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REVIEW

The Freestyle Aortic Bioprosthesis: A Systematic Review

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Background The Medtronic Freestyle bioprosthesis (FSB) provides an alternative to other prostheses for both aortic valve and aortic root surgery. This paper is a systematic review of the post-operative outcomes in patients with aortic valve and/or aortic root disease following FSB implantation.

Methods Electronic databases were searched for primary analysis, prospective randomised studies comparing the FSB with an alternative aortic prosthesis were included. Additionally, case series that included data for at least 100 individual operated patients were used for secondary analysis.

Results Among three identified randomised studies, 199 FSB cases were compared with homografts, and stented and an alternative stentless bioprosthesis. The FSB showed comparable hospital mortality (4.5% vs 5.3%) and eight-year actuarial survival ($80 \pm 5.0\%$ versus $77 \pm 6.0\%$) with the homograft (respectively) and comparable reduction in left ventricular mass index relative to other prosthesis types. Over 6000 individual patients were included in the selected 15 case series. Weighted mean operative mortality, neurological event rate and five-year actuarial survival was 5.2%, 5.5% and 77.8%, respectively.

Conclusion The FSB performed comparably against alternative prostheses regarding in-hospital mortality, long-term survival and reduction in left ventricular mass index. Included case series demonstrated robust post-operative outcomes in both the short and long term.

Keywords Aortic root • Aortic valve • Biological prosthesis • Valve replacement • Aortic surgery

Introduction

The Medtronic Freestyle bioprosthesis (FSB) is an alternative to stented bioprosthetic, mechanical and homograft valves for both aortic valve replacement and aortic root surgery; it has been available in Australia since 1996. The prosthesis consists of a porcine aortic root that includes the aortic valve, aortic sinuses (with left and right coronary artery ostia) and a portion of the ascending aorta. Valve leaflets are treated with an alpha-amino oleic anti-calcification process and zero pressure leaflet fixation, aiming to preserve a natural collagen crimp and thereby maintain optimal shock-absorbing

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capacity [1]. The FSB can be inserted as an aortic valve replacement alone in a subcoronary position, as a root inclusion technique, or as a full root replacement with coronary artery re-implantation [2]. This latter approach, however, can be associated with longer operating and cardiopulmonary bypass times.

Unlike following mechanical valve insertion, the need for long-term warfarin is unnecessary; nonetheless, mechanical valve longevity thus far remains superior. The FSB prosthesis is available in a variety of sizes and, unlike homograft or pulmonary autograft valves, is readily available 'off the shelf'. The absence of a stent potentially reduces risk of patient-prosthesis mismatch and thereby facilitates improved left ventricular mass regression (LVMR), a known predictor of long-term survival [3].

The aim of this paper is to perform a systematic review of the described short, medium and long-term outcomes in patients with aortic valve and/or aortic root disease after specific stentless valve implantation (the FSB) compared with aortic valve and/or aortic root replacement alternatives.

Material and Methods

Search Strategy

We sought to perform a systematic review of the current literature using previously published guidelines [4]. We performed a literature search of the Cochrane Central Register of Controlled Trials, MEDLINE and EMBASE from January 1992 – April 2013 for search terms [(freestyle) AND (aort*) AND replac*)]. Upon completion of this initial search, reference lists of all potentially suitable abstracts were additionally hand searched for further published literature. Studies published in languages other than English were not included. Selected local authors and experts in the field were contacted for identification of additional relevant published studies.

Study Retrieval

Studies deemed suitable according to title and abstract were selected for full review by the primary author (first reviewer) and verified by a second reviewer. Any disagreements were resolved with collaboration with a third party (expert in field). All included studies had their methodology and results documented and tabulated for comparison by the first reviewer.

Selection Criteria

For primary analysis, any randomised study that compared the FSB with an alternative equivalent aortic prosthesis and reported at least one post-operative clinical outcome was included. In secondary analysis, we included only case series with data for ≥100 consecutive operated patients who had received the FSB and where at least one post-operative clinical outcome was included. This 100 patient case series cut-off was chosen to only include centres of higher surgical volume; randomised studies were included in the primary analysis regardless of the number of FSB patients. Exclusion criteria were: conference abstracts; letter-to-editor articles; review articles; studies including the FSB but without separating its clinical results from other prostheses; and studies with identified overlapping patient populations.

Data Collection

The first reviewer performed eligibility assessment for study inclusion with consequent verification by the second reviewer. Disagreement was resolved with consensus after consultation with a third reviewer. Data were extracted in a standardised fashion using pre-determined target endpoints; this included baseline demographics of patient age, patient sex, concomitant procedures and pre-operative New York Heart Association class (NYHA). Clinical outcomes at any time point post-operatively were included for comparison. Discrete considered clinical post-operative outcomes included hospital (or 30-day) mortality, medium and long-term survival, reoperation (for any cause), patient-prosthesis mismatch, structural valve deterioration (SVD), aortic valve regurgitation, endocarditis, thromboembolic and neurologic events, major anti-coagulant associated haemorrhage and LVMR. Clinical outcomes of continuous measure included surgical cross-clamp duration and cardiopulmonary bypass time. Definitions for these clinical outcomes were determined using previously published guidelines [5]. The utilised surgical approach for FSB implantation was additionally documented.

Results

Study Selection

Our search strategy identified 339 articles; 143 of these were excluded after title review revealed the study not relevant. An additional 96 were excluded due to their presence in duplicate. Consequently, 100 abstracts were identified; all abstracts had their reference lists interrogated for further suitable studies, this produced a further 44 for abstract review. An additional 23 studies were identified after discussion with a local expert in the field; in total 167 abstracts were reviewed for potential inclusion. Ninety-six abstracts were excluded due to not meeting inclusion criteria. Seventy-one papers were reviewed in full; 32 of these were additionally excluded producing 39 studies for inclusion. Reasons for exclusion following full review were: conference abstract only (n = 5), patients were in duplicate from an associated included study (n = 6), nil distinction between the FSB and other stentless valve types in results section (n = 9), <100 patients in a case series (n = 6), mathematical model only (n = 1), full text in language other than English (n = 1) and inadequate description of randomisation process (n = 4). Studies from the same research groups were included but only the most recent or available results were utilised. This resulted in three prospective randomised studies for primary analysis [6–8] and 15 case series for secondary analysis [3,9–22]. The literature selection process is illustrated in Fig. 1.