Post-TAVR Conduction System Abnormalities

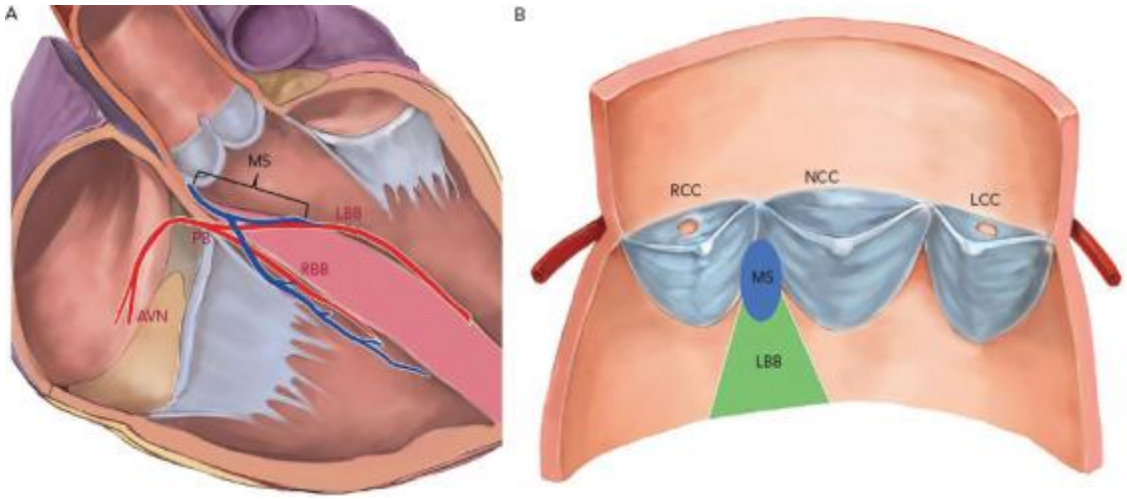
BACKGROUND AND INTRODUCTION

The development of conduction disturbances post transcatheter aortic valve replacement (TAVR) is explained by the proximity of the aortic valve to the conduction system. The AV node is located within the triangle of Koch near the subaortic region and the membranous septum. While the bundle of His is located in the membranous septum, the left bundle emerges below the posterior inferior membranous septum edge at the level of the non-coronary cusp. This close relationship predisposes conduction disturbances after TAVR either from direct mechanical insult, inflammation, edema, localized hematoma, or ischemia of the surrounding tissue (Figure 1).

High-grade AV block (HAVB) or complete heart block (CHB) requiring permanent pacemaker implantation (PPMI) and new onset left bundle branch block (LBBB) are the most common conduction abnormalities requiring attention post TAVR. New onset LBBB and PPMI post TAVR have been associated with variable impacts on clinical outcomes ranging from no impact, increased heart failure hospitalizations, and failure to improve ejection fraction. Additionally, these conduction disturbances may lead to prolonged length of stay and increased medical cost.

The utilization of different modalities of electrocardiogram (ECG) monitoring pre and post TAVR have been studied and reported to identify peri-procedural conduction abnormalities. A summary is provided below.

Figure 1



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ECG monitoring and identifying conduction abnormalities

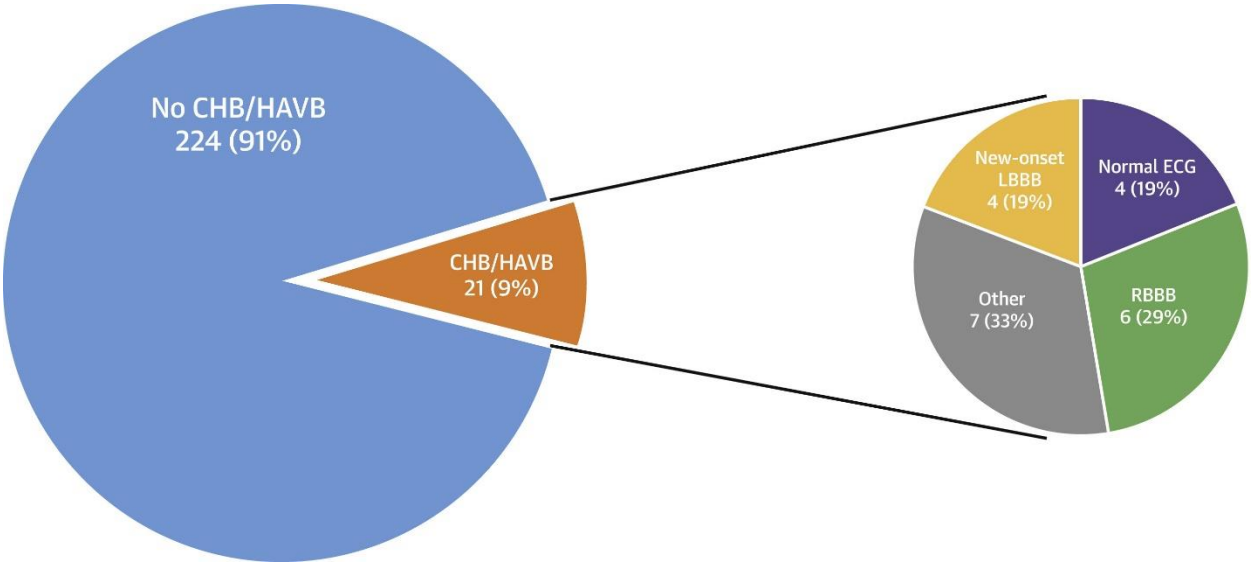
Pre procedural ECG monitoring

Studies utilizing ECG monitoring prior to TAVR identified severe bradycardia in 3.2% - 18.9 %, HAVB/CHB in 1.9% - 10 % with permanent pacemaker implantation prior to TAVR between 1 to 7% in these studies, mostly in otherwise asymptomatic patients. These appear to be more common in patients with baseline right bundle branch block and first-degree AV block.

Post-procedure ECG monitoring

Post TAVR, duration of ECG monitoring in studies has ranged from 24 hours and up to three years. Some have studied all TAVR patients and patients without PPM, while others have studied patients with persistent LBBB. In patients who developed post TAVR LBBB, up to 16% develop HAVB/CHB at 2 years, 9% within 30 days, up to 80% within the first 4 months, with 66% of them receiving PPM. In patients with baseline RBBB, 40% develop HAVB/CHB with an odds ratio of 20.46 95% CI 2.67-158.31, p = 0.004. Remarkably, 4% of patients with normal ECG developed HAVB/CHB (Figure 2).

Figure 2



Reprinted from "Ambulatory Electrocardiogram Monitoring in Patients Undergoing Transcatheter Aortic Valve Replacement: JACC State-of-the-Art Review" by G. Muntane-Carol, 2021, *J Am Coll Cardiol., 77*(10):1344-1356.

PREDICTIVE MODEL FOR PERMANENT PACEMAKER REQUIREMENT

Both patient and procedural factors impact the rate of conduction disturbances and PPMI after TAVR, as highlighted below (Figure 3).

1. Patient Factors:

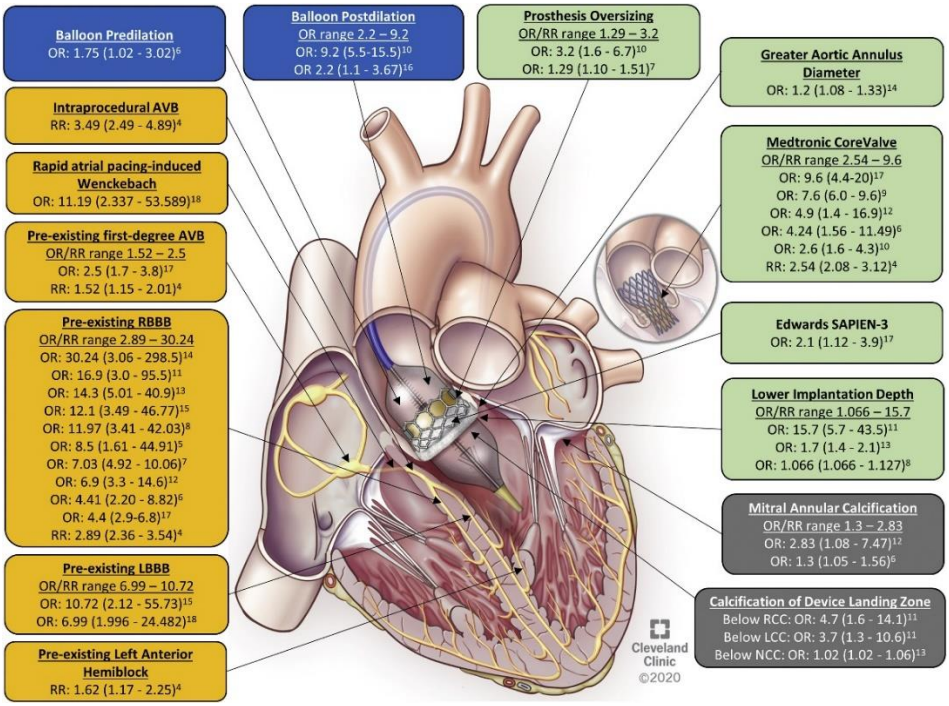
Clinical factors associated with increased conduction disturbances include age greater than 80, DM, prior MI, prior CABG, and annular and LVOT calcium.

In addition, as mentioned above, the presence of RBBB, and first-degree AV block particularly in the presence of hemifascicular block represent a high-risk population for conduction disturbances post TAVR and consideration for pre-procedural ECG monitoring may be warranted. While PPM implantation in that population in the absence of symptoms or HAVB/CHB is unclear, further studies would be warranted to elucidate its impact on post-procedural care. The exact duration of pre-procedure monitoring is unclear but may be warranted for up to 30 days before the procedure. Patients with short membranous septum are at risk for PPM.

2. Procedural Factors:

The type of valve (self-expanding versus balloon expandable versus mechanically deployed valves), depth of implantation, percent of valve oversize, and implantation depth greater than the membranous septum length are all procedural factors that impact the rate of conduction disturbances post TAVR. The incidence of new onset LBBB is up to 22% in Sapien 3, 51% in Evolut, 28% in Portico, and 78% in Lotus. Newer implant techniques (cusp overlap) that have allowed better visualization of the LVOT and the proposed membranous septum have allowed lower PPM rates.

Figure 3



Reprinted from "Incidence, Predictors, and Implications of Permanent Pacemaker Requirement After Transcatheter Aortic Valve Replacement" by Y. Sammour, 2021, *JACC Cardiovasc Interv,14*(2):115-134.

RECOMMENDATIONS

Previous data on the duration of ECG monitoring post TAVR as well as PPMI post TAVR has been variable. This is particularly true due to the low incidence of pacemaker utilization in those who have received PPM. Due to the low incidence of conduction abnormalities in patients with normal discharge ECG post TAVR, recommendation of monitoring of all post TAVR patients is not warranted. However, in patients with baseline RBBB, 40% require PPM in hospital with the majority (98%) developing HAVB/CHB within 3 days post procedure. Some reports suggested delayed HAVB/CHB in 40% and a strategy of 2-4 weeks post-procedure monitoring would seem beneficial.

The majority of patients with new onset LBBB, do not eventually require PPMI. However, they remain at risk of developing HAVB/CHB, as noted above, and a strategy of 2-4 weeks of post-procedure monitoring would also seem beneficial.

Other forms of conduction abnormalities such as first-degree AV block, progressive increase in PR duration, and nonspecific intraventricular conduction delay, may also require post-procedural monitoring for the same duration.

Finally, patients who develop asymptomatic temporary HAVB/CHB during or after the procedure while in the hospital may be considered for PPMI. However, further studies may be warranted in this population.

In a small study of high-risk patients with pre-existing RBBB or peri procedural brief HAVB/CHB, and comparing pre- and post- ECG monitoring, QRS prolongation occurred in all patients while PR prolongation only developed in patients who developed HAVB/CHB. Additionally, 11% of the patients required PPMI, the majority of which were before the onset of symptoms. This suggested that post-TAVR monitoring may be beneficial in this population.

Currently, five groups of patients with peri-procedural types of management in regard to conduction abnormalities are identified. We highlight these groups below and recommend in accordance with published data, the following best practice workflow.

Group 1 – Patients without significant pre- and post- procedural ECG abnormalities.

a. Post-procedural removal of TVP
b. Telemetry monitoring overnight
c. Discharge, if appropriate, the following day
d. Escalation of care if new conduction abnormalities are noted

Group 2 – Patients with pre-existing RBBB

a. Multidisciplinary pre-procedural discussion with consideration of pre-procedural ECG telemetry monitoring especially in patients who present with syncope or presyncope, have additional 1st degree av block or left fascicular block, consider early EP referral
b. TVP remaining for 48 hrs. with similar duration of telemetry
c. If HAVB/CHB PPMI
d. 30-day post-TAVR ECG monitoring in those who do not develop HAVB/CHB
e. Hospital discharge day 2-3
f. In a select group of patients who do not demonstrate any widening of the QRS or change in the QRS axis or change in PR interval, next-day discharge may be considered

Group 3 – Patients with pre-existing QRS duration > 120 ms or first-degree AV block who develop further prolongation of the QRS or PR interval

a. Less consideration for pre-procedural ECG telemetry monitoring
b. For post-procedure management, same as group 2

Group 4 – Patients with new onset LBBB

a. TVP for 24 hrs.
b. Telemetry 48 hrs.
c. Removal of TVP after 24 hrs. if no HAVB/CHB or further widening of the QRS
d. If HAVB/CHB then PPMI
e. 30-day post-TAVR ECG monitoring in those who do not develop HAVB/CHB
f. Hospital discharge day 2
g. If there is no prolongation of the QRS duration overnight next-day discharge may be considered

Group 5 – Patients with transient HAVB/CHB peri procedurally (highest risk)

a. TVP for 24 hrs.
b. Telemetry for 48 hrs.
c. Removal of TVP after 24 hrs. if no HAVB/CHB
d. If recurrent or persistent HAVB/CHB then PPMI
e. 30-day post-TAVR ECG monitoring in those who do no develop recurrence
f. Hospitalization up to 3 days

General Considerations

a. Per the discretion of the treatment team, AV nodal blocking agent(s) may be held post TAVR
b. If any AV node conduction blocking agent is re-introduced, TVP should be maintained to exclude high grade conduction abnormalities
c. It is strongly recommended that patients with RBBB or bifascicular block receive jugular venous access for TVP
d. An early EP consult is recommended for patients who develop HAVB/CHB if PPMI post TAVR

CONCLUSION

Both patient and procedural factors dictate the evolution of conduction disturbances and PPMI post TAVR. New onset LBBB and PPMI post TAVR have been associated with variable impacts on clinical outcomes ranging from no impact, increased heart failure hospitalizations, and failure to improve ejection fraction. The presence of baseline RBBB as well as the development of procedural or transient HAVB/CHB constitute the highest risk for PPMI and may require either preprocedural or prolonged post-procedural ECG monitoring.

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Brittany Pridham, NP, and Amr E. Abbas, MD, led development of this protocol with the support of the MISHC Best Practice Protocol Task Force.

DISCLAIMER

MISHC Best Practice Protocols are based on consortium-wide consensus at the time of publication. Protocols will be updated regularly, and should not be considered formal guidance, and do not replace the professional opinion of the treating physician.

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