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Perioperative Management in Patients with Temporary Pacemaker Who Underwent Craniotomy in Prone Position

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ABSTRACT

Introduction: As the incidence of the need for a pacemaker increases, an anesthesiologist may encounter patients with pacemakers who need surgery other than the heart. With enough knowledge, the outcome of patients with pacemakers undergoing procedures other than cardiac surgery can be optimized with the hope that mortality and morbidity can be avoided.
Case presentation: Male, 42 years old, with Temporary Pacemaker (TPM), programmed for evacuation craniotomy and decompression. The patient had Intracranial Hemorrhage (ICH) after the Percutaneous Intra Arterial Thrombolysis (PIAT) procedure 2 days earlier. The patient was stable during the operation, which lasted for 3 hours in the prone position.
Conclusion: The perioperative strategy should be customized based on the procedure, the needs and values of the patient, and the device attached. The primary focus of perioperative management in patients who underwent surgery is minimizing the possibility of electromagnetic interference (EMI).
Keywords: temporary pacemaker, prone position, craniotomy, perioperative

Introduction

Patients with heart disease are often encountered in anesthesia practice and pose a significant challenge because they have a high risk of perioperative mortality and morbidity. Patients with temporary pacemaker candidates for anesthetic management for both cardiac surgery and non-cardiac surgery. Pacemakers are an important part of electrophysiology and cardiology in general. There is a steady rising in pacemaker uses due to the increasing life expectancy and aging population.[6,7] Estimation of the global number of patients who underwent pacemaker implantation continues to rise to an annual implant rate of ~1 million devices.[6] Cardiac degeneration of the conduction system and changes in the conduction of the intercellular interstitial space may be a manifestation of cardiac pathology or non-cardiac disease and are most commonly found in older patients. Sinus node dysfunction (SND) and high-grade atrioventricular block (AVB) are the most common indications for permanent pacemaker therapy.[8,9] As the number of patients using pacemakers increases, the chance of an anesthesiologist meeting these patients also increases. Therefore, as anesthesiologists, we need to prepare and know what to pay attention to in patients with pacemakers who are about to undergo surgery, especially non-cardiac surgery. Hopefully, with good knowledge, the outcome of patients with pacemakers who underwent non-cardiac surgery can be more optimal.

Case Presentation

The male patient, with the initials Mr. S, 42 years old, planned for Intracerebral Hemorrhage (ICH) evacuation craniotomy and decompression. The patient had intracranial hemorrhage (ICintraventricularular hemorrhage (IVH), cerebral edema, and acute limb ischemia (ALI). The patient had decreased consciousness after Percutaneous Intra Arterial Thrombolysis (PIAT) 2 days earlier. The patient complained of headache followed by projectile vomiting. Then consciousness tended to be restless and unable to communicate well 1 day after PIAT was performed. Due to the suspicion of complications after thrombolysis, a CT scan was performed, and an intracranial hemorrhage was found.

The patient previously had a history of heart disease, hypertension, and congestive heart failure 6 years ago but did not take medication regularly. The patient was admitted to ICVCU RSUD Dr. Moewardi Surakarta on August 10th, 2021. The patient complained of pain in his right hand 1 day earlier. The patient had a cold sweat, vomiting, and shortness of breath. The patient was then admitted to the ICVCU with the diagnosis of NSTEMI, pulse VT, right upper extremity ALI and cardiogenic shock. On the day of treatment at the ICVCU, the patient was

immediately treated with Percutaneous Intra Arterial Thrombolysis (PIAT) and continued with heparin for 24 hours. On the second day of treatment at the ICVCU, the patient had a total AV-Block (TAVB), then Temporary Pacemaker (TPM) was installed with settings R 80, O2, S2, and a Permanent Pacemaker (PPM) was planned if in the next 7 days the patient's intrinsic sinus rhythm did not return.

On the third day of treatment, the patient's consciousness decreased, and patiently spoke slurred. Previously the patient complained of headache and projectile vomiting. On physical examination, the airway was clear, with malampati hard to check because the patient was not cooperative, opened mouth with 3 fingers, free neck movement, symmetrical expansion of both right and left chest with vesicular lung base sounds without any additional sounds, and peripheral O2 saturation showed 99% in supine position with oxygen at 3 lpm.

On cardiovascular examination, blood pressure was 129/87 mmHg, heart rate 89x/minute (TPM installed), strong pulse with regular I-II heart sounds, and no murmurs. On Glasgow Coma Scale examination, Eye 3, Verbal 4, and Motoric 5 with isocor pupils, diameter 3mm each, with good light reflexes in both eyes. The temperature was 36.7°C.

On support, examination showed Leukocytes 23 000 (leukocytosis). Electrolytes, liver function, kidney, and coagulation factors were within normal limits. On thorax examination, cardiomegaly with early pulmonary edema was found. On preoperative ECG examination, when TPM was installed, ventricular pacing was found. And when the ECG was not attached, TAVB was found. The results of echocardiography on August 10th, 2021, obtained LVOT with a diameter of 20 mm, EF 26%, and found MR mild with vcw 0.2 and TR Mild with vcw 0.1.

CT scan on the head without contrast was performed on the third day of treatment. There were multiple ICH in the right frontitemporoparietooccipital lobe and left parietooccipitalis with a size of 4.7 x 3.7 x 3.1 (estimated volume 28 ml) and in bilateral cerebellar hemispheres with a size of 3.3x6.4 x2.5 cm (estimated volume 27.4 ml), also found perifocal edema and IVH in the posterior and anterior horns of the right lateral ventricle. Based on the ICH score assessment, the total score was 3, due to decreased consciousness, intracerebral hemorrhage > 30 cc, and the presence of IVH.

Intraoperative anesthetic management was performed with intravenous premedication of midazolam 0.1 mg/kg intravenously because the patient was restless and not cooperative. In the operating room, a standard monitor was installed according to ASA recommendations. The patient's blood pressure was 125/66 mmHg with a pulse rate of 89x/min (TPM installed) and SpO2 99% in room air with the supine position. Induction was started by giving Propofol 1

mg/kg BW intravenously and the analgesic Fentanyl at a dose of 2 mcg/kg BW. Rocuronium at a dose of 0.5 mg/kg BW intravenously was administered before insertion of a 7.5 non-kinking cuff endotracheal tube. The drugs that were administered before the surgery was started, lidocaine 1 mg/minute and dobutamine 5 mcg/kg BW/minute, were given continuously intravenously. Monitoring the invasive arterial line through the arterial cannula on the left brachial artery and CVC on the right femoral vein. A Foley catheter was also placed to monitor urine output. After the induction and preparation were completed, the patient was positioned prone while maintaining the ETT, arterial line, CVC, and TPM firmly in place. Changes in the patient's position from supine to prone did not cause significant changes in the patient's hemodynamics.

Anesthesia was maintained with controlled ventilation of sevoflurane 1 - 2 vol% in 60% oxygen versus air bar and Fentanyl 0.5 mcg/kg/hour and Rocuronium 9mcg/kg/hour given intravenously continuously. The patient was stable during the operation, which lasted for 3 hours with a pulse in the range of 80-90 x/min with TPM installed, systolic in the range of 90-110 mmHg, SpO2 98-99% with EtCO2 of 30-35. 50 ml of bleeding and 200 ml of urine output were replaced with Ringer Fundin crystalloid solution. Fluid maintenance of as much as 200 ml/hour was given. After the operation was done, the patient was not extubated, continued care, and weaned off the ventilator in the ICU. At the end of the operation, the patient was positioned supine again, there was a rhythm disturbance on ECG, and the patient's heart rhythm was found to return to TAVB with a heart rate of 52x/minute. Then the TPM rate was increased to 100 x/minute so that the patient's heart rate a few minutes later returned to ventricular pacing with a heart rate of 80 x/minute.

Postoperatively, the patient was not extubated and was admitted to the ICU. The ventilator weaning process is carried out in the ICU. Management of postoperative pain by giving the analgesic Fentanyl 0.5 mcg/kg/hour for 24 hours postoperatively and Paracetamol 1 gram every 8 hours. Pain assessment was assessed using the NRS scoring.

During postoperative monitoring, the patient was hemodynamically stable, and there were no complications post-anesthesia and surgical. The patient was extubated on the 2nd day of postoperative care and transferred to ICVCU on the 3rd day of postoperative care. On the 8th day, the patient was transferred from the ICVCU to the cardiac HCU with consciousness level E4V4M6, TPM was still installed with stable hemodynamics without supporting drugs and PPM (Permanent Pacemaker) installation was planned by the cardiology department.

Discussion

During the operation, it is necessary to avoid the use of unipolar electrocautery and short wave diathermy (SWD) near the pacemaker. The use of SWD can increase the temperature of the tissue around the pacemaker, cause overheating of the generator, and cause damage to the pacemaker insulator. Another thing to avoid is the use of a harmonic scalpel because ultrasonic waves can cause mechanical damage to the pacemaker and cause ventricular extrasystole (VES).[1-5]

In induction, this patient was given propofol and analgesic fentanyl at a dose of 2 mcg/kg BW with consideration not to use high doses of fentanyl and consideration the patient was already on continuous intravenous lidocaine therapy previously. This is consistent with the recommendation that in patients with a pacemaker and consequent bradycardia, the use of high doses of fentanyl and dexmedetomidine should be avoided because they may affect the threshold of pacemaker stimulation and increase the dependency of the heart on the pacemaker. During surgery, anesthesia is maintained by giving sevoflurane gas and air bar with consideration of neurosurgical principles, and besides that, intraoperative N2O can also cause pacemaker malfunction.[2,3,5]

Other agents that should be avoided in patients with pacemakers are etomidate, succinylcholine, and ketamine because they can induce fasciculations or myoclonus that can interrupt the pacemaker. The use of methadone, haloperidol, ondansetron, and inhalation of high doses of anesthetic agents should be avoided because they can cause prolonged QT interval syndrome. During surgery, long-acting opioids can be used as adjuvants for faster recovery and better postoperative pain control.[2,3,5] With this recommendation, postoperative analgesia with fentanyl is the right choice for this patient.

Intraoperative monitoring was performed according to the ASA recommendations with tools such as pulse oximetry (with plethysmograph), ECG monitor, and noninvasive blood pressure (NIBP). Patients with pacemakers have a high risk of experiencing dysrhythmias, so ECG monitoring should be performed continuously. Meanwhile, monitoring with pulse oximetry is useful to see heart rate and hemodynamic status.[3]

A temporary Pacemaker (TPM) can provide electronic cardiac stimulation in patients with life-threatening acute bradycardia or can be used as prophylaxis to anticipate needs (e.g., after cardiac surgery).[11,12] Modalities for emergency pacemakers include epicardial, transvenous, and transcutaneous approaches. The transvenous approach often requires fluoroscopic guidance, although echo-guided placement is also feasible.[13]

Patients who underwent transient transvenous pacing have a high risk for procedure-related complications (e.g., bleeding, cardiac perforation, arrhythmias, malfunction, and inadvertent electrode displacement) and complications related to immobilization (e.g., delirium, infection, and thrombotic events).[11,12,13-20] Percutaneous transvenous active fixation cables connected to external devices are more comfortable and safer for patients who require prolonged transient pacemakers.[21,22] Because of the instability of passive leads placed through the femoral vein and immobilization of the patient, the duration of this approach should be as short as possible until the bradycardia has resolved or a more permanent solution has been established.[23-27] The patient's position when a procedure is performed is prone. Positioning the patient correctly is important. Anesthetic management in prone positions must be administered safely based on a deep understanding of the physiological changes and risks that can occur.[28,30]

Some complications that are consequences of improper positioning are air embolism, peripheral nerve paralysis, blindness, tetraplegia, compartment syndrome, necrosis due to pressure on the skin, profuse bleeding, and venous thrombosis.[31, 32] Various kinds of injuries can occur in the prone position as a result of pressure on various parts of the body. Injuries due to compression can be divided into injuries due to direct pressure or indirect pressure. These injuries mainly occur in the face, ears, chest, genitalia, and other body parts.[30] In the cardiovascular system, there is a decrease in cardiac output. In a study, there was a decrease in the cardiac index by an average of 24%, and this was mainly due to a decrease in stroke volume caused by an increase in thoracic pressure, resulting in a decrease in the arterial filling, stimulating the baroreceptor reflex so that sympathetic activity increased. In most patients, mean arterial pressure is maintained by increasing systemic vascular resistance and pulmonary vascular resistance. Based on this theory, in the prone position, there is a decrease in stroke volume. Also, there is an increase in sympathetic activity (increased heart rate, increased total vascular resistance, increased plasma noradrenaline).[28,32] The pressure-free abdominal area in the prone position can prevent the risk of increased venous pressure. Excessive hypotension can increase the risk of blindness during surgery / perioperative vision loss (POVL).[29]

When changing the position from supine to prone after induction, during surgery, and when stoping anesthesia, there is a risk of hemodynamic disturbances, so it is important to have good teamwork from the anesthetic and surgery teams to ensure the correct prone position and to make sure that the pacemaker position is not shifted which can result in a change in position so that it cannot be paced, also important to make sure that the abdominal, thoracic, eye, genital and breast areas are free of pressure.

Conclusion

The perioperative strategy should be customized based on the procedure, the needs and values of the patient, and the device attached. The primary focus of perioperative management in patients who underwent surgery is minimizing the possibility of electromagnetic interference (EMI).

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