nasal nerve block was done by:

- Both anterior and posterior ethmoidal nerves were blocked. This was achieved by inserting 2 pledgets in each nostril soaked in a mixture of lidocaine (2%), bupivacaine (0.5%) and xylometazoline Hcl (0.1%). The pledgets were kept with gentle compression for 5 minutes *(Boberg-Ans and Barner, 1980)*.

- Sphenopalatine block was done via a transoral approach using 2ml of a mixture of lidocaine (2%) and bupivacaine (0.5%) for each side. The ganglion was blocked at the greater palatine foramen *(Douglas and Wormald, 2006)*.

- Supratrochlear and infratrochlear nerves were blocked using 4mls of lidocaine (2%) and bupivacaine (0.5%) on each side. The supratrochlear nerve was blocked at the glabella, and the infratrochlear was blocked below the inner canthus *(Zide and Swift, 1998)*.

- Infraorbital nerve was blocked via an intraoral approach using 3mls of lidocaine (2%), and bupivacaine (0.5%). The needle was inserted into the mucolabila fold just anterior to the apex of the first premolar tooth. The needle was then inserted along the axis of the tooth for about 5 cm. The non-dominant hand was gently palpating the foramen transcutaneously to ensure that the needle was not advanced through the foramen to avoid injury to the nerve *(Takahashi et al., 2011)*.

• The surgical field visualization was assessed every 15 minutes using the Average Category scale *(Ismail and Anwar, 2005)*.

● **Post-operatively**

• Patients were taught to interpret pain using the visual analogue scale. *(Turk and Melzack, 2001)*.

• Post-operative consumption of analgesics at the ward was monitored for the first 24 hours. Patients with score ≥4 were given

Ketorolac (30mg) by intravenous infusion.

Statistical analysis:

Data were collected, revised, coded and entered to the Statistical Package for Social Science (IBM SPSS) version 23.

The comparison between groups regarding qualitative data was done by using Chi-square test and/or Fisher exact test when the expected count in any cell found less than 5.

The Independent t-test was used to compare between two independent groups with quantitative data and parametric distribution.

The confidence interval was set to 95% and the margin of error accepted was set to 5%. So, the significance of the p-value < 0.05 was considered significant.

RESULTS

There was no statistically significant difference found between groups A and B regarding demographic data (age, and sex) and ASA classification (table 1).

Table (1): Comparison between group A and group B regarding demographic data and ASA classification

Parameters \ Groups		Group A No. = 20	Group B No. = 20	P-value
Sex	Male	11 (55.0%)	11 (55.0%)	>0.05
	Female	9 (45.0%)	9 (45.0%)	
Age (years)	Mean±SD	34.9 ± 6.85	33.35 ± 6.95	>0.05
	Range	24 – 46	23 – 46	
ASA Classification	1	13 (65.0%)	15 (75.0%)	>0.05
	2	7 (35.0%)	5 (25.0%)	

*: Chi-square test; •: Independent t-test

There was no statistically significant difference found between groups A and B regarding average category scale except at 30 minutes, and 90 minutes. However, the mean of the readings during the operation showed a highly statistically significant difference between them (table 2).

Table (2): Comparison between group A and group B regarding average category scale (ACS)

Average Category Scale \ Groups		Group A No. = 20	Group B No. = 20	P-value
After induction	0	20 (100.0%)	20 (100.0%)	NA
After 15 minutes	0	0 (0.0%)	2 (10.0%)	>0.05
	1	13 (65.0%)	12 (60.0%)	
	2	6 (30.0%)	6 (30.0%)	
	3	1 (5.0%)	0 (0.0%)	
After 30 minutes	0	1 (5.0%)	0 (0.0%)	0.033
	1	5 (25.0%)	13 (65.0%)	
	2	14 (70.0%)	6 (30.0%)	
	3	0 (0.0%)	1 (5.0%)	
After 45 minutes	1	6 (30.0%)	13 (65.0%)	>0.05
	2	12 (60.0%)	7 (35.0%)	
	3	2 (10.0%)	0 (0.0%)	
After 60 minutes	1	12 (60.0%)	13 (72.2%)	>0.05
	2	7 (35.0%)	5 (27.8%)	
	3	1 (5.0%)	0 (0.0%)	
After 75 minutes	1	8 (40.0%)	6 (33.3%)	>0.05
	2	9 (45.0%)	12 (66.7%)	
	3	3 (15.0%)	0 (0.0%)	
After 90 minutes	1	5 (25.0%)	11 (68.8%)	0.028
	2	14 (70.0%)	5 (31.3%)	
	3	1 (5.0%)	0 (0.0%)	
After 105 minutes	1	5 (50.0%)	8 (88.9%)	>0.05
	2	5 (50.0%)	1 (11.1%)	
After 120 minutes	1	5 (71.4%)	2 (40.0%)	>0.05
	2	2 (28.6%)	3 (60.0%)	
Mean of ACS	1	4 (20.0%)	15 (75.0%)	0.001
	2	16 (80.0%)	5 (25.0%)	

*: Chi-square test

There was no statistically significant difference found between group A and group B regarding heart rate at different times of measurement (table 3).

Table (3): Comparison between group A and group B regarding heart rate (Mean±SD)

Groups / Heart rate (Beat/min.)	Group A No. = 20	Group B No. = 20	P-value
Baseline	83.35 ± 10.054 70 – 110	87.8 ± 12.813 65 – 110	>0.05
After induction	67.2 ± 6.204 60 – 81	73.1 ± 12.519 57 – 105	>0.05
After 15 minutes	67.45 ± 6.955 59 – 80	71.2 ± 11.143 55 – 100	>0.05
After 30 minutes	68.8 ± 5.872 60 – 83	71.75 ± 9.803 60 – 98	>0.05
After 45 minutes	71.95 ± 7.316 63 – 90	72.7 ± 8.927 60 – 92	>0.05
After 60 minutes	69.65 ± 6.761 60 – 81	71.39 ± 8.168 59 – 88	>0.05
After 75 minutes	71.35 ± 7.795 60 – 88	73.61 ± 6.509 62 – 86	>0.05
After 90 minutes	70.26 ± 6.814 62 – 85	70.75 ± 5.196 60 – 81	>0.05
After 105 minutes	72 ± 5.172 65 – 80	71.57 ± 6.373 61 – 81	>0.05
After 120 minutes	69.86 ± 6.669 60 – 78	73.6 ± 4.98 70 – 80	>0.05

•: Independent t-test

There was no statistically significant difference found between group A and group B regarding mean arterial blood pressure at different times of measurement except after induction showed higher mean arterial blood pressure in group B than group A with p-value = 0.025 (table 4).

Table (4): Comparison between group A and group B regarding mean arterial blood pressure (Mean±SD)

Groups / Mean Arterial Blood Pressure (mmHg)	Group A No. = 20	Group B No. = 20	P-value
Baseline	83.95 ± 4.383	86.7 ± 9.314	>0.05
	79 – 95	78 – 120	
After induction	66.65 ± 3.801	69 ± 1.732	0.01
	60 – 73	65 – 71	
After 15 minutes	67.2 ± 6.685	69.85 ± 5.334	>0.05
	59 – 90	65 – 90	
After 30 minutes	65.85 ± 5.47	68.9 ± 4.941	>0.05
	58 – 75	59 – 79	
After 45 minutes	69.65 ± 9.287	71.6 ± 10.787	>0.05
	62 – 95	60 – 100	
After 75 minutes	68.75 ± 7.973	70.06 ± 6.855	>0.05
	57 – 95	59 – 90	
After 90 minutes	70.37 ± 9.057	68.81 ± 7.943	>0.05
	60 – 98	60 – 96	
After 105 minutes	69 ± 9.165	70.38 ± 8.245	>0.05
	59 – 88	65 – 90	
After 120 minutes	69.86 ± 5.815	66.6 ± 4.722	>0.05
	63 – 80	61 – 71	

•: Independent t-test

There was no statistically significant difference found between group A and group B time of surgery while there was statistically significant difference found between them as regard need for intraoperative top up dose, blood loss and time of anesthesia (table 5).

Table (5): Comparison between group A and group B regarding need for intraoperative top up dose, blood loss, and time of surgery

Parameters	Groups	Group A No. = 20	Group B No. = 20	P-value
Need for intraoperative top up dose	Yes	20 (100.0%)	1 (5.0%)	<0.001
	No	0 (0.0%)	19 (95.0%)	
Blood Loss	Mean± SD	231 ± 54.763	115.35 ± 27.122	<0.01
	Range	180 – 350	75 – 180	
Time of surgery	Mean± SD	105.05 ± 14.274	94 ± 31.05	>0.05
	Range	76 – 128	30 – 166	

*: Chi-square test; •: Independent t-test

There was a highly statistically significant difference found between the two studied groups regarding VAS score immediately postoperative, 6, 12 and 24 hours postoperatively table (6).

Table (6): Comparison between group A and group B regarding visual analogue scale (Mean±SD)

Groups / Visual Analogue Scale	Group A No. = 20	Group B No. = 20	P-value
6 hours postoperatively	4 ± 0.73	1.55 ± 0.51	0.001
	3 – 5	1 – 2	
12 hours postoperatively	4.85 ± 0.59	4.35 ± 0.49	0.006
	4 – 6	4 – 5	
24 hours postoperatively	4 ± 0.65	4.7 ± 0.80	0.004
	3 – 5	3 – 6	

•: Independent t-test

DISCUSSION

Functional endoscopic sinus surgery (FESS) is a minimally invasive intervention that uses nasal endoscopes for enhancing the drainage of nasal pathways to improve sinus ventilation. This procedure is most commonly indicated for chronic sinusitis refractory to medical treatment, nasal polyposis, and sinus mucoceles. It can be performed also for repairing cerebrospinal fluid leaks, optic nerve decompression, and Dacryocystorhinostomy. It has been reported by *Atighechi et al. (2013)* that FESS significantly influences the quality of life.

The surgical field bleeding has become a major limitation for this kind of procedures as the slightest amount of hemorrhage is enough to dramatically reduce visibility, thus creating a poor surgical field, increasing the operative time, and exposes the patient for the risk of blood loss *(Govindaraj et al,. 2010)*.

Induced hypotension has been widely advocated for controlling the surgical field bleeding. This technique aims at lowering the blood pressure with a controlled manner to reach the lowest acceptable blood pressure that can limit intraoperative blood loss thus providing the best field for surgery *(Rayan, 2016)*.

Another alternative for the induced hypotensive anesthesia is administering regional anesthesia for the cavity of the nose and nasal sinuses along with topical mucosal decongestion. This would help, not only, in decreasing the blood loss thus enhancing the surgical field, but also would help maintaining a stable non-fluctuating hemodynamic profile, and would provide a good postoperative analgesia.

In the present study, 40 patients scheduled for FESS were randomly selected to participate in the study. They were divided into two equal groups. In the first group (A), an induced hypotensive technique was advocated along with general anesthesia. The other group (B) has received a regional block for the nose after induction of general anesthesia. The two groups were compared regarding the surgical field visualization, the hemodynamic stability, intraoperative bleeding and postoperative analgesia.

As regard to the demographic data, there was no statistically significant difference between the two groups of the study.

The surgical field visualization assessment, using the average category scale (ACS), showed that the numbers were lower in the regional block group with better surgical conditions, and less blood loss. This was achieved in the block group without any rescue doses of glyceryl trinitrite, propranolol, or fentanyl, and without increasing the MAC of sevoflurane.

Ghanem and Elmalt (2017) have found that the bleeding did not compromise the field and the surgeon was very satisfied. They have assessed the surgical field using the six-point (average category) scale and have reported that the numbers in all cases were ≤ 2, which means that there was no significant bleeding enough to compromise the extent of surgical dissection for all the study population.

The results obtained in this study were similar to the study done by *Dyomina et al (2017)*. They have found that the group that received bilateral sphenopalatine block have encountered less blood loss, less anesthetic consumption, less use of hypotensive agents, less recovery and anesthesia times, and better postoperative analgesia.

Amorocho et al. (2015) has reported that the sphenopalatine ganglion block is a useful adjunct in patients undergoing FESS; as it provided good operative conditions with lower ACS numbers, and lower blood loss. This is all along with better recovery characteristics, less consumption of anesthesia and better postoperative analgesia.

Also, *Scott et al. (2017)* have concluded, after their studies, that FESS under local anesthesia offers many advantages over general anesthesia alone as the blood loss was very minimal.The field conditions was very appropriate and major and minor orbital and intracranial complications were not seen during the study.

Interestingly, *Mohseni and Ebneshahidi (2011)* have perfrormed a prospective blind randomized controlled trial. The aim of this study was to assess the effect of pterygopalatine fossa infiltration with lidocaine and adrenalin on bleeding in the surgical field during endoscopic sinus surgery. Fifty-five patients were selected randomly to receive a unilateral transoral infiltration of the pterygopalatine fossa (which contains the sphenopalatine ganglion). The surgical field was graded on a previously validated surgical field grading scale every 15 minutes with the side being operated on alternated every 30 minutes. All the time points from 30 minutes to 3.5 hours have shown a significant difference in surgical grade between injected and non-injected sides in favor of the injected side.

Moreover in this study, we eliminated the use of epinephrine either as an adjuvant to the local anesthetics, as subcutaneous field infiltration, or as topical decongestant. Instead we used topical application of Xylometazoline (0.1%), and interestingly the surgical field had a very optimum condition for operation without obtaining the undesirable effect of tachycardia or increased blood pressure that follows the usage of the epinephrine.

The mean arterial blood pressure (MAP) and the heart rate measurements have shown no statistically significant difference. However, the stable hemodynamic profile was easily

achievable in the block group as there was no need for maintaining a continuous infusion of the hypotensive agent (glyceryl trinitrite) or frequent increments of the beta blocker (propranolol).

Amorocho et al. (2016) have found that the average mean of heart rate was significantly less in the block group than the non-block group during the periods of assessment. On the other hand, there was no significant difference between both groups regarding the average of MAP during the overall measurement periods. Also, fewer patients in the block group needed either increased MAC of sevoflurane, increments of fentanyl, or boluses of urapidil.

Regarding the surgical time, the results have shown no significant difference between both groups. *Dyomina et al. (2017)* have found that the operative time was comparable in both groups with no statistically significant difference. However, the time to full recovery was significantly lower in the block group.

In the present study, the postoperative pain was assessed using the visual analogue scale (VAS) immediately postoperatively, and after 6, 12, and 24 hours. The results showed a highly significant statistical difference in favor of the block group especially in the first 12 hours.

Rezaeian et al. (2019) have shown that the VAS in the intervention group was significantly lower than in the control group immediately after anesthesia, as well as 6, 12, and 24 h after the operation.

Amorocho et al. (2016) have found after concluding their study that fewer patients required additional analgesics through the postoperative period in the block group in comparison with the non-block group during the first four hours after the operation, as 6 out of 30 patients in the block group required additional analgesics versus 24 out of 30 patients in the non-block group. They have found also that there was a highly significant difference between both groups in the time to the first recues pain medication post operatively. The difference was in favor of the block group. Moreover, the pain intensity was less in the block group at 6, 12, 24 hours postoperatively.

Dyomina et al. (2017) have shown that the patients in the block group had significantly lower VAS numbers especially until 150 minutes postoperatively.

Ghanem and Elmalt (2017) have reported that the patients were very satisfied due to effective postoperative pain management. They have assessed that using the VAS and the rescue analgesic requirement in the first 24 hours postoperatively. The rescue analgesia plan has comprised the use of tramadol and/or diclofenac. In the first 6 hours the VAS was less than 2 and no rescue analgesia required. During the consequent hours the VAS was less than 7 and only diclofenac was effective without the need to use tramadol.

DeMaria et al. (2012) have shown that the patients who received the SPG block have consumed less or no opioids in the recovery room than did the patients who didn't. Although the outcome at 24 hours postoperatively did not differ significantly between groups but trended towards increased satisfaction in the block group.

Ma'somi and Abshirini (2013) have found that the VAS scores were lower, and the patients needed less rescue doses of postoperative analgesia.

The present study has shown the effectiveness of the involvement of regional block for the nose after induction of general anesthesia in patients undergoing FESS as it optimized the surgical field, provided a stable hemodynamic profile without the need for multimodal drugs, minimized perioperative complications, and enhanced the postoperative analgesia. The regional block for the nose has shown no complications in the study population. However, it is always advised to mind the risks of neurapraxia, needle breakage in the canal, and local anesthesia toxicity while performing regional anesthesia for the nose and the nasal sinuses.

One of the limitations to the study was the crowded operation list that may not allow the proper time before the regional anesthesia to be fully settled. However, these allegedly wasted minutes were cost-effective as they provided less anesthesia and analgesia consumption, avoided us the risks of hypotensive anesthesia with more stable hemodynamic profile, reduced the PACU stay time, and increased both the surgeon's and the patient's satisfaction. Another limitation was that it was not applicable to perform all the cases with the same surgeon.

CONCLUSION

Regional anesthesia of the nose after induction of general anesthesia in patients undergoing FESS was a simple and a very effective method that can provide better surgical field visualization with fewer bleeding, more stable hemodynamic profile without the use of multimodal drugs, less anesthesia time, and better postoperative analgesia when compared to the technique of induced hypotension.

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مقارنة تأثير التخدير الكلي مع التخدير الموضعي للأنف، بتأثير التخدير الكلي مع تقنية خفض ضغط الدم في عمليات مناظير الجيوب الأنفية

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قسم التخدير والعناية المركزة، كلية الطب، جامعة الأزهر

خلفية البحث: لقد لاقت المناظير الوظيفية للجيوب الأنفية رواجاً هائلاً منذ نشأتها في سبعينات القرن الماضي، كأحد العمليات الجراحية ذات الطابع التدخلي البسيط. فالهدف منها هو تنظيف الجيوب الأنفية لتحسين التهوية و بالتالي تقليل معدل، و حدة الإصابة بالعدوى.

الهدف من البحث: المقارنة بين التخدير الموضعي للأنف و بين تقنية خفض ضغط الدم في المرضى الذين يخضعون لعمليات مناظير الجيوب الأنفية، و ذلك من حيث رؤية المجال الجراحي، و المضاعفات المصاحبة للعملية و أهمها النزيف، و ثبات المعدلات الحيوية، و مقدار تسكين الألم بعد العملية.

المرضى و طرق البحث: تضمنت هذه الدراسة أربعين مريضاً من الذين أجريت لهم عمليات مناظير الجيوب الأنفية في مستشفيات جامعة الأزهر. و قد تم تقسيمهم عشوائياً و بالتساوي على مجموعتين: الأولى استخدمت فيها تقنية خفض ضغط الدم، و الثانية استخدم فيها التخدير الموضعي للأنف. و لقد تم أخذ موافقتهم المسبقة و التبين من لياقتهم الطبية لإجراء التخدير و العملية قبل إشراكهم في الدراسة.

نتائج البحث: أظهرت المجموعة التي خضعت للتخدير الموضعي رؤية أفضل للمجال الجراحي، و معدلات أقل في النزيف، و ثبات في العلامات الحيوية بدون الحاجة لاستخدام العديد من الأدوية، كما أظهرت نتائج أفضل في تسكين الألم بعد العملية.

الاســـتنتاج: إن التخـــدير الموضـــعي للأنـــف المـــدمج مـــع التخـــدير الكلـــي فـــي عمليـــات منـــاظير الجيـــوب الأنفيـــة، مـــن الطـــرق الفعالـــة التـــي تســـتطيع تـــوفير أفضـــل رؤيـــة للمجـــال الجراحـــي مـــع معـــدلات أقـــل للنزيـــف؛ مـــع تحقيـــق ثبـــات فـــي العلامـــات الحيويـــة دون الحاجـــة لاســـتخدام العديـــد مـــن الأدويـــة. كمـــا قللـــت هـــذه التقنيـــة مـــن الوقـــت المســـتغرق للتخـــدير و وفـــرت درجـــة عاليـــة مـــن تســـكين الألـــم بعـــد العمليـــة، و ذلـــك مقارنـــة مـــع استخدام تقنية خفض الضغط المستحث.