

# Understanding the risks of and right ventricular biopsy in the contemporary catheterization laboratory

## Key points

1. Right Heart Catheterization (RHC) and Right Ventricular Biopsy (RVB) are safe procedures that occasionally result in clinically meaningful complications.
2. Tricuspid regurgitation is the most common complication and occurs five times more frequently from RVB than RHC.
3. Death from RHC/RVB is exceedingly rare, and mortality is related to the disease prompting the procedure rather than the procedure itself

## Description

Right Heart Catheterization (RHC) and Right Ventricular Biopsy (RVB) are invasive procedures typically performed in the catheterization laboratory by invasive and interventional cardiologists [1]. RHC assesses cardiopulmonary hemodynamics to diagnose and manage conditions like heart failure, pulmonary hypertension, and valvular disease [2]. Patients undergoing RHC range from stable outpatients with unexplained dyspnea to decompensated inpatients in extremis. RVBs are most commonly performed in the post-transplant population to monitor for rejection and adequacy of immunosuppressive regimens, but they are sometimes needed in native hearts to define a specific cardiomyopathy process, such as myocarditis, sarcoidosis, amyloidosis or other infiltrative disorders affecting the heart [3]. While these procedures can be performed in isolation, they are often in conjunction with other diagnostic investigations that can increase the complication risk, including left heart catheterization (including percutaneous coronary intervention), trans septal puncture, supine bike exercise, and drug administration [4]. Ultrasound-guided vascular access has also improved the safety of these invasive procedures [5]. Noninvasive imaging modalities, like echocardiography, CT and PET, now provide surrogate information traditionally derived from RHC and biopsies, but there remains a role for direct measurements and pathologic tissue diagnosis [6-8]. RHC and RVB complication rates had not been well studied until recently [1,9].

A Mayo Clinic retrospective study of 17,696 catheterization laboratory patients between 2002 and 2013 undergoing RHC alone, RVB alone, multiple RHC/RVB, and combination of RHC/RVB with left heart catheterization was performed to evaluate procedural safety and the rate of complications [1]. The primary endpoint was the incidence of major adverse cardiovascular events, including death, myocardial infarction, stroke, unplanned bypass surgery, pneumothorax, hemorrhage, hemoptysis, heart valve repair/replacement, pulmonary artery perforation, ventricular arrhythmias, pericardiocentesis, complete heart block, and Deep Vein Thrombosis (DVT). The combined risk for the primary endpoint was 21.6 and 20.8 of 10,000 procedures for RHC and RVB, respectively (24.9 per 10,000 overall). Nearly three-fifths of the deaths were due to cardiogenic shock, arrhythmia, and postoperative (10% with respiratory

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failure of a noncardiac etiology). No death was directly attributable to the RHC, and the acute illness necessitating the procedure was the ultimate cause of death. There were 208 total deaths with 190 (1.1%) during the index hospitalization (nine deceased on the day of the procedure; 80 within seven days of RHC). This is the first study of this population to report periprocedural mortality rates.

Significant worsening of Tricuspid Regurgitation (TR) was the most common complication after RVB. TR was considered a complication only if worse than baseline (e.g., severe TR following the procedure when none/mild pre-procedure). Worsening TR occurred approximately five times more frequently with RVB than RHC (5.1% vs. 1.3%, respectively). TR has not been reported in many studies historically, likely due to fluoroscopic guidance alone (without pre-and post-procedure TR assessment) and minimal to no post-procedure symptoms or hemodynamic consequence to prompt echocardiographic evaluation. Importantly, 25% of orthotopic heart transplant patients have severe TR, and there is a correlation between TR severity and number of specimens obtained [10]. The role for echocardiographic guidance is debated without a clear consensus [11]. Interestingly, the rate of worsening TR post-procedure was greater in cases utilizing echocardiographic guidance with fluoroscopy compared to fluoroscopy alone (9.7% vs. 5.1%). Possible explanations for this finding include greater identification of the TR due to imaging all echocardiographic-guided patients post-biopsy (instead of only those with suspected complications after fluoroscopy guidance), selection bias related to greater utilization of echocardiographic guidance in challenging RVBs, and the Mayo Clinic institutional policy of utilizing echocardiographic guidance in RVBs performed within three months of transplant.

Other notable complications of RHC and RVB include Ventricular Tachycardia (VT), cardiac tamponade, hemoptysis, and pneumothorax. VT is over twice as likely with RVB compared to RHC (7.8 versus 3.6 per 10,000). The rate of tamponade from RHC is 0 per 10,000 but 7.8 per 10,000 for RVB, typically attributable to free wall perforation. Hemoptysis is more common from RHC and occurs at a rate of 3.6 per 10,000 but 0 per 10,000 from RVB. Pneumothorax from RVB occurs in 2.6 per 10,000 and 0 per 10,000 for RHC. There were no myocardial infarctions, unplanned coronary artery bypass or valve surgeries, or DVTs in this study. Strokes were rare at 1.7 per 10,000 and only occurred in patients undergoing multiple procedures. One patient had a

pneumothorax, and there were eight hemorrhages within a week of the procedure (4.5 per 10,000).

### Conclusion

In conclusion, RHCs and RVBs are common procedures, can be safely performed with low complication rates (21.6 and 20.8 per 10,000, respectively), and have no mortality directly attributable to the procedure. Periprocedural death is driven by the underlying illness necessitating these diagnostic evaluations. While the rates of these complications are low, they still occur infrequently in a high volume center. The findings highlight the importance of carefully weighing risks and benefits and obtaining informed consent prior performing these procedures.

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