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# Knowledge of native valve anatomy is essential in follow-up of patients after aortic valve replacement

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ABSTRACT

*Background:* After aortic valve replacement (AVR), bicuspid aortic valve (BAV) patients continue to be at risk of aortic complications. Therefore, knowledge of native valve anatomy is important for follow-up. We aimed to determine the extent of which the presence of BAV disease is known in a regional post-AVR population.
*Methods:* The Electronical Medical Record system was used to collect all patients under follow-up after AVR. We documented their clinical data and used the operative report to determine valve phenotype; lacking reports were retrieved.
*Results:* We identified 560 patients who underwent AVR between 1971 and 2012, with a median of 6.2 years follow-up postoperatively. Mean age at surgery was 66 years (SD13.2 years), and 319 patients (57%) were male. In 29 cases (5%), an operative report was not available and in 85 patients (16%) the report lacked a description of valve phenotype. In 446 patients, a surgeon's description of native valve was available: 299 patients (67%) had tricuspid aortic valve, 140 (31%) BAV, and 3 (1%) quadricuspid aortic valve. In 4 patients (1%) the description was non-conclusive. In 66/140 BAV patients the surgeon's diagnosis was not reported back to the referring cardiologist, which corresponded with 12% of all 560 AVR patients. Another 21% of these 560 lacked a clear description of native valve anatomy: no report, no native valve description or an unclear valve description.
*Conclusions:* Native valve anatomy was not known in one-third of AVR patients under follow-up, which included almost half of the BAV patients. This lack of knowledge withholds patients from appropriate ascending aorta surveillance.



## 1. Introduction

A bicuspid aortic valve (BAV) may lead to progressive aortic stenosis and/or aortic insufficiency. Based on community studies, in cases of asymptomatic patients with no or minimal valve dysfunction at initial diagnosis, 24% of BAV patients need aortic valve replacement (AVR) in the first 20 years post follow-up [1]. In cases of dysfunction at initial diagnosis, the need for AVR is over 50% during 25 years follow-up [2]. BAV is also associated with progressive dilatation of the ascending aorta, which may lead to aneurysm formation or dissection. In the first mentioned study, the prevalence of dilatation rose from 15% to 39% after 10 years (>40 mm) [1]. The reported prevalence of ascending aorta dilatation varies depending on differences in age and diameter thresholds [3]. Because of this association, the BAV condition may be viewed as valvulo-aortopathy [4]. The rate of aortic dilatation slows after AVR, but AVR does not halt progression of aortic dilatation, hence BAV patients continue to be at risk for aortic complications [4–8]. Therefore, knowledge of native valve anatomy is important for follow-up after AVR. Nowadays, valve phenotype can be determined preoperatively using sophisticated imaging tools [9,10], but this was less possible in the past. Furthermore, calcification makes preoperative diagnosis difficult. Native valve anatomy can also be assessed during surgery, but this information is not always documented and reported back to the referring cardiologist, which may be the case especially in countries where cardiothoracic surgery is concentrated in a limited number of referral hospitals. These clinical routines do not automatically keep in pace with scientific progress. We aimed to determine the extent of which the presence of BAV disease is both reported back and known

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or unknown in a regional post-AVR population. We also aimed to assess the clinical relevance of having this information.

## 2. Methods

In 2012, we retrospectively reviewed the Electronic Medical Record (EMR) system of a regional general hospital to collect all patients under follow-up after AVR. (Fig. 1) We documented their clinical data, the indication for surgery, type of surgery performed and operative reports; lacking reports were traced and retrieved from the surgical centres. Surgical assessment was used as a method to determine valve phenotype in concordance with other studies [8–13].

To assess whether the rate of documentation improved over the years, we dichotomized the data in two cohorts based on the median follow-up after surgery, and compared these rates with the chi squared test. Likewise, we compared within the patients with BAV whether documentation of the presence of BAV improved over the years with the chi squared test.

In the BAV patients we investigated additional follow-up data in order to analyse the consequences of having this information, such as death, surgery, aortic dilatation or advised family screening. We described occurrences as absolute numbers and percentages. The study was submitted to our hospital research committee. They judged that this retrospective study fell outside the scope of the Dutch law of medical-scientific research with humans (WMO), and therefore the patient's consent was not required.

## 3. Results

We identified 560 patients who comprised 4.7% of the annual population of the outpatient cardiology clinic (n = 11,997). Patients underwent their first operation between 1971 and 2012, with a median time of 6.2 years follow-up postoperatively (range 0.4-41 years). Mean age at surgery was 66 years (standard deviation 13.2 years, range 18-89 years), and 319 patients (57%) were male.(Table 1) The main indication for surgery was aortic stenosis in 368 patients (66%), aortic insufficiency in 90 (16%) and combined malfunctioning in 43 (8%).(Table 2) A Bentall procedure was concomitantly performed on 56 (10%), supracoronary ascendens replacement on 15 (3%), and aortic arch replacement on 24 (4%).

After all surgery reports were traced and retrieved, in 29/560 cases (5%), the surgery report was not available at all (21/250 cases of surgery before 2006 [8.4%]; and 8/310 from 2006 [2.6%; p = 0.002]) and in 85/560 patients (15%), the report lacked the surgeon's description of the native aortic valve (34/250 before 2006 [13.6%]; 51/310 from 2006 [16.4%; p = 0.002]). In the 446 patients in whom the operative report contained a description of the aortic valve, the prevalence of native valve anatomy in our patient cohort could be determined: 299 patients (67%) had a tricuspid aortic valve (TAV), 140 (31%) had a BAV, and 3 (1%) a quadricuspid aortic valve. From 4 patients (1%) the description of the valve anatomy was non-conclusive. (Fig. 2) Histopathologic review of resected valves was not routinely performed.

Concerning the 140 patients with BAV, this diagnosis was preoperatively known in 13 patients (9.3%). In 74 patients (53%), the diagnosis of BAV was noted at surgery and subsequently reported back to the referring cardiologist, either in the discharge letter, or by sending the operative report separately. In 15 patients (11%) the information was also coded in the patient's EMR. For the remaining 66 BAV patients (47%), the diagnosis at surgery was not reported back to the referring cardiologist (35/74 before 2006: [47%]; 31/66 from 2006 [47%]; p = 0.97). These 66 patients corresponded with 12% of all 560 AVR patients which is highlighted in blue in Fig. 3. The Figure also shows that 21% of the 560 patients lacked a clear description of native valve anatomy: no operative report, no native valve description or an unclear valve description.

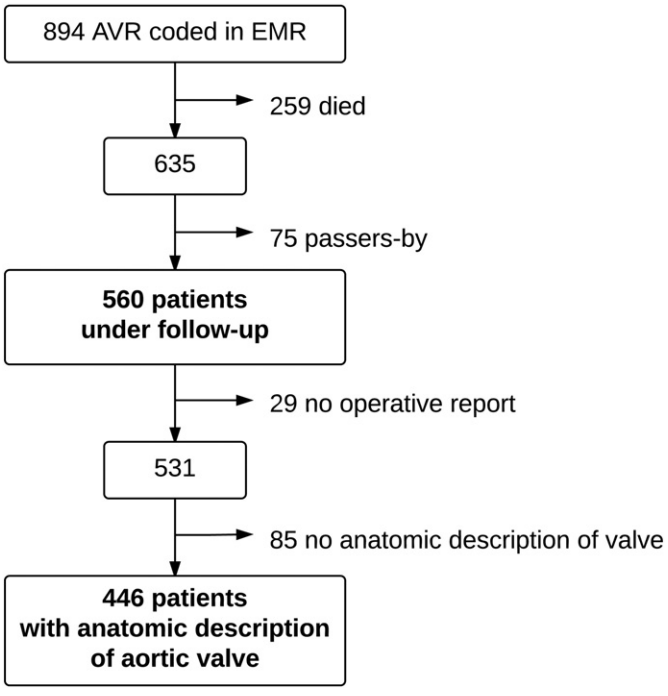


**Fig. 1.** Flowchart of collection of patients under follow-up after AVR. AVR, aortic valve replacement; EMR, electronic medical record.

**Table 1**
Baseline characteristics of patients under follow-up after AVR.

| | N = 560 |
|---|---|
| Male, n (%) | 319 (57) |
| Mean age at surgery, years (SD) | 66 (13.2) |
| Age range, years (min-max) | 18-89 |
| Year of surgery, median (IQR) | 2006 (2001-2009) |
| Years since surgery, median (IQR) | 6.2 (3.0-11.1) |
| Former LVOTO operation, n (%) | 7 (1) |
| Rheumatic fever, n (%) | 8 (1) |

IQR, interquartile range; LVOTO, left ventricular outflow tract obstruction: coarctation (n = 4), valvulotomie (n = 2), subvalvular membrane (n = 1); n, number; SD, standard deviation.

### 3.1. Reoperations

Among the follow-up cohort of 560 patients, 25 patients (4%) underwent one or more reoperations. The total number of reoperations was 32, including 5 transfemoral aortic valve interventions. Most often, reoperations were related to endocarditis (occurring before, at the time of, or after the first AVR; n = 13), or related to failure of homograft (n = 8), autograft (n = 3) or bioprosthesis (n = 4). Only 5 reoperations (16%) were indicated for ascending aorta dilatation: 1 as main indication, 4 in combination with a valvular indication for reoperation. In patients with known native valve anatomy, we discovered no significant difference in reoperations (one or more) between patients with TAV and BAV: 11 (3,7%) versus 7 (5%) respectively (p = 0.52).

### 3.2. Follow-up BAV patients in whom this diagnosis was not known initially

In the cohort of 66 patients in which we traced and obtained lacking operative reports, we analysed follow-up data. At time of coding the

**Table 2**
Indications for surgery.

| | N = 558* |
|---|---|
| Aortic stenosis, n (%) | 368 (66) |
| Aortic insufficiency, n (%) | 90 (16) |
| Combined aortic stenosis and insufficiency, n (%) | 43 (8) |
| Concomitant indication, n (%) | 26 (5) |
| Aneurysm, dissection, n (%) | 19 (3) |
| Endocarditis, n (%) | 12 (2)† |

*2 patients without data; † including 9 cases with aortic insufficiency; n, number.