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EDITORIAL COMMENT

Left Bundle Branch Block After Transcatheter Aortic Valve Implantation

Still a Matter of Concern?*

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Transcatheter aortic valve implantation (TAVI) has experienced unprecedented growth since its first description by Alain Cribier in 2002 (1) and is now routinely performed in many institutions worldwide. New-onset left bundle branch block (LBBB) or atrioventricular (AV) block necessitating permanent pacemaker implantation (PPI) are among the most frequent complications of TAVI (2–5). Case reports describing late occurrence of complete AV block and the fact that LBBB has been associated with a worse outcome after surgical aortic valve implantation led clinicians to adopt a generous strategy of pacemaker implantation after TAVI. This strategy was further enhanced by the urge to ambulate patients early after TAVI instead of prolonged monitoring for resolution of AV conduction impairment. Improvement

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of valve design and implant strategy has lowered the rate of AV conduction abnormalities, but they continue to be a matter of concern. Moreover, new-onset LBBB after TAVI was associated with increased mortality in a study by Houthuizen et al. (3), whereas others have found no association (4,6–8). Additional insights into the outcome of patients with LBBB after TAVI are therefore needed.

In this issue of *JACC: Cardiovascular Interventions*, Urena et al. (9) evaluate the impact of new-onset LBBB on the outcome in 668 patients undergoing TAVI with a balloon-expandable valve. New-onset persistent LBBB was found in 11.8% of patients. Compared with the remaining patients, there were no differences in mortality and rate of heart failure hospitalizations during follow-up. However, new-onset LBBB was associated with a higher rate of PPI, a lack of left ventricular ejection fraction (LVEF) improvement, and poorer functional class at follow-up.

There are 2 hypotheses about how new-onset LBBB can increase mortality after TAVI: it is a harbinger of 1) sudden cardiac death; and 2) dyssynchrony-induced progressive heart failure culminates in increased cardiovascular mortality. Table 1 gives an overview of the most important studies reporting on new-onset LBBB after TAVI and mortality. Houthuizen et al. (3) found an association with increased mortality. So far, other groups were not able to confirm this result, including the study under discussion here. What are the reasons for this discrepancy? Houthuizen et al. (3) included lower-risk patients, but their incidence of new-onset LBBB and PPI after TAVI was significantly higher, even though a balloon-expandable valve was implanted in a significant proportion of patients. This could be the result of differences in implantation technique, which may also have affected outcome. Furthermore, patients with any new-onset LBBB were analyzed by Houthuizen et al. (3), whereas in the other studies, the focus was on patients with new-onset persistent LBBB. This detail might have important consequences. It is well described that as many as 50% of new-onset LBBB cases resolve within a short time after TAVI (4,7). However, those patients could still be at risk of late occurrence of complete AV block, and excluding those patients might affect outcome. Because of a higher incidence of new-onset LBBB in the study by Houthuizen et al. (3) and longer follow-up, the study probably also had more power to detect any differences. In the study by Urena et al. (9), 4% of deaths were sudden, compared with 17% in the study by Houthuizen et al. (3). Thus, patients often died of different causes before sudden cardiac death occurred, further obscuring the effect of new-onset LBBB on mortality and limiting the power of the study.

None of these studies reported in detail the PPI strategy and timing. However, the timing of PPI after TAVI is important. It is possible that complete AV block resolves after TAVI and complete LBBB may remain. If a permanent pacemaker is implanted early, those patients would not show up in the group of patients with new-onset LBBB at hospital discharge, as they are excluded. However, if PPI is performed only after several days, complete AV block might have resolved to complete LBBB in some patients, thus leading to ad hoc cancellation of PPI. Nevertheless, those patients might be at increased risk of recurrent complete AV block during follow-up. Unfortunately, no study reports this important fact in detail.

In the study by Urena et al. (9), in 8 of 79 patients with new-onset LBBB (10.1%) a high degree of or complete AV block developed during follow-up compared with 8 of 589 patients (1.4%) in the group without new-onset LBBB.

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Table 1. The Most Important Studies Analyzing Outcome After TAVI With Respect to New-Onset LBBB

	Houthuizen et al. (3)	Testa et al. (4)	Nazif et al. (6)	Urena et al. (9)
n	679	818	1,151	668
Logistic EuroSCORE	16	23	25	21
Age, yrs	81	82	84	81
Balloon-expandable valve, %	43	0	100	100
Exclusion criteria	Pre-existing LBBB and PPI; post-procedural PPI before discharge (15%)	Pre-existing LBBB and PPI; post-procedural PPI within 48 h (7%)	Pre-existing PPI and intraventricular conduction disturbance; paced rhythm on discharge ECG (3%)	Pre-existing LBBB and PPI; post-procedural PPI before discharge (7%)
Independent core laboratory (ECGs/echocardiograms)	No	No	Yes	No
LBBB group definition	New onset	New-onset persistent	New-onset persistent	New-onset persistent
New-onset (persistent) LBBB, %	34.3	27.4	10.5	11.8
Mortality with vs. without new-onset LBBB	26.6% vs. 17.5% at 1 yr ($p = 0.006$)	18.7% vs. 19.7% at 1 yr ($p = 0.1$)	16.9% vs. 17.7% at 1 yr ($p = 0.73$)*	27.8% vs. 28.4% at 13 months ($p = 0.40$)
Rate of hospitalization for heart failure	—	No difference	Higher if new-onset LBBB	No difference
NYHA functional class	—	No difference	No difference	Higher if new-onset LBBB
Echocardiography data available at follow-up	—	40%–45%	71%	83%
Improvement in LVEF	—	No difference at 1 yr	Less improvement if new-onset LBBB†	Less improvement if new-onset LBBB

*Excluding patients with PPI before discharge. †Most pronounced in patients with baseline LVEF <35%.

ECG = electrocardiogram; EuroSCORE = European System for Cardiac Operative Risk Evaluation; LBBB = left bundle branch block; LVEF = left ventricular ejection fraction; NYHA = New York Heart Association; PPI = permanent pacemaker implantation; TAVI = transcatheter aortic valve implantation.

This points to a more than 7-fold increased risk of an arrhythmia that may cause sudden cardiac death in patients with new-onset LBBB after TAVI. Another study by Urena et al. (7) reported a significantly increased risk of syncope in patients with LBBB after TAVI but without PPI compared with patients without LBBB (20% vs. 0.7%; $p = 0.001$). Similarly, Nazif et al. (6) report significantly higher PPI rates after discharge in the new-onset LBBB group (5.1% vs. 1.5%; $p = 0.01$), one-half of which were because of a high-degree of AV block.

In summary, although it is reassuring that several studies have shown no important differences in mortality in cases of new-onset LBBB after TAVI, we should continue to be vigilant about fluctuating AV conduction impairment after TAVI or any symptoms suggesting transient complete AV block. These patients should proactively undergo PPI. PPI is a safe and rapid procedure that reliably prevents syncope or bradyarrhythmic sudden cardiac death with minimal adverse effects on long-term outcome (10).

It is now well established that complete LBBB or chronic right ventricular pacing can adversely affect outcome (11). However, these deleterious effects are most pronounced in patients with pre-existing heart failure, and most TAVI patients have preserved LVEF. Nazif et al. (6) also reported a lack of LVEF improvement in patients with new-onset LBBB after TAVI. This lack of improvement was mostly seen in patients with a baseline LVEF <35%. Other studies have found inconsistent effects of new-onset LBBB after TAVI on LVEF (4,12). The reasons for this might be the different rates of echocardiography available at follow-up and the absence of independent echocardiography core laboratories. Similarly, the effect of new-onset LBBB on New York Heart Association functional class and the rate of hospitalization for heart failure are inconsistent among studies (4,6). We have to wait for larger studies that evaluate the effect of new-onset LBBB after TAVI on LVEF and heart failure parameters in a patient population with impaired baseline LVEF. The impact of biventricular PPI in this patient population will be interesting.

As indications for TAVI widen to younger patients with fewer comorbidities, it can be expected that the relative occurrence of conduction blockers will diminish.

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Key Words: aortic stenosis ■ atrioventricular heart block ■ bundle branch block ■ syncope ■ transcatheter ■ valve replacement.