



A Patient Undergoing Laparoscopic Radical Prostatectomy and Atrial Defect Closure Simultaneously: A Case Report

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Abstract

Background: Prostatectomy offers the greatest potential for a definitive cure for localized prostate cancer. Closure devices for secundum atrial septal defects have a good safety and efficacy profile. Simultaneous operation of the two types of surgery has not been reported to date.

Case Presentation: A 65-year-old man was admitted to receive laparoscopic radical prostatectomy for prostate cancer under general anesthesia. The chest CT imaging unexpectedly showed that the heart and the pulmonary artery were obviously enlarged. Subsequently, a secundum atrial septal defect (ASD) with left-to-right shunt measuring 27*23mm was observed on transthoracic echocardiography (TTE). After a multi-disciplinary team (MDT) consisting of departments of urology, cardiac surgery, and anesthesiology was assembled to discuss the surgical procedure, an atrial septal defect closure device was scheduled to be implanted, followed by laparoscopic radical prostatectomy. The patient underwent both surgeries and was successfully discharged from the hospital.

Conclusions: Adequate perioperative assessment and management are crucial for patients. We should pay more attention to patients with cardiac disease undergoing both cardiac and non-cardiac surgery.

Keywords

Laparoscopic Radical Prostatectomy, Atrial Septal Defect Closure, Perioperative Management, Case Report

Abbreviations

PSA: Prostate-Specific Antigen; MRI: Magnetic Resonance Imaging; ASD: Atrial Septal Defect; ECG: Electrocardiogram; CT: Computed Tomography; PIRADS: Prostate Imaging Reporting And Data System; DWI: Diffusion-Weighted Imaging; ADC: Apparent Diffusion Coefficient; TTE: Transthoracic Echocardiography; SVC: Superior Vena Cava; IVC: Inferior Vena Cava; MDT: Multi-Disciplinary Team; TEE: Ransesophageal Echocardiography; ICU: Intensive Care Unit; CO₂: Carbon Dioxide; SVR: Systemic Vascular Resistance; MAP: Mean Arterial Pressure; PVR: Pulmonary Vascular Resistance; PCO₂: Partial Pressure of Carbon Dioxide; EtCO₂: End-Tidal Carbon Dioxide Pressure

Introduction

Prostate cancer is the most frequently diagnosed malignancy in over fifty percent of countries and the sixth leading cause of cancer death among men worldwide [1,2]. Diagnosis is primarily based on Prostate-Specific Antigen (PSA) testing, which remains controversial, as well as Magnetic Resonance Imaging (MRI) scans and prostate tissue biopsies, among other methods [3]. The cancer is considered localized and potentially curable when it is limited to the prostate [4]. Radical prostatectomy offers the greatest potential for a definitive cure for localized prostate cancer, leading to a significant improvement in overall survival, cancer-specific survival, and the prevention of distant metastases [5]. The choice between minimally invasive and open surgical radical prostatectomy is mostly dependent on the surgeon's experience, which appears to be the most critical factor associated with a successful outcome [6].

Atrial Septal Defect (ASD) is a congenital cardiac anomaly that accounts for 25-30% of congenital heart disease cases diagnosed in adulthood [7]. It should be closed in the presence of a hemodynamically significant shunt that causes enlargement of right heart structures, irrespective of symptoms [8, 9]. Closure of ASD confers morbidity and mortality benefits compared to medical therapy alone for patients after the age of 40 years [10]. We report a case of a man who underwent closure of ASD and laparoscopic radical prostatectomy consecutively on the same day. Informed consent for publication was obtained from the patient.

Case Presentation

A 65-year-old man weighing 68.5 kg was admitted to receive laparoscopic radical prostatectomy for prostate cancer under general anesthesia. He had a history of hypertension and irregularly took medication. Preoperative examinations, including vital signs, blood samples, 12-lead electrocardiogram (ECG), and chest computed tomography (CT), were completed. A first-degree atrioventricular block was shown on the ECG. Contrast-enhanced MRI scan showed the prostate size to be 4.7cm * 3.7cm * 3.5cm, with lesions located in the left middle transitional zone and left apical transitional zone. Low signal on T2WI

matched prostate imaging reporting and data system (PIRADS) with a score of 3, and high signal on diffusion-weighted imaging (DWI) with low signal on apparent diffusion coefficient (ADC) were consistent with PIRADS with a score of 5 [11]. The PSA level was significantly elevated. After discussion with the patient and his relatives, laparoscopic radical prostatectomy was scheduled and written informed consent was obtained from the patient before the surgery.

The day before the surgery, the anesthesiologist found that the heart and the pulmonary artery were obviously enlarged on the chest CT imaging (**Fig-1**). The patient was advised to undergo cardiac ultrasonography for further investigation of the patient's condition. Transthoracic echocardiography (TTE) revealed that the size of the left atrium, left ventricle, right atrium, and right ventricle were 36mm, 41mm, 44mm, and 33mm respectively. A secundum ASD with a left-to-right shunt was observed, with a size of 27*23mm. The anterior rim was absent, and the posterior rim length was 5mm. The rim lengths from ASD to the superior vena cava (SVC) and inferior vena cava (IVC) entrances were 8mm and 6mm respectively.



Fig-1: Preoperative Chest CT Showed Significant Cardiac Enlargement

A Multi-Disciplinary Team (MDT) consisting of departments of urology, cardiac surgery, and anesthesiology was formed to discuss the next surgical procedure. Ultimately, an atrial septal defect closure device was scheduled to be implanted, followed by laparoscopic radical prostatectomy.

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Mechanical ventilation (volume controlled with FiO₂ 50%) was performed after induction of general anesthesia. Anesthesia was maintained with sevoflurane and remifentanyl. Atrial septal defect was confirmed by transesophageal echocardiography (TEE), consistent with the findings from TTE (**Fig-2**). A small incision was made to access the femoral vein. A wire was inserted into the vein and guided into the heart by TEE, followed by a catheter which was passed over the guidewire into the heart and through the defect. A 34 mm septal occluder was used to close off the defect. Subsequently, laparoscopic radical prostatectomy was successfully performed at the surgeon's discretion. Due to the consecutive nature of the two operations, the patient was transferred to the intensive care unit (ICU) with an endotracheal tube for further monitoring and improvement. After one day of treatment in the ICU, the patient was transferred back to the general ward and discharged from the hospital on the 5th day.

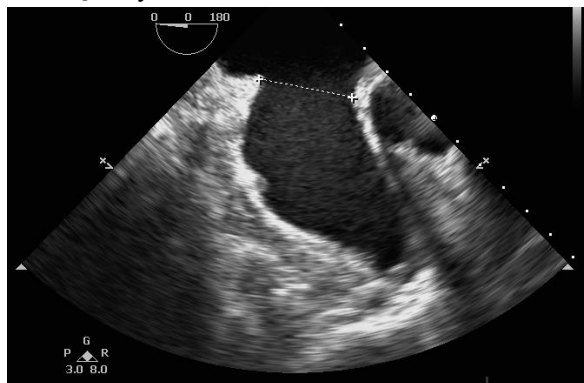


Fig-2: Atrial Septal Defect was Found by Perioperation Transesophageal Echocardiography

Discussion and Conclusions

Prostatectomy and percutaneous ASD occlusion have been reported separately, but the simultaneous operation of these two procedures has not been reported to date.

Atrial septal defect typically results in a left-to-right shunt in most patients. Defects larger than 10 mm in diameter may lead to a pulmonary-to-systemic flow ratio exceeding 1.5, initiating a cascade of changes in the myocardium and pulmonary vasculature [12]. This can lead to a decrease in left ventricular diastolic filling and diminished systemic output. A longstanding shunt can result in right ventricular dilatation, impairing right atrial reservoir and pump functions [13]. The size

of a secundum defect can change with age if it does not close spontaneously [14-16]. It remains unclear whether changes in defect size are proportional to increases in heart size or to somatic growth [12]. Mild or moderate pulmonary hypertension is common in adults with large atrial septal defects, and it tends to increase with age, especially in patients living at high altitudes [17,18].

Studies have demonstrated that untreated atrial septal defects are associated with a reduced lifespan [19,20]. Therefore, it is recommended to close atrial septal defects in the presence of a significant hemodynamically significant shunt, leading to enlargement of right heart structures, regardless of symptoms (class I, level of evidence B) [9,21]. Secundum atrial septal defects can be closed either surgically or percutaneously using an occluding device delivered by catheter, although this may not be feasible in small infants with large secundum defects.

Many hospitals now prefer transcatheter closure of secundum defects due to advancements in minimally invasive techniques [22]. Current studies indicate that closure devices for secundum atrial septal defects have a good safety and efficacy profile. For example, a study of 650 adult patients undergoing septal occluding device implantation showed a success rate of 98% with an occlusion rate of 96% [23]. Similarly, a review of 478 patients reported similarly good results with technical success in 96% and an occlusion rate of 99.6% [24]. The rates of major and minor complications have been reported to be roughly 1% and 5%, respectively, including atrial arrhythmias, vascular complications, and transient heart block [23-25].

In the presented case, the patient was scheduled to undergo laparoscopic radical prostatectomy. It is important to note that carbon dioxide (CO₂) insufflation can lead to significant hemodynamic and pulmonary changes due to increased intra-abdominal pressure and hypercarbia during laparoscopic surgery. Studies have shown that systemic vascular resistance (SVR) and mean arterial pressure (MAP) rise abruptly with abdominal insufflation, which is attributed to abdominal aortic compression and neuroendocrine effects in healthy individuals [26]. Elevated SVR could

potentially increase the shunt amount, leading to hemodynamic instability in patients with ASD. Additionally, CO₂ insufflation could cause hypercarbia, potentially resulting in pulmonary artery constriction and exacerbating pulmonary vascular resistance (PVR) and pulmonary hypertension [27].

Given these considerations, the perioperative management plan for the patient prioritized lowering PVR and maintaining SVR. Therefore, the decision was made to perform ASD closure first, followed by laparoscopic radical prostatectomy. The partial pressure of carbon dioxide (PCO₂) was estimated using the end-tidal carbon dioxide pressure (EtCO₂) value, and blood gas analysis was performed regularly to allow for timely corrections.

While most practitioners prescribe antiplatelet drugs after device implantation, the exact mechanism of device-related thrombus formation is not yet fully understood, and consensus regarding the optimal post-procedural antithrombotic management is still under investigation.

In summary, we presented a case involving ASD closure followed by prostatectomy and discussed the surgical sequence, surgical success rate, and perioperative management strategies. This case underscores the importance of adequate perioperative assessment of patients and the unique considerations for patients with ASD during the perioperative period. Furthermore, it emphasizes the need to strengthen the decision-making abilities of surgeons and anesthesiologists to reduce the incidence of postoperative risks.

Conflict of Interest

The authors have read and approved the final version of the manuscript. The authors have no conflicts of interest to declare.

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