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CASE STUDY

ANESTHESIA IN LOW EJECTION FRACTION PATIENT: CASE REPORT

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ABSTRACT

Ejection fraction (EF) is a measurement, expressed as a percentage the percentage of the difference between volume of the end-diastolic and the volume of end-systolic divided by the volume of end-diastolic. This measurement is important to know how well the heart is pumping out blood and decide in diagnosing heart failure (HF). Normally the percentage of EF is above 50%. A decrease in EF will make it difficult to perform anesthesia during surgery due to life-threatening emergency irregular heartbeats, leading sudden cardiac arrest become sudden death. Patients with a very low ejection fraction need identification of risk factors, accompanying by preoperative evaluation and optimization, correct medical therapy, adequate monitoring, and appropriate anesthetic technique and drugs. In this report, we present a 67-year-old woman with HFmrEF (estimated ejection fraction 46%) and coronary artery disease who underwent partial hip replacement surgery under general anesthesia. General anesthesia was performed on the patient and induction used fentanyl, midazolam, and atracurium. Management of patients is aimed at maintaining cardiac output and avoiding myocardial depression by maintaining a balance between oxygen supply and demand. Therefore good anesthetic management is needed to maintain the hemodynamic stability of the patient.

Keywords: Anesthesia Management; Heart Failure: Low Ejection Fraction

АБСТРАКТ

Фракция выброса (ФВ) - это выраженная в процентах разница между конечным диастолическим объемом и конечным систолическим объемом, деленная на конечный диастолический объем. Это измерение важно для определения того, насколько хорошо сердце перекачивает кровь, и помогает в диагностике сердечной недостаточности (СН). В норме процент EF составляет более 50 %. Снижение EF затрудняет проведение анестезии во время операции из-за опасных для жизни неравномерных сердечных сокращений, приводящих к внезапной остановке сердца и внезапной смерти. Пациенты с очень низкой фракцией выброса нуждаются в выявлении факторов риска, сопровождающемся предоперационной оценкой и оптимизацией, правильной медикаментозной терапией, адекватным мониторингом, а также соответствующей техникой и препаратами для анестезии. В данном отчете мы представляем 67-летнюю женщину с HFmrEF (расчетная фракция выброса 46 %) и ишемической болезнью сердца, которой была проведена операция по частичному эндопротезированию тазобедренного сустава под общей анестезией. Пациентке была проведена общая анестезия, для индукции использовались фентанил, мидазолам и атракуриум. Ведение пациентов направлено на поддержание сердечного выброса и предотвращение депрессии миокарда путем поддержания баланса между потребностью в кислороде и его подачей. Поэтому для поддержания гемодинамической стабильности пациента необходим хороший анестезиологический менеджмент.

Ключевые слова: Анестезиологическое обеспечение; сердечная недостаточность: Низкая фракция выброса

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INTRODUCTION

Ejection fraction (EF) is a quantitative assessment, represented as a percentage, of the disparity between the volume of blood in the heart's chambers at the end of relaxation and the volume of blood in the heart's chambers at the end of contraction, divided by the volume of blood at the end of relaxation.1 Knowing this value is crucial for assessing cardiac output and determining the presence of heart failure (HF). Heart failure (HF) impacts approximately 2% of the population in western countries. The prevalence of HF rises from 1% in those over 40 years to 10% in those over 75 years. It is projected that by 2030, the incidence of HF would reach 9.9 million cases.Two Heart failure (HF) is the primary reason for hospitalisation in persons aged 65 and above. Due to its occurrence in the senior population, it is projected that the prevalence and incidence of HF would see exponential growth in the coming decade. According to a doctor's diagnosis, the prevalence of HF in Indonesia in 2013 was 0.13%, which corresponds to an estimated 229,696 individuals. However, when considering both a doctor's diagnosis and symptoms, the prevalence increased to 0.3%, corresponding to an estimated 530,068 individuals.[3]

The European Society of Cardiology (ESC) 2016 classifies heart failure (HF) according to the assessment of the left ventricular ejection fraction (LVEF) measurement. The European Society of Cardiology (ESC) categorises heart failure (HF) into three distinct classes based on ejection fraction (EF): HF with reduced ejection fraction (HfrEF) which is defined as EF less than 40%, HF with midrange ejection fraction (HFmrEF) which is defined as EF between 40% and 49%, and HF with preserved ejection fraction (HfpEF) which is defined as EF equal to or greater than 50%. Patients with a low ejection fraction (EF), specifically an EF below 35%, are at a heightened risk of life-threatening complications owing to arrhythmias.[4]

The number of elderly patients with heart disease presenting for any surgery is steadily increasing. Anesthesiologists are required to provide good quality and safe care in the operating room for patients with low ejection fraction. Patients with a very low ejection fraction require early identification of risk factors, preoperative evaluation and optimization, correct medical therapy, adequate monitoring, and appropriate anesthetic technique and drugs. During induction of anesthesia and intubation, hemodynamic changes are critical. This procedure is a noxious stimulus, which can trigger unwanted responses in the cardiovascular, respiratory, and other physiological systems such as tachycardia, hypertension, and arrhythmias that can be detrimental to patients with poor cardiovascular reserve.

Patients with a low EF are considered at high risk for anesthesia because life-threatening emergency irregular heartbeats leading sudden cardiac arrest become sudden death. The goals of anesthetic management of the patient with low ejection fraction include avoiding drug-induced myocardial depression, preventing arrhythmias and maintaining adequate cardiac output.[5]

A 67-year-old woman (40 kg, 150 cm) complained of right hip pain since she fell 3 days before. The pain is felt continuously and is very painful when moved. The patient was planned for emergency partial hip replacement surgery. The patient has a history of CVA, myocardial infarction and HF. The echocardiographic examination results concluded that HFmrEF (LVEF 46%) with CAD (Figure 1). The patient 2 months previously had undergone percutaneous transluminal coronary angioplasty. For 2 months the patient routinely went to the heart polyclinic and received treatment with bisoprolol, atorvastatin, clopidogrel, acetylsalicylic acid, furosemide, valsartan, glycerin, and spironolactone. The patient had a history of CVA about 5 years ago with right sided weakness.

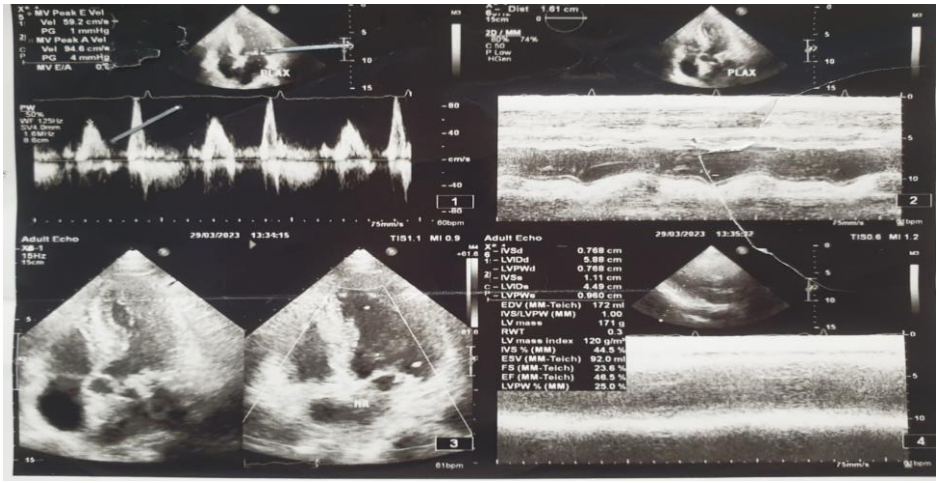

Figure 1. Echocardiography

On physical examination, the patient's general condition was weak, compos mentis awareness, increased BP 145/98 mmHg, RR 20x/minute, HR 82x/minute, SpO2 99%, with VAS 7. Local examination found a shortening deformity on the right leg compared to the left leg. On complete blood examination (Table 1), the levels of leukocytes, lymphocytes, blood glucose, serum creatinine, BUN, and potassium were found to be increased, and sodium levels were decreased. Thorax AP obtained a cor and pulmo image within normal limits (Figure 2). ECG evaluation (Figure 3) found sinus rhythm, normoaxis, HR 74x/m, with anteroseptal ischemia (V1, V2, V3, V4). Photo of the AP pelvis and femur (D) concluded that the intertrochanteric fracture of the dextra femur (Figure 4).

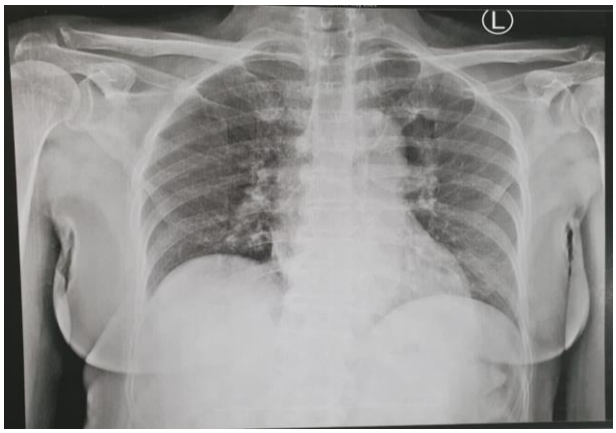

Figure 2. Thorax AP Preoperative

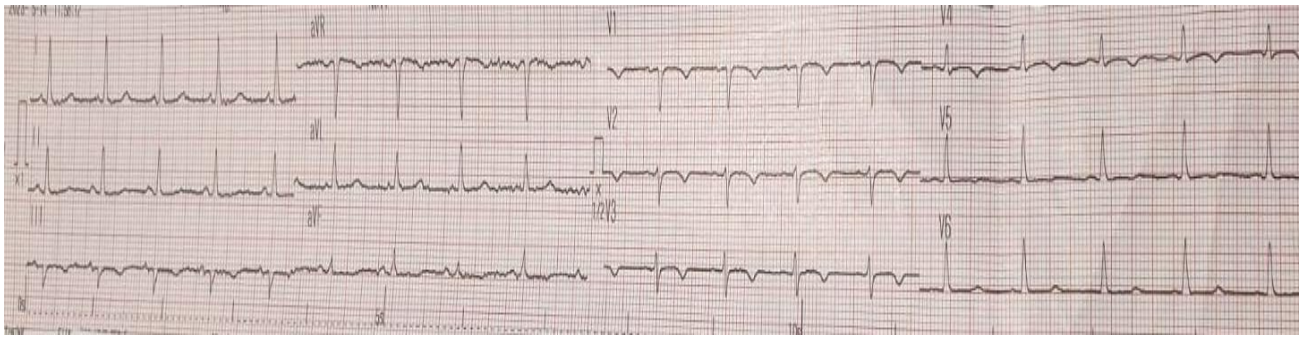

Figure 3. EKG

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Figure 4. Pelvis AP and Femur (D) Preoperative

Tabel 1. Laboratory Findings Preoperative

Parameter	Value	Normal Value
Hematology		
Hemoglobin	13,6	12.0-16.0 gr/dL
Leukosit	12,0	4.5-11.0 10^9/L
Hematokrit	42,3	36-46 %
Trombosit	414	150-450 x 10^9/L
PPT		
PPT Patient	10,0	Unlike the control <2 seconds
PPT Control	10,7	
APPT		
APPT Patient	28,8	Unlike the control <7 seconds
APPT Control	27,0	
LFT		
SGOT	11	10-31 U/L
SGPT	12	9-43 U/L
Albumin	4,2	3,4-4,8 g/dL
RFT		
Serum Kreatinin	1,6 (H)	0,5-1,1 mg/dL
BUN	44 (H)	6-20 mg/dL
Elektrolit		
Natrium	134,2 (L)	135-155 mmol/L
Kalium	5,08 (H)	3,5-5,0 mmol/L
Clorida	104,4	90-110 mmol/L
GDS	302	<200 mg/dL
HbA1C	9,8	>= 6,5

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The patient's diagnosis was CF Collum Femur with ASA 3 physical status and complications of HFmrEF + DM + electrolyte imbalance. The patient was planned for partial hip replacement surgery with intermediate risk ESC and cardiac risk index (CRI) class 1. Prior to surgery, the patient was given informed consent regarding the patient's condition and fasted for 6 hours before surgery. The patient was positioned supine and pre-oxygenated for 5 minutes with 100% O2. Anesthesia induction of the patient was carried out by giving a combination of midazolam 1.5 mg i.v, tofodex 50 mg i.v., fentanyl 250 mcg i.v., and atracurium 40 mg i.v. Maintenance of anesthesia was carried out by giving desflurane (MAC 6%) and continuous thiopental 150 mg iv. Monitoring during surgery by evaluating blood pressure (systolic/diastolic), pulse, respiratory rate, and oxygen saturation. Right after induction of anesthesia the patient's blood pressure had decreased and increased again at 30 minutes after induction (Figure 5). The operation lasted 60 minutes. Intraoperatively the patient received norepinephrine pump 3 cc/hour and ephedrine 4mg i.v when there was a decrease in blood pressure, nicardipine pump 1.25 mg/hour 60 minutes after induction, intake of 1000 mL of ringer fundin crystalloid fluid and 500 mL of Hes. Fluid output during surgery was 300 mL of bleeding. As a reversal of the muscle relaxant, the patient was injected with 2 mg i.v neostigmine and 0.75 mg i.v atropine sulfate.

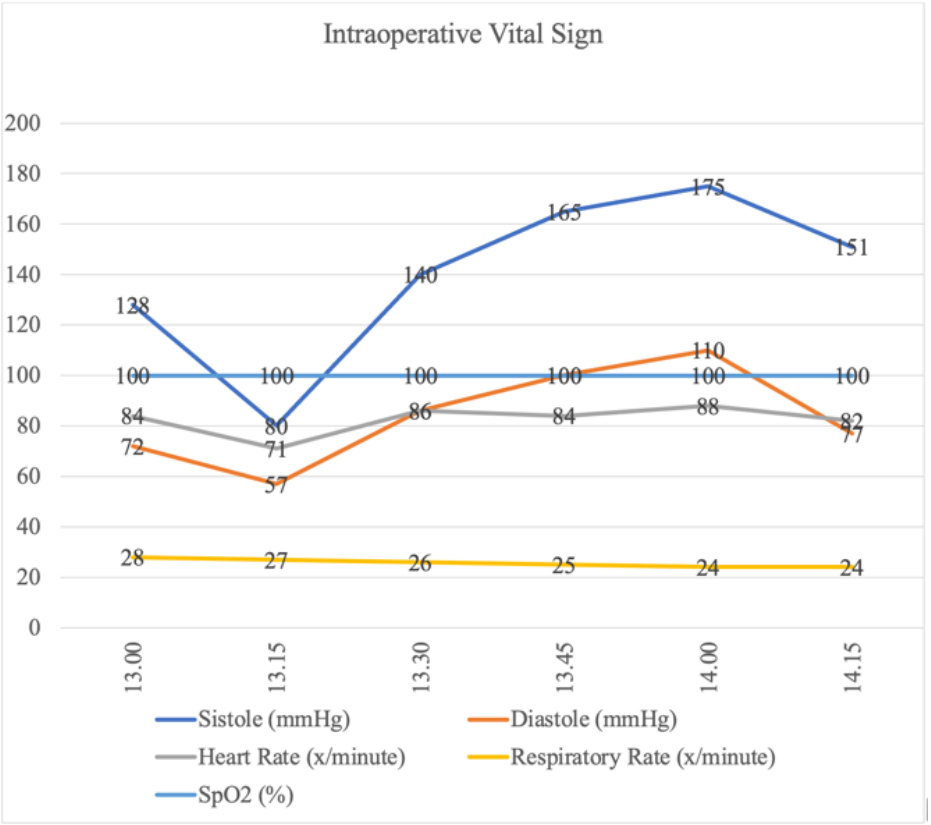

Figure 5. Intraoperative Vital Sign

Postoperatively, the patient was transferred to the postanesthesia care unit for further intensive monitoring and the patient received ICU backup. Postoperative monitoring is carried out by re-evaluating the patient's clinical symptoms and vital signs. During ICU treatment the patient received intravenous fluids clinimix 1000cc/24 hours, nicardipin pump 1.25mg/hour as an antihypertensive, fentanyl 15 mcq/hour, dexketoprofen 3x50mg, and paracetamol 3x500mg as an analgesic, antibiotic cefazolin 3x1gr, gastroprotector

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ranitidine 2x50mg, and antiemetic ondansetron 3x4mg. Postoperative laboratory evaluation was performed and Hb was 9.4g/dL; WBC 26.4x103/uL; HCT 30.7%; platelets 423x103/uL; Na 139.5 mmol/L; K 4.39 mmol/L; and Cl 107.8 mmol/L. The patient received a PRC 1 kolf transfusion with 10 mg prelasix im. The first postoperative day the patient had no specific complaints with the patient's vital signs in normal range limits with blood pressure 115/81 mmHg, pulse 74x/minute, RR 22x/minute, temperature 36.7°C, 98% oxygen saturation, drain filled with blood approximately 100 cc. The first day postoperatively the patient's condition was quite stable and he was transferred to the inpatient room with a stop nicardipine and fentanyl. On the second postoperative day, the patient complained of postoperative pain. The patient's vital signs were within normal limits with blood pressure 114/60 mmHg, pulse 81x/minute, RR 25x/minute, temperature 36.7°C, 95% oxygen saturation, drain containing approximately 50 cc of blood. On the third day after surgery, the patient complained of less postoperative pain. The patient's vital signs were within normal limits with blood pressure 110/70 mmHg, pulse 88x/minute, RR 20x/minute, temperature 36.6°C, 98% oxygen saturation. During treatment in the inpatient room, the patient received other therapies, in the form of cefazolin, ketorolac, ranitidine, ondancetron, insulin, furosemide, atorvastatin, and bisoprolol.

DISCUSSION

Ejection fraction is an important measurement in determining function of the hearth. An increase in the aging population is thought to lead to an increase in the prevalence of HF (Lindenfeld et al., 2010). Normal ejection fraction varies from 50% to 75%. Patients with an EF < 35% (very low EF) may be at risk for life-threatening irregular heartbeats (arrhythmias) leading sudden cardiac arrest become sudden death.[6] The presence of cardiac abnormalities has been described as the most important risk factor for predicting perioperative morbidity and mortality. In the perioperative period, all factors precipitating the cardiac pathology should be sought and aggressively treated prior to anesthesia and surgery.

The decrease in ejection fraction in this patient was caused by myocardial infarction which caused impaired myocardial contractility. The use of antiplatelets in the medication of patients with myocardial infarction requires special attention, especially in patients with a high risk of bleeding such as trauma or surgery.[7] Discontinuation of antiplatelet in this patient was carried out at the initial admission of the patient or D-5 of surgery. Platelet function will return as new platelets are formed and usually reach optimal function after 5 days.[8] Medical strategy for patients with low EF includes use of beta-adrenergic antagonists, diuretics, and salt restriction to decrease fluid retention and angiotensin converting enzyme inhibition or angiotensin II receptor blockers to decrease cardiac remodeling.[9] Treatment of diuretics, β blockers, and ARBs in these patients was continued during the peri, intra, and postoperative periods. Discontinuation of β-blockers, ARBs, calcium channel blockers, nitrates, statins, or ACE inhibitors in the perioperative period can increase perioperative morbidity and mortality and should be avoided.[10] In line with a study by Anderson, et al in 2014 concluded that among patients with ischemic heart disease who underwent non-cardiac surgery, the use of β-blockers was associated with a lower risk of major cardiovascular adverse events (MACE) such as myocardial infarction, ischemic stroke, cardiovascular death at 30 days.[11]

During induction of anesthesia and intubation, hemodynamic changes are critical, because most induction agents induce depression of myocardial and cause a decrease in systemic vascular resistance. The goals of anesthetic strategy of the patient with a low ejection fraction include maintaining cardiac output, preventing arrhythmias and avoiding myocardial depression by avoiding factors that upset the balance of oxygen supply and

demand.[5] Oxygen balance in the myocardium is achieved by neither reducing supply nor increasing demand. Decreased supply may happend due to hypotension, and increased demand due to tachycardia or hypertension.[12]

In this patient, general anesthesia was carried out by induction using the drugs midazolam, fentanyl, and atracurium while maintenance anesthesia was carried out using desflurane. After induction the patient had a decrease in blood pressure (MAP = 64). These hemodynamic changes can be caused by the induction agent given. This patient received 250mcg Fentanyl i.v, 1.5 mg midazolam i.v, and 40 mg atracurium i.v. Fentanyl is an opioid that is widely used with an induction dose of 2-50mcg/kgbb with a common dose of fentanyl that can be given for induction is 2.5-5mcg/kgbb.[12] Administration of high doses of fentanyl may cause hypotension due to vasodilation due to lowering of sympathetic activity and the direct effect of calcium movement on intercellular smooth muscle. [13] A study stated that doses of 5 mcg/kg and 10 mcg/kg could cause hypotension in 10% and 45% of the sample, respectively.[14] So the use of fentanyl with higher doses is recommended in patients who have tachycardia and hypertension. This patient was also given a combination of low-dose midazolam 1.5 mg iv. Midazolam is a water-soluble benzodiazepine drug that has a fast onset of action, which is 2-12 minutes. The benzodiazepines have minimal cardiovascular depressant effects even at general anesthetic doses, except when co-administered with opioids because these agents have interaction to produce myocardial suppresion and arterial hypotension.[12] Administering intravenous midazolam will decrease blood pressure and peripheral vascular resistance more than diazepam and lorazepam. Atracurium is used as a muscle relaxant of choice in these patients because it has a shorter duration of action (30-45 minutes) than rocuronium.[15] However, this hypotensive condition can also be caused by administration of atracurium at high doses (>0.5 mg/kgbb). Atracurium has the effect of releasing histamine and causing peripheral vasodilation so that it will evoke hypotension. The potential harm from histamine release can be minimized by pretreatment with H1 and H2 antagonists, or both.[12] The final effect of histamine release can be reversed by intravenous infusion of fluids and vasopressors. Post induction the patient received a vasopressor norepinephrine pump 3cc/hour and ephedrine 4mg iv. Ephedrine is commonly used as a vasopressor during anaesthesia. Ephedrine acts on receptors α1, β1, and has little effect on β2, while norepinephrine acts on receptors α1, α2, β1.[12] Ephedrine in adults can be given at a dose of 2.5mg-10mg, whereas high-dose intravenous ephedrine is accompanied by significant side effects, which is reactive hypertension, usually considered as systolic blood pressure > 140mmHg or systolic blood pressure more than 20% above baseline.[16] A study concluded that the smallest dose of ephedrine that is still effective in reducing the incidence of hypotension is 5 mg. However, this dose does not completely eliminate hypotension, because it can cause reactive hypertension in some patients (18.9%).[17] Hemodynamic maintenance in these patients is very important, because after administration of ephedrine 4 mg i.v in these patients it causes reactive hypertension. These conditions can trigger myocardial ischemia to hang failure because the oxygen supply to the myocardium is not fulfilled. In this patient, after an increase in blood pressure, the vasopressor agents nicardipine and ephedrine were discontinued and replaced with a vasodilator agent, namely nicardipine pump 1.25 mg/hour until stable blood pressure was achieved one postoperative day.

In this patient, the maintenance anesthesia used desflurane inhalation agent with 6% MAC. Supplementation of inhalation anesthetics has the ability to rapidly eliminate through the lungs and reduce the dose of intravenous anesthetics.[12] Inhaled anesthetic agents (sevoflurane and desflurane) are recommended for maintenance of general anesthesia in patients with dysfunction of ventricular because of their hemodynamic

stability and the nature of the ischemic precondition. Sevoflurane is considered better because this agent is very effective in preventing increased blood pressure, increased pulse, pulmonary hypertension and ischemia compared to isoflurane because it can reduce coronary perfusion and desflurane it can cause tachycardia.[18]

CONCLUSION

Patients with a low ejection fraction are considered at high risk for anesthesia because of life-threatening irregular heartbeats, progressing to sudden cardiac arrest become sudden death.

Patients with a very low ejection fraction require early identification of risk factors, preoperative evaluation and optimization, correct medical therapy, adequate monitoring, and as well as anesthetic technique and dosage of appropriate anesthetic drugs. The goals of anesthetic management in patients with decreased EF include maintaining adequate flow, heart rate and avoiding arrhythmias by maintaining hemodynamics during intubation and surgical stimuli.

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DECLARATIONS

According to the author, this study has no conflicts of interest.

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