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Anesthetic considerations for implantation of the Watchman(R) device for left atrial appendage occlusion: A single center experience

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ABSTRACT

Many patients with chronic atrial fibrillation are treated with anticoagulants to mitigate the risk of embolism. An option for avoiding the risks associated with lifelong anticoagulation is the implantation of left atrial appendage occlusion devices, such as the Watchman(R). The purpose of this article is to describe appropriate anesthesia care for Watchman(R) device implantation, including the use of fluoroscopy and echocardiography. The management of major complications, such as hemopericardium and device embolization, is also discussed. Our approach to the anesthetic management of the patient undergoing Watchman(R) procedure has proven safe and reliable and could be considered at other institutions.

1. Introduction

Atrial fibrillation (AF) is an increasingly prevalent condition with significant associated morbidity and mortality. Among the most significant of the sequelae is the increased risk for cerebrovascular accidents and other embolic phenomena. It has been reported that >90% of thrombi in nonvalvular AF form in the left atrial appendage (LAA) [1]. The main strategy to mitigate this risk of clot formation has been long-term anticoagulation, such as with warfarin or more recently, direct oral anticoagulants (DOACs). However, there is significant risk of hemorrhagic complications due to indefinite anticoagulant use. The population of patients with persistent AF are frequently at high risk for falls and endure the risks inherent in polypharmacy [2].

The Watchman® is a LAA occlusion device that can prevent formation and mobilization of thrombi into the systemic circulation. Implantation of the Watchman® device has become increasingly common since the PROTECT-AF trial, which verified the Watchman® as a safe and effective alternative to lifelong anticoagulation with warfarin in patients with nonvalvular AF [3]. The follow-up PREVAIL trial showed similarly high event-free rates between Watchman® and warfarin therapy at 18 months (where an "event" was defined as stroke, systemic embolism, or cardiovascular or unexplained death) [4]. Other real-world clinical experiences with the Watchman® device estimate an 84% risk reduction for ischemic stroke compared to the predicted stroke rate by CHA_2DS_2-VASc score [5]. In addition to therapeutic efficacy, the Watchman® device has also resulted in greater improvement in physical functioning and greater cost-effectiveness than either warfarin or DOAC therapy [6,7].

While the benefits and technical details of the Watchman® procedure are well described, the perioperative and anesthetic management of the patient undergoing this procedure has not been well characterized. This is a narrative review article with the purpose of describing appropriate anesthesia care for Watchman® device implantation. Topics of focus will include the safe induction, intraoperative imaging, and emergency management. This manuscript could serve as a resource for anesthesiologists, cardiologists, and cardiac surgeons in offering an option for perioperative management that has proven safe and reliable. This review may prove particularly useful for the non-cardiac trained anesthetist in detailing steps that are relevant to providing safe anesthetic care. As this is a description of our institutional experience and does not involve human subjects, submission to and approval of the Institutional Review Board was not required.

2. Procedure description

2.1. Device and procedure description

The Watchman® device is a nitinol self-expanding cage covered by a permeable polyethylene terephthalate membrane, with 10–12 fixation anchors for added stability [8] (Fig. 1). Pre-procedure measurements are made of the left atrial appendage with transesophageal echocardiography (TEE) in order to select the appropriate device size (Fig. 2).

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Fig. 1. Images of Watchman® device.

Heparin bolus and drip are given to maintain an activated clotting time (ACT) > 300 s. ACT is remeasured by procedure room nursing staff every 15 min.

Using Seldinger technique with ultrasound guidance, two sheaths are placed in the right femoral vein. An intracardiac echocardiography (ICE) catheter, if using per the cardiologist's preference, is advanced. Transseptal access is obtained using fluoroscopy and TEE, with or without ICE as a supplemental imaging modality. A pigtail wire is placed in the left atrium, adjacent to the left superior pulmonary vein. A delivery sheath is advanced over the wire and the wire is removed. A pigtail catheter is advanced into the left atrial appendage using fluoroscopy and TEE guidance (Fig. 2). Contrast is injected to help delineate the ostium of the left atrial appendage. The Watchman® delivery system is advanced into the left atrial appendage. The device is deployed into the appendage. Good coaxial apposition with the appendage is ensured and the proceduralists confirms that there are no leaks and adequate compression. After completion of satisfactory tug test, the device is released and the entire delivery system is pulled back to the right atrium.

2.2. Anesthetic considerations

Standard American Society of Anesthesiologists monitoring should be performed throughout the procedure. This includes an electrocardiogram, noninvasive blood pressure, pulse oximeter, temperature, and capnography. Standard vascular access at our institution includes one large-bore peripheral intravenous line. We do not typically place an arterial or central line. Due to the relatively short nature of these procedures, monitoring of urinary output with a Foley catheter is generally not required.

Patients at our institution receive general anesthesia with single-lumen endotracheal intubation. GlideScope video laryngoscope-assisted intubation is performed to minimize airway trauma because all patients are anticoagulated. Induction agents are chosen based on the patient's medical history. General anesthesia is typically preferred for percutaneous interventions that require use of TEE [9], the use of which is discussed in more detail below. Common induction agents include fentanyl and rocuronium with propofol and dexmedetomidine infusion; midazolam and ketamine can also be used. Phenylephrine is often used for blood pressure support, with ephedrine and epinephrine as alternatives. General anesthesia is maintained with inhaled agents.

General anesthesia is weaned and heparin is reversed once TEE confirms adequate seal and positioning of the Watchman(R) device, as well as the absence of pericardial fluid. The proceduralists will remove the femoral sheaths, place sutures, and hold manual pressure once the ACT is <200. Patients are extubated in the electrophysiology procedure room immediately after the procedure. They are taken to recover in the post-anesthesia care unit and spend one night in the cardiac intensive care unit.

2.3. Echocardiography considerations

Patients undergo pre-procedure TEE to evaluate the size and morphology of the LAA (Fig. 2). Intraprocedural TEE is also utilized, and the probe is placed by either the radiologist, cardiologist, cardiac anesthesiologist after induction and intubation. TEE is necessary to verify device sizing and to ensure proper positioning of the catheter at the time of device deployment [10] (Fig. 3). TEE is also vital for visualizing intracardiac thrombi (which is a contraindication to Watchman® implantation), verifying safe transseptal puncture, and recognizing intraprocedural complications such as pericardial effusion [10,11]. After device deployment, color-flow Doppler is used to verify that the device has nearly completely sealed off the LAA (Fig. 2).

2.4. Fluoroscopy considerations

Biplane fluoroscopic guidance is used in conjunction with TEE for verifying device sizing and ensuring efficacy and safety during the critical parts of the procedure, namely during transseptal puncture and device deployment. It also has high utility for measuring device leak after placement. Fluoroscopy and TEE are both used to confirm that the device release criteria (Position, Anchor, Size and Seal) have been met [12]. It is critical that all procedure room staff wear appropriate leaded apparel for the duration of x-ray usage.

2.5. Staffing considerations

Various medical staff are required for the Watchman® procedure. The device is implanted by an electrophysiologist or interventional cardiologist, and anesthesia is performed by a cardiac anesthesiologist. TEE may be performed by cardiology or anesthesia; at our institution, this role is typically assumed by cardiology. As this is a sterile procedure, there is a need for a scrub technician or scrub nurse, as well as a circulating nurse who can obtain ACTs, gather additional equipment, and perform other supporting tasks. Additional trainees (such as residents and fellows) may also be involved in the procedure. While not necessary in the procedure room, the institution must have cardiac and vascular surgeons available in the rare event of serious complications that cannot be managed by the primary team.

2.6. Emergency considerations

As with procedures of any kind, bleeding is a potentially life-threatening complication that should be recognized and managed expediently. This is particularly important for Watchman® implantation since patients are anticoagulated. Two major sites where bleeding may occur include the catheter access site and the pericardium. Access site hematomas are fairly common in all femoral catheterization procedures due to damage to the femoral vessels; risk is mitigated by local pressure applied at the procedure

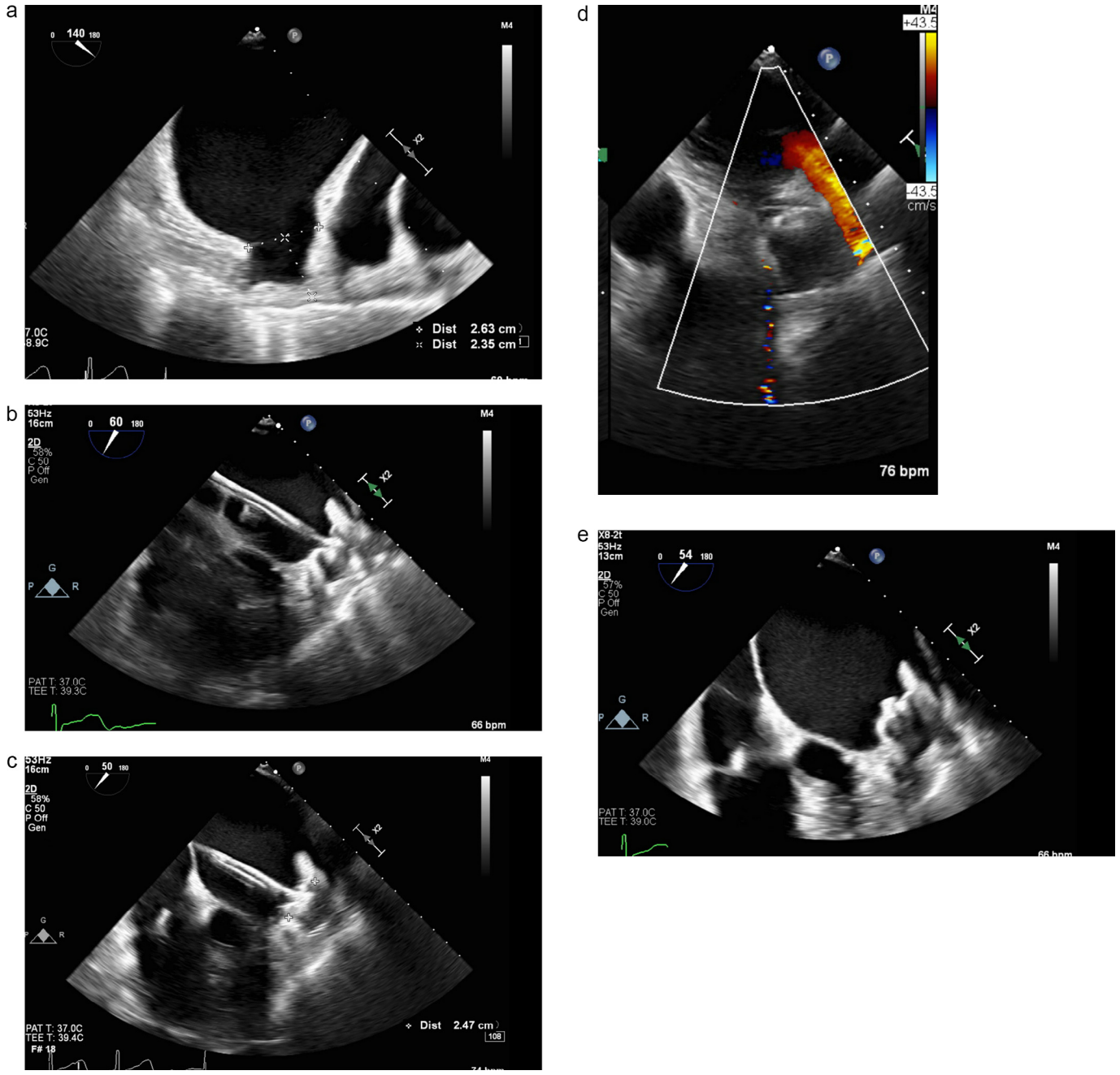

Fig. 2. Periprocedural echocardiographic images. a. Pre-device placement with LAA measurement. b. Delivery device in LAA. c. Delivery device in LAA with measurement. d. Post-device placement with Doppler. Note absent color flow in the LAA with flow present in the pulmonary vein. e. Device in place, occluding LAA ostium.

conclusion. Hemopericardium secondary to LAA perforation is a more serious emergency and is also the most commonly reported complication in the literature, with approximately 1% of patients experiencing tamponade that requires percutaneous drainage [13]. The use of imaging throughout the procedure, especially at the times of transseptal puncture and device deployment, often allows for recognition of pericardial effusion on TEE before vital sign abnormalities become apparent on monitoring.

Procedure-related stroke may occur due to air embolism, which may result from introduction of air in the transseptal access sheath or from preprocedural hypovolemia causing low left atrial pressure during implantation [12]. Air embolism may present with tachycardia or a reduction in end-tidal CO_2 on capnography. Stroke due to systemic thromboembolism is also a potential complication due to anesthesia-induced muscle paralysis during the procedure and endothelial damage from intravascular catheter manipulation. The use of heparin to maintain an ACT in the desired range is critical to reducing the risk of stroke.

Embolization of the device itself out of the LAA into nearby cardiovascular structures is another rare but serious complication. While often seen on TEE, patient monitoring may show various signs of hemodynamic compromise depending on the location of the embolized device. Intraprocedural embolization may be treated with a percutaneous retrieval device if the Watchman® is in an accessible location; otherwise, surgical retrieval is required.

3. Discussion & conclusions

Left atrial appendage occlusion with the Watchman® device is a safe alternative to lifelong anticoagulation in patients with persistent atrial

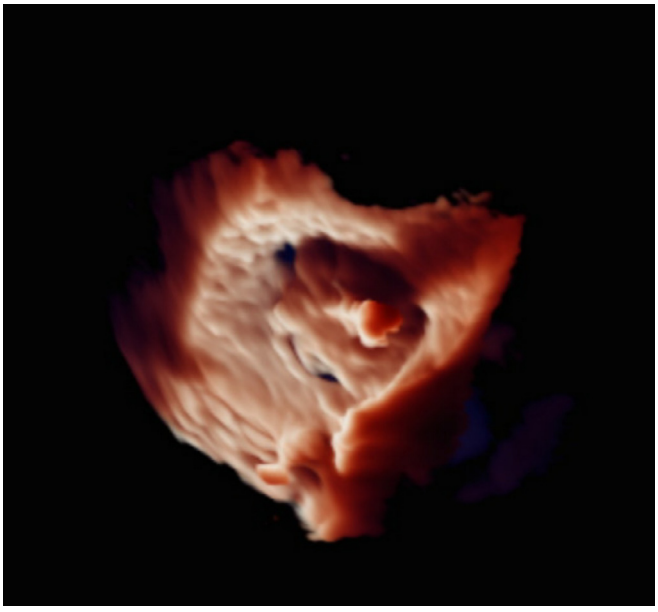

Fig. 3. 3-D TEE of Watchman® device in place in the LAA.

fibrillation. As described in this narrative review, the standard at our institution is general anesthesia with endotracheal intubation. However, other centers have described LAA occlusion procedures using conscious sedation with midazolam and fentanyl (in the absence of an anesthetist), with success observed for device implantation and in avoiding aspiration-related complications in a small sample [14]. Non-invasive ventilation with the Janus mask (which allows for continuous TEE) has also been explored as a means of mitigating pulmonary complications in a typically frail population [15]. Despite a short-lived respiratory acidosis in the Janus mask group compared to general anesthesia with intubation, hemodynamic and metabolic parameters were not different between the two approaches. While these may be valid alternatives to general anesthesia, studies specifically comparing complications and measures of procedural success between conscious sedation and general anesthesia have not yet been conducted. Thus, choice of anesthesia for an LAA occlusion procedure is dependent on institutional practices and the needs of the specific patient, with patient safety remaining at the forefront of the decision.

Our approach to the anesthetic management of the patient undergoing Watchman® procedure has proven safe and reliable and could be considered at other institutions. Effective communication with the procedure team is necessary to ensure swift recognition and management of intraprocedural complications, especially hemopericardium. Anesthetic management should take into consideration the comorbidities of the patient when selecting induction agents. In general, patients tolerate the procedure well and recover appropriately.

Conflicts of interest / financial disclosures

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Ethics statement

Institutional Review Board approval was not necessary as this is not a research study.

CRediT authorship contribution statement

Lauren M. Poston: Writing – original draft, Investigation. **Samantha Pope:** Writing – review & editing, Project administration. **Luis E. Tollinche:** Writing – review & editing, Supervision. **Maninder Singh:** Writing – review & editing, Investigation, Conceptualization.

Data availability

No data was used for the research described in the article.

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Glossary

AF: atrial fibrillation
LAA: left atrial appendage
DOAC: direct oral anticoagulant
PROTECT-AF: Watchman(R) Left Atrial Appendage Closure Technology for Embolic Protection in Patients With Atrial Fibrillation
PREVAIL: Watchman(R) LAA Closure Device in Patients With Atrial Fibrillation Versus Long Term Warfarin Therapy
TEE: transesophageal echocardiography
ACT: activated clotting time
ICE: intracardiac echocardiography