Simple Minimal Sedation for Catheter Ablation of Atrial Fibrillation

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Background: Deep sedation or general anesthesia is generally used during atrial fibrillation (AF) ablation. The aim of this study was to report the safety and feasibility of minimal sedation during AF ablation.

Methods and Results: One thousand and fifty-two AF ablation procedures in 819 patients (62±11 years, 621 men, 506 paroxysmal) were included. Boluses of intravenous hydroxyzine pamoate and pentazocine were administered, with a maximal dose of 100 mg of hydroxyzine and 60 mg of pentazocine in response to pain. If the pain was intolerable or patients requested deeper sedation, moderate sedation using dexmedetomidine or propofol was introduced. Among 819 consecutive first procedures, the procedure was completed under minimal sedation in 795 (97.1%) patients without inotropic drugs or respiratory support, whereas in 20 (2.4%) patients, anesthesia was switched to moderate sedation due to pain. Patients requiring a switch to moderate sedation were significantly younger than those without (53.6±2.3 vs. 62.6±10.4, P<0.01). No procedures were abandoned due to adverse effects of sedation. Significant intra-procedural blood pressure decreases requiring inotropic drugs were not observed in any patients. Among 233 patients who underwent repeat procedures, 6 (2.6%) requested moderate sedation before the procedure. The mean procedure time was 151±54 min. Cardiac tamponade, unrelated to sedation, was observed in 7 (0.66%) procedures.

Conclusions: Minimal sedation might be acceptable anesthesia in the vast majority of AF ablation procedures performed in electrophysiological laboratories. (Circ J 2015; 79: 346–350)

Key Words: Atrial fibrillation; Catheter ablation; Sedation

Catheter ablation of atrial fibrillation (AF) is increasingly applied for symptomatic AF refractory to antiarrhythmic drugs. Although the success rate is acceptable, procedures may be painful, and patient immobilization is required during the procedure. As a result, moderate-to-deep sedation or general anesthesia has been generally applied during AF ablation procedures. Propofol, dexmedetomidine, midazolam and opioids are commonly used to sedate the patients and to control pain. However, deeper sedation to reduce pain makes patient cooperation more difficult to obtain. The inevitable waxing and waning levels of sedation cause patients to move when under-sedated due to discomfort and when oversedated due to delirium. Actually, individual patients may have exaggerated responses to sedatives. General anesthesia commonly leads to hypotension, and in addition, it requires careful management by an anesthetist throughout the procedure. The American Society of Anesthesiologists describes a continuum of sedation that is divided into levels as follows: minimal sedation, moderate sedation (“conscious sedation”), deep sedation, and general anesthesia. Minimal sedation is defined as a drug-induced state during which patients respond normally to verbal commands. In this study, we describe the safety and feasibility of minimal sedation for AF ablation while maintaining good communication between the operator and patient during the ablation procedure.

Methods

Study Population

This study consisted of 819 consecutive patients (total 1,052 procedures) undergoing AF ablation in our institute. AF was classified according to the HRS/EHRA/ECAS 2012 Consensus Statement on Catheter and Surgical Ablation of AF. All patients gave written informed consent.
Minimal Sedation Protocol

Catheters were manipulated under local anesthesia. Boluses of hydroxyzine pamoate (Atarax-P®) 25 mg and pentazocine (Sosegon®) 15 mg were administered intravenously prior to the start of radiofrequency (RF) application. If necessary, each drug was added with a maximal dose of hydroxyzine of 100 mg and pentazocine of 60 mg in response to pain. If the pain was intolerable or patients requested deeper sedation during the procedure, moderate sedation using dexmedetomidine or propofol was introduced. The peripheral oxygen saturation, heart rate, and blood pressure (BP) were monitored continuously. Femoral arterial access is routinely acquired for continuous arterial pressure monitoring. Supplemental oxygen was used to avoid hypoxemia if necessary, starting with a flow rate of 3 L/min via a nasal cannula. When the BP fell significantly during the procedure, we added a fluid infusion while evaluating the possibility of cardiac tamponade.

The procedures were performed by 2 electrophysiologists. The cases were assisted by 1 nurse. All operators were trained in advanced life support, including tracheal intubation and cardiopulmonary resuscitation. The administration of sedation and analgesics, monitoring the patients and documentation were performed by a designated nurse under supervision and according to the instructions of the electrophysiologist. The recommended appropriate emergency equipment, including a defibrillator, advanced airway management equipment and emergency medications, were always present in the electrophysiology laboratory.

Mapping and Ablation Protocol

All antiarrhythmic drugs were discontinued for at least 5 half-lives prior to the procedure, with the exception of amiodarone. All patients were effectively anticoagulated for >1 month before the procedure. Transesophageal echocardiography was performed to exclude any atrial thrombi. The surface electrocardiogram and bipolar intracardiac electrograms were continuously monitored and stored on a computer-based digital recording system (LabSystem PRO, Bard Electrophysiology, Lowell, MA, USA). The bipolar electrograms were filtered from 30 to 500 Hz. A 7-F 14 pole 2-site mapping catheter (Irvine Biomedical Inc, Irvine, CA, USA) was inserted through the right jugular vein for pacing, recording and internal cardioversion.

The ablation was performed according to the strategy described previously.4–8 In brief, after a single transseptal puncture, 2 long sheaths (SL0; St. Jude Medical, Minneapolis, MN, USA) were introduced into both superior pulmonary veins (PVs). Pulmonary venography during ventricular pacing and contrast esophagography was performed to obtain the relative locations of the PV ostia vis-a-vis esophagus. A 100 IU/kg body weight of heparin was administered following the transseptal puncture, and heparinized saline was additionally infused to maintain the activated clotting time at 250–350 s. Two circular mapping catheters (Lasso; Biosense Webster, Diamond Bar, CA, USA) were placed in the superior and inferior PVs, and the left-sided then right-sided ipsilateral PVs were circumferentially and extensively ablated, guided by a 3-D mapping system (CARTO3; Biosense Webster). The end-point was the achievement of a bidirectional conduction block between the left atrium (LA) and PVs. The RF current was delivered point-by-point with a 3.5 mm externally irrigated-tip quadripolar ablation catheter (Thermocool; Biosense-Webster) with a power of the PV ostia vis-a-vis esophagus. A 100 IU/kg body weight of heparin was administered following the transseptal puncture in 17 and 3 patients, respectively. In the remaining 4 (9%) patients, a switch to moderate sedation was required due to pain; this was in addition to a mean of 34.9±27.5 mg of hydroxyzine pamoate and 32.2±10.6 mg of pentazocine, whereas in 20 (2.4%) patients, a switch to moderate sedation using dexmedetomidine (17 patients) or propofol (3 patients) was required due to pain; this was in addition to a mean of 34.9±27.5 mg of hydroxyzine pamoate and 31.6±14.0 mg of pentazocine. Among those 20 patients, moderate sedation was introduced due to severe pain during RF deliveries at the posterior part of the left ipsilateral PVs and during the femoral puncture in 17 and 3 patients, respectively. In the remaining 4 (0.5%) patients, moderate sedation was introduced from the beginning of the procedure because they were foreigners (non-Japanese) and good communication with the laboratory staff was difficult. The 20 patients in whom minimal sedation was switched to moderate sedation due to pain were significantly younger than those without moderate sedation (53.6±23.2 vs. 62.6±10.4, P<0.01), whereas there were no other differences in the clinical characteristics. The mean total procedure time from the femoral puncture to the removal of the sheaths) and the mean procedure time required for the PVAI were 151±54 and 69±26 min, respectively. The freedom from arrhythmia recurrence after the initial ablation procedure was similar be-
required in any patients. The mobilization could be controlled by the operator’s command. In 24 patients who required moderate sedation for any reason, the systolic BP prior to the procedure, just after the LA access, just after the left PVI, just after the right PVI, and at the end of the procedure was 155.0±24.2, 154.5±25.4, 142.4±23.4, 136.4±22.0, and 134.6±21.6, respectively. The BP significantly decreased gradually over the time-course, and the time-course pattern of the BP was similar between the patients undergoing AF ablation under minimal and moderate sedation (P=0.972, Figure).

No adverse effects of the sedation resulted in procedural complications or a reason to switch to another analgesic in any of the patients. The only reason to switch the analgesia was to control the pain during the procedure. Cardiac tamponade requiring pericardiocentesis was observed in 7 (0.66%) procedures, and was unrelated to the analgesia.

Discussion

We here present the results of a single-center study on the procedural feasibility of simple minimal sedation during AF ablation. To the best of our knowledge, this is the first report describing minimal sedation during AF ablation procedures. Although 2.4% of the procedures required a switch to moder-
ate sedation due to pain, the procedure was completed under minimal sedation without any sedation-related complications, such as persistent hypotension or respiratory depression in the remaining 97.1% of the patients. The rate of cardiac tamponade (0.66% in the study collective) seems to be acceptable.

**General Anesthesia and Moderate/Deep Sedation**

General anesthesia is widely used in a large number of centers. However, general anesthesia provides the most sufficient control of movement and pain, it has certain disadvantages. Of those, excessive hypotension and (when combined with muscle relaxants) reduced sensitivity to high-output pharmacologic nerve mapping, are particularly relevant. In addition, the anesthetist is required to perform monitoring throughout the procedure even for short procedure times. While propofol-based deep sedation is common practice in a wide range of electrophysiologic procedures, there is a risk of airway complications under a strong anticoagulated state, which requires well-trained personnel and adequate monitoring. Besides that, propofol may alter the arrhythmia inducibility and can lead to hypokalemia, especially after a prolonged infusion. A prior report has clearly shown that the important limitation of deep sedation is persistent hypotension, and 15.6% of the patients with propofol sedation required a switch to midazolam sedation. Due to its profound cardiovascular depressive effects by reducing the myocardial contractility and systemic vascular resistance and preload, propofol should be administered slowly at a small divided dose and titrated on an individual basis. Careful hemodynamic and respiratory monitoring are important, particularly in elderly cardiac patients, or those with hypovolemia, poor ventricular function, concurrent negative ionotropic medications, or vasodilating medications. After the procedure, the patients were allowed to recover from anesthesia and were transferred to an intermediate care unit for monitoring of their vital signs. Deep sedation or general anesthesia might delay the diagnosis of thromboembolic events leading to transient ischemic attacks or strokes.

Compared to deep sedation, moderate sedation with midazolam carries a reduced risk of airway complications or hemodynamic impairment. In general, benzodiazepines have minimal effects on the cardiovascular system within the therapeutic dose range; however, the infusion of midazolam alone often does not provide an adequate anesthetic outcome for a prolonged procedure. Halfway sedation often leads to an unpredictable patient response. Procedural discomfort may be increased during moderate sedation and patient movements may be more likely. Usually, it is difficult to control patient movements in such a situation when communicating with the patient is difficult.

**Minimal Sedation**

Despite the development of AF ablation procedures and the increasing experience with the procedures, few studies are available on a minimal sedation strategy. Because anesthetics typically have a narrow therapeutic window and patient's sensitivity to anesthetics varies with age, body weight, composition, genetics, medical conditions, and concomitant use of other medications, a more prominent or prolonged sedative effect might unexpectedly occur at an apparently lower administered dose. Furthermore, when used in combination, the inhibitory effects of anesthetics on the brain function, spontaneous respirations and hemodynamic status are synergistic. The use of this type of minimal sedation was started in our institute more than 10 years ago, and the same convincing results have been achieved in several thousand patients. In the experience in our group, mutual communication with the patient under minimal sedation can control the depth of breathing, and avoid unpredictable patient movements because they can be controlled by the operator’s command. One of the major advantages is that minimal sedation does not lead to sedation-related adverse effects, such as hypotension and hypoxia. Thus, the use of ionotropic drugs and an airway does not need to be considered. In the present study, the BP during the procedure was similar between the patients undergoing ablation under minimal sedation and those who required moderate sedation because there were few patients in whom moderate sedation was introduced from the beginning of the procedure. Thromboembolic events could be evaluated during and immediately after the procedure, which is clearly comfortable for the operator. Neither an anesthesiologist nor special equipment, such as assisted ventilation and an intermediate care unit is required for the procedure, which is also an important advantage from the economical standpoint. In addition, the perception of severe pain during the RF energy application has been described as a possible measure to reduce the risk of esophageal injury.

In the present study, patients who were eligible for AF ablation were included and thus represent a typical population encountered in clinical practice with a broad range of age and comorbidities. Patients requiring a switch to deeper sedation were younger compared with those who tolerated minimal sedation. Pain is subjective and is also largely influenced by one’s mental state. We speculate that the tolerability to pain is lower in younger patients than elderly patients during the procedure, presumably because young patients have less experience of previous invasive procedures. Recent advancements in mapping systems and procedural experience have contributed to the shorter procedure time and explosive spread of AF ablation procedures in clinical practice. Given the above advantages and economical standpoint, we believe that minimal sedation could be a standard anesthesia method used during AF ablation, and that deeper sedation should be applied in specific populations. Further exploration and efforts should be continued to find better medications to control the pain, and in which patients, deeper sedation is suitable.

**Hydroxyzine and Opioids**

Opioid analgesics are among the oldest known medications. In spite of their long usage, clinical success in controlling pain in many settings appears to be limited by a lack of understanding of the clinical pharmacology of these agents. Efforts to achieve better outcomes often focus on the use of adjunctive agents, such as hydroxyzine, in an attempt to control postoperative pain with a minimum of toxicity. Hydroxyzine is classified as an antihistamine, antipsychotic, anxiolytic and is also used as a tranquilizer. Unlike most other first-generation antihistamines, it has negligible affinity for the mACh receptors. For many years, it was especially preferred for its ability to boost the effectiveness of opioids by slowing the metabolism of opiates by inhibiting certain enzymes.

**Study Limitations**

The study was retrospective and observational by design, and the patients were not randomized against a comparison group with an alternative form of sedation. In fact, the study included few patients in whom moderate sedation was introduced from the beginning of the procedure.

**Conclusions**

In the vast majority of the general population eligible for AF ablation, AF ablation procedures can be completed under sim-
ple minimal sedation and minimal equipment, with an acceptable complication rate. Minimal sedation might be an acceptable anesthesia method during AF ablation procedures conducted in electrophysiological laboratories.

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Disclosures
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References