PRO-CON Debate

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Can the Results of Aortic Valve Repair Equal the Results of a Biologic Aortic Valve Replacement?

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Abstract

Aortic valve replacement (AVR) has been the default procedure for the surgical management of aortic valve disease, with repair techniques heterogeneously and infrequently used. However, surgical aortic valve repair has evolved with improved techniques. Yet many questions remain regarding the ideal techniques and real-world applicability and effectiveness of valve repair. The AORTA Great Debate highlighted and discussed the controversies regarding the surgical management of aortic valve disease.

Key Words

Aortic valve replacement · Aortic valve repair · Aortic valve · Aortic valve surgery

Introduction

Type and timing of surgical intervention for significant aortic valve disease continue to be controversial and debated. Historically, aortic valve replacement (AVR) has been the default procedure for the surgical management of aortic valve disease, with repair techniques heterogeneously and infrequently used. However, surgical aortic valve repair has evolved with improved techniques and increased understanding of valve pathology. Yet many questions remain regarding ideal techniques and real-world applicability and effectiveness of valve repair.

The Debate took place at the 2013 Surgery of the Thoracic Aorta (STA) meeting in Bologna, Italy on the 12th of November. The Debate highlighted the aforementioned underlying issues and discussed whether the results of aortic valve repair in different pathologic entities can match the results of bioprosthetic AVR.

As the chairman of the STA meeting, Prof. Di Bartolomeo opened the session with a welcoming note to all the delegates and panel.

The panel of the Debate included Mr. Aung Oo from the Aortic Aneurysm Service at Liverpool Heart and Chest Hospital (LHCH), Dr. Ruggero De Paulis from the Cardiac Surgery Department, European Hospital-Rome, Dr. Michael Borger from the Heart Center Leipzig-Germany, Prof. Gebrine El Khoury from St-Luc Hospital, Belgium, and Dr. Joseph Bavaria from the University of Pennsylvania. The debate was moderated by Dr. John A. Elefteriades of the Aortic Institute at Yale University.

The aim of this article is to provide a transcription of the Debate. A video recording of the Debate is also available via the interactive features of *AORTA* (http://dx.doi.org/10.12945/j.aorta.2014.14.005.vid.01).

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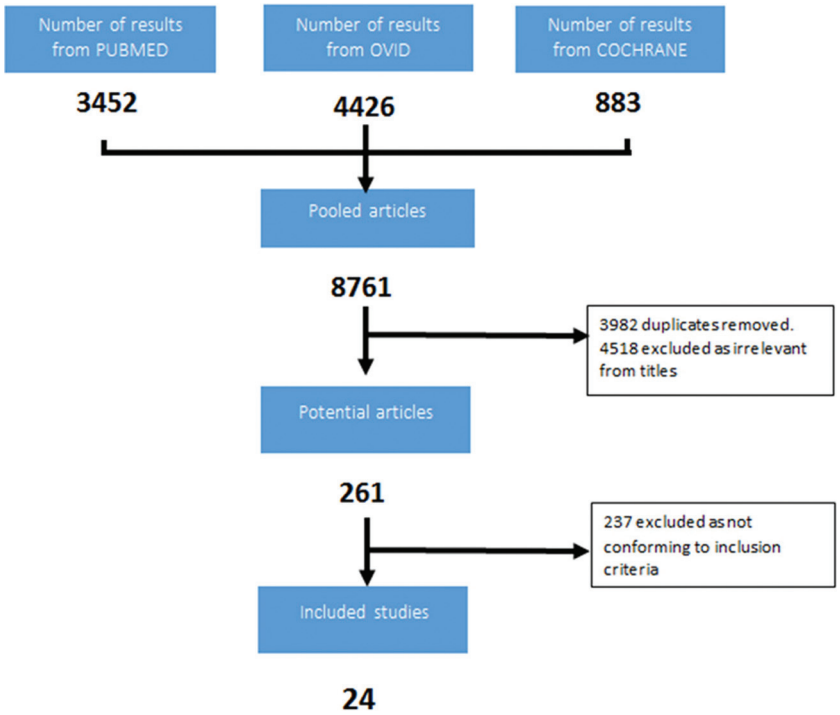

Figure 1. Identified results from 3 databases (PUBMED, OVID and COCHRANE). 24 studies were included in the systematic review and meta-analysis.

Dr. Elefteriades. Good morning. Through the journal *AORTA*, we will be holding regular debates to be published in the journal on important topics in aortic disease. Through this Debate program, we would like to take a thirty thousand foot view of certain issues in our specialty and have experts like we have today assembled to discuss these different issues. For this morning, we have chosen the topic of aortic valve repair and framed it around the question - "Can the results of aortic valve repair equal the results of a biologic aortic valve replacement?"

With these experts here today, we would like to look at a number of specific questions around this topic. I have asked Dr. Mohamad Bashir from LHCH to start off the session by presenting his data from a systematic review and meta-analysis of aortic valve repair (AVRep) in the published literature.

Dr. Mohamad Bashir. Thank you Dr. Elefteriades and good morning Chairman, members of the panel and colleagues.

It is a privilege to be asked by Dr. Elefteriades to present the results of our meta-analysis and I would like to thank also Prof Di Bartolomeo for giving us this excellent opportunity. We have systematically looked at the published literature on aortic valve repair and conducted a meta-analysis from that. Because this will be a brief presentation, I will point out to you the reoperation rates according to etiology, based on bicuspid aortic valve (BAV), cusp prolapse, and aortic root aneurysm. I am just going to set a brief conclusion toward that.

We looked at 8761 papers that reported aortic valve repair pooled from 3 main electronic databases (PubMed, OVID & COCHRANE) (Fig. 1). Out of these 8761 we pulled out 261 papers that potentially matched our inclusion and exclusion criteria. We ended up with 24 relevant papers from which we derived our analysis. All papers reported in-hospital mortality (Fig. 2) and as you can see all papers are listed in the slide. The In-hospital mortality weighted average was 1.46% following aortic valve repair. We also looked at reoperation rates (Fig. 3), and this slide shows reoperation following bicuspid aortic valve repair. These were the papers that mentioned reoperation and as you can see the weighted average is 10.23% with an average follow-up of 4.1 years. This slide shows reoperation following valve cusp prolapse

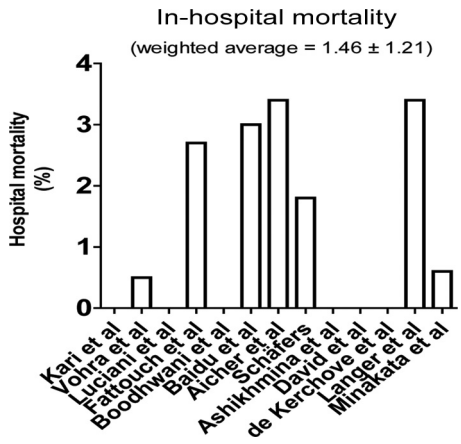

Figure 2. In-hospital mortality per study. (Weighted average is based on study size, average follow up was four years in all studies, studies originated from the same center are assessed and if potential overlap in patient populations occurs, the smaller cohort is removed to avoid duplicate patients.)

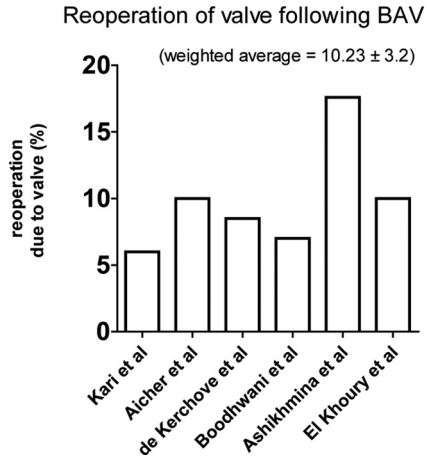

Figure 3. Graph displaying the percentage of patients in each study requiring reoperation due to valve failure. (Weighted average calculated with follow up patient years, average follow up 4.1 ± 0.93 years.)

repair (Fig. 4) and the weighted average for this was 3.83% with an average follow-up of 3.72 years. Moreover, this slide shows also the reoperation on the aortic valve following aneurysm repair (Fig. 5), with a weighted average of 4.25% and an average follow-up of 3.2 years. We concluded that aortic valve repair may be a useful option for selected patients. However, there is a lack of uniformity in data reporting and lack of compelling supportive evidence for valve repair. We obviously encourage an international multi-center study comparing and assessing the results between aortic valve repair and replacement. Thank you.

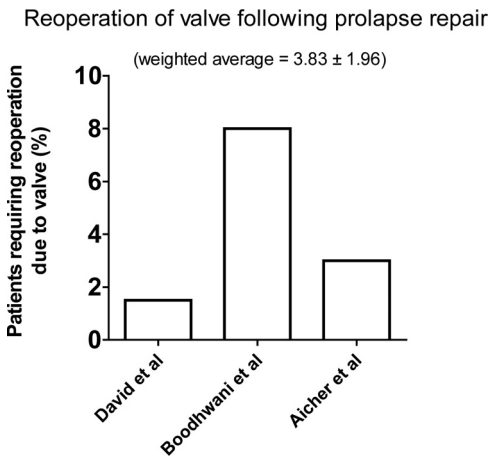

Figure 4. Graph displaying the percentage of patients per study requiring reoperation due to valve failure following prolapse repair. (Weighted average calculated with follow up patient years, average follow up 3.72 ± 0.74 years.)

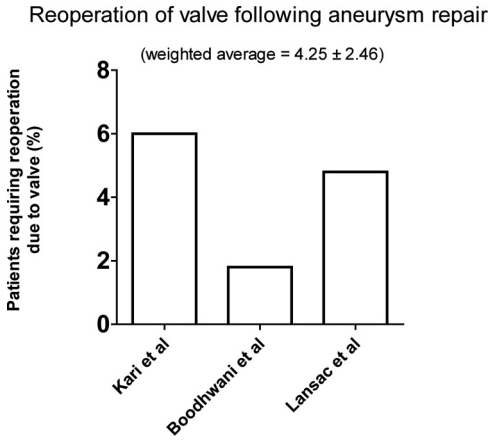

Figure 5. Percentage of patients requiring reoperation due to valve failure following aortic valve repair with concomitant aneurysm repair, average follow up 3.2 ± 0.97 years.)

Dr. Elefteriades. Thank you, Mohamad. Now I would like to frame the discussion for the panel around a number of particular questions. I start out with a quotation that "Several repair techniques have been described to correct aortic valve dysfunction. In contrast to mitral valve repair techniques, few of them have become the gold standard because of the unpredictability of their results." Now this quotation comes from probably the greatest valve surgeon in history, Dr. Alain Carpentier. In particular, it points out that there is a small amount of tissue with a smaller potential surface area of coaptation and this prejudices negatively aortic valve repair compared to mitral valve and tricuspid repair.

I would like to start out by asking the panelists to comment on this. In particular, do you feel that aortic valve repair is in the same league as mitral valve repair or do you share Dr. Carpentier's thoughts about the lack of adequate substrate of tissue for repair?

Prof El Khoury. I think if we look to the aortic valve as a leaflet only, I think Carpentier is right. But nevertheless, I think we should look at the aortic valve not only as a leaflet but also as a functional unit. So, the goal of any valve repair, as Carpentier says, is really the matching between the orifice and the quantity of tissue we have. So if we have less tissue, we reduce the annulus or we add the tissue; the goal is really to restore the match of quantity between the orifice and quantity of tissue. I cannot really agree with Carpentier that what he says is a limiting factor for us. We should really always find the equilibrium between the quantity of tissue and the orifice. That is my opinion.

Dr. Elefteriades. Thank you Dr. El Khoury. I think everyone in this room has tremendous respect for the techniques you have developed and taught. Do we have other comments from the panel on this question?

Dr. De Paulis. I personally think that what Carpentier was meaning is the quality of tissue is different, of course, between the mitral and the aortic valve. The tissue of the aortic valve is much thicker so it's difficult to deal with, and besides the leaflet and the annulus, there are other components present in both. I think for the mitral there are the chordae, which is a component we do not have in the aortic valve—and that is what makes things probably more difficult. Also regarding the quality of tissue, I think there is also a difference between the bicuspid and tricuspid in terms of tissue. That is why sometimes it is easier to repair a bicuspid than a tricuspid valve, because anatomically the geometry is different and also the quality of tissue.

Mr. Oo. The answer to the question is yes. I am sure Dr. Carpentier is right. It is easier to repair a bicuspid valve rather than creating a tricuspid from bicuspid valve. Due to the difference in quality and amount of tissue, aortic valve repair has [a] narrower margin of error. We have seen Professor El Khoury and Professor Schaeffer performing excellent aortic valve repair. We are grateful for their contribution in advancement and progress of aortic valve repair. However, I have to agree with Dr. Carpentier that the margin of error is too much to accept for surgeons like us who started repairing aortic valves.

Prof El Khoury. Only a short answer, I mean it's difficult, it is a little bit confusing to say that bicuspid valve repair is easier to be repaired than the tricuspid. I mean the problem is that I agree that on the level of the leaflet, yes, because we have two lines of coaptation to control. But the big problem in bicuspid is not only the leaflet; it is really the (aortic) root, the annulus. So for me it is much more difficult to have a good valve repair in bicuspid aortic valve than in tricuspid aortic valve. It is really, for me, more difficult. It is not only the problem of the leaflet, but we should take care of the VAJ (ventricular aortic junction), which is really very difficult to treat in bicuspid aortic valve.

Dr. Bavaria. I think the substrate issue is the answer to your question. There is a difference between leaflet surface area availability and substrate. I think you can answer the substrate issue with one simple question or simple observation: How many times in your practice have you ever seen a Marfan's patient need an aortic valve replacement in the absence of an aneurysm? The answer is zero—never. So the substrate and, even the worst patient of all is the Marfan's patient, has nothing to do with need to repair. So if you can take a Marfan's patient, with their crummy substrate, and you put in a normal geometric aortic root, then that valve will last forever, because you never see an isolated aortic valve replacement in the absence of an aneurysm in Marfan's patients. So I do not think the substrate issue has any issue.

Dr. De Paulis. I would like to make another comment regarding what Gebrine just said. It is true when you speak about bicuspid and tricuspid you are speaking about two entities, but while tricuspid is more or less looking the same, bicuspid has [a] lot of variability. So it is true in some cases that it can be easy to repair, so the spectrum of bicuspid is so variable, that probably can make comments different depending on what the presentation of bicuspid is like. The unicuspid we saw yesterday is very different too.

Dr. Elefteriades. Thank you; let us move on to some other particular questions. This is some very recent published data about the longevity of biological valves (Fig. 6), and as we can see, in patients over 70 there is no reoperation whatsoever. In patients

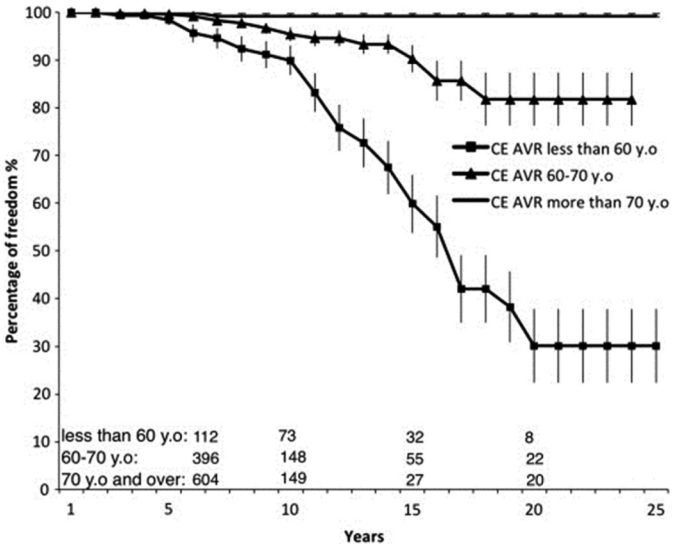

Figure 6. Freedom rate from re-exploration for prosthesis valve dysfunction by age groups (excluding endocarditis) (log-rank: $P = 0.001$); mean ± standard error. (■ = Carpentier-Edwards [CE] aortic valve replacement [AVR] < 60 years old [y.o.]; ▲ = CE AVR 60 to 70 y.o.; — = CE AVR > 70 y.o.) *Reprinted with permission: Forcillo et al., The Thoracic Surgery 2013;96:486-493.*

60-70, results are very good, and even patients less than 60 at 10 years have greater than 90% freedom from reoperation. Let me ask the panel, how do you feel about biological valves in the aortic position? Are you concerned that the poorer performance in younger people is an "Achilles' heel" of the biological valve?

Mr. Oo. In my opinion, biological valves in most of our hands are reliable and predictable. If you look at the recent results published in the paper that you kindly alluded to, as well as the published results of aortic valve repair by Professors El Khoury and Schaffer, demonstrating 90% freedom from structural degeneration at three years, I think biological valves perform better at three years. The second question is if we feel that the results in younger patients are the Achilles' heel of the biological valve. We must not forget that plenty of young patients around the world with mechanical aortic valves are perfectly managed with anticoagulant and are living a normal life.

Dr. Elefteriades. Thank you, Mr. Oo. Any other comments about biological valves?

Dr. Borger. It is well known that younger age is the largest risk factor for premature structural valve deterioration for biological valves and that the results of aortic valve replacement are reproducible. However, one important message from Carpentier's quote is that the long-term results of aortic valve repair are unpredictable and this issue has contributed to its lack of widespread use. But another big problem is the small number of these patients that present for surgery. If you consider the United States, for example, where the average cardiac surgeon does 10 aortic valve replacements per year, one cannot expect the average cardiac surgeon to be an expert in aortic valve repair. So, I would argue if you have a young patient with aortic insufficiency (AI) and pliable cusps, then this patient should be referred to an aortic valve repair specialist.

Dr. Elefteriades. Dr. El Khoury?

Prof El Khoury. The main issue is the selection of patients. Young patients with normal leaflets are excellent candidates for aortic valve repair. We should really highlight the difference, as with the mitral valve, if we have a leaflet problem or annulus problem. The annulus problem for me is the aneurysm, the dilatation of aortic root, sinotubular junction or ventriculo-annular junction. We should really look to this functional aortic annulus exactly the same way as the mitral annulus. So if we are talking about the pathology of [the] annulus of the aortic valve with normal leaflets, the result will be perfectly reliable. That valve will function forever. If you look to the cusp pathology—leaflet pathology, prolapse, calcification, thickening—those are different. So if you are talking only about prolapse with normal leaflets, then I think when you repair the prolapse you achieve immediate good results and the valve will last for a long time. I think we should really insist [upon] now-because this is evolving surgery—the aortic valve repair. We should insist more and more on the selection of patients for aortic valve repair in young patients with normal leaflets or dilated aortic root. This is really my opinion.

Dr. Elefteriades. Thank you. Let's move on (to a) couple other questions. These are very recently published results from Mayo from Dr. Schaff (Fig. 7) applying all of the aortic valve repair techniques, and they show a 20% reoperation rate at 10 years. So I would like to ask the panel: Do you think we can really match the durability of biological valves in the aortic position and how do you feel about a 20% reoperation rate, especially if it's a young patient? How do you feel about these data?

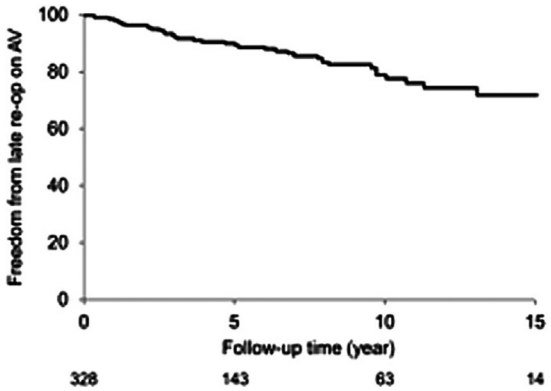

Figure 7. Freedom from Reoperation after Aortic Valve Repair. *Reprinted with permission from: Sharma et al. J Thorac Cardiovasc Surg. 2014 [In press].*

Dr. Bavaria. I think these data are wrong. This is data from way back. Especially bicuspid, but even three cusps aortic valve repair techniques, really have only matured in the last decade, and the results now are so much better than looking at that old commissural operation that they did in Mayo for all these years. I actually don't believe this data, and I think it's irrelevant. It is kind (of) like a text book; it is already gone in history. I think if you look at the newest data, though, about the newest repair techniques, both for bicuspid and three cusps aortic valve, especially if you use reimplantation techniques, the reoperation rates are much lower than what you are seeing here. And also, going back to that last slide, the average age of patients in these aortic valve repair series are in their 40s and tissue valves are not very good for that age group. How I feel about this data, I think it is irrelevant.

Dr. De Paulis. I think if you consider the last slide you showed, I think it shows a 10% reoperation at 10 years for biological valve below the age of 60. Just briefly, there have been published reviews or known results for valve repair, bicuspid or tricuspid. The average at five years was 10% (reoperation) among all the most relevant studies. So now, I think because in recent years many advances (have) been made (in valve repair), at five years the result is the same as biological prosthesis, also at 10 years. The problem is—if we can reach 10 years with the valve repair, it is much better than with bioprosthesis, because after 10 years the bioprosthesis [results] at that age will go steeply (downward).

Dr. Borger. Could you show that slide again as Ruggero is making an excellent point. You don't see the logarithmic increase in structural valve degeneration (SVD) over time, which is the case for biological valves. The only question with biological valves is where the tipping point is and when the logarithmic increase in SVD will occur, when all of the patients will start coming back? You know for the Toronto Stentless Porcine Valve (St. Jude Medical, Minneapolis, MN) it was earlier than for the Perimount (Edwards Lifesciences, Irvine, CA), for example. And what Ruggero said was very true; a repaired valve that is still functioning at 10 years is very good because it will probably continue to function well for a long time, and you have the added benefit of very low risk of endocarditis and other complications.

Dr. De Paulis. Reoperation is better after valve repair than after failed bioprosthesis at 10 years; that is the main point. Because, after 10 years, the biporostheses (results) below the age of 60 really go very steeply down, while for valve repair it is probably not the same steepness; or, the steepness of the curve is different, but the result of the reoperation is probably better because it is easier with less complications than standard removal of a bioprosthesis.

Dr. Bavaria. The other thing about these young patients has to do with the concept of prosthesis—patient mismatch (PPM). If you take these young patients with quite high cardiac output, and even if you put a standard valve, whether it is mechanical or tissue, you would be surprised at the amount of mild to moderate PPM that you see in these patients. You almost never see that in any valve repair procedures. So, it (is) more than just durability, it is a lot of other issues—hemodynamic, freedom (from) endocarditis, and all sorts of things that are probably superior in (the) reparative group.

Dr. Elefteriades. These are all very important points. Let me move on to a couple more questions. Basically all the experts have made major changes in their techniques of repair within the last ten years, just to the point you were making that some of the old data have been outmoded. What are the implications for patients treated earlier, and do we know that our new, current techniques will be durable? Can I have some comments on that, please?

Mr. Oo. Can I start with that. We are mixing up different patient groups here. I have no problem with the valve reimplantation (David) procedure. These are

(a) different group of patients compared to the group where you perform leaflet repair. If you perform a good reimplantation procedure, I have no doubt that the operation would be durable. This is a technique that we should teach surgeons to perform to a high standard. However, the leaflet repair techniques and annuloplasty techniques, over the last decade, have undergone so many modifications. These techniques have been evolving with variable results even in the best hands. We can still see three year results of valve repair with the freedom from structural dysfunction of 90%. It would be worse in the hands of average surgeons like me. Therefore, at this time point in the aortic valve repair era, I do not think that the leaflet repair on its own will be durable.

Prof El Khoury. I agree, and if you go back to the last slide, I do not know about what patients they are talking about. That is really the problem now in aortic valve repair and the entire published articles. I think some years ago I wrote a paper about the comparison between mitral and aortic repair; and if you want to progress in our communications and in our aortic valve work, I think we should know what we are talking about. If you look into the sparing surgery, for me that is an annulus problem; so then we talk about only (an) annulus problem, like the mitral. And, if you talk about the leaflet, then that is another problem. So, look at the mitral prolapsed P2 segment, we know what that is; but what is the equivalent on the aortic side? We should look at the prolapse case of yesterday. So, we should really know what we are talking about, and that is the big problem in aortic valve repair. We should have analogous work when talking about valve repair. When you see the 20% recurrence following aortic repair operation, I do not know if it was aneurysm, rheumatic, endocarditis, calcific, bicuspid or tricuspid. We do not know. I think in order to progress we should now separate when we talk about valve-sparing surgery, about tricuspid aortic valves, about prolapse, about rheumatic vales, so in that way we can compare our results meaningfully. Really, going forward we need to focus on identifying the excellent candidate for valve repair regarding the most appropriate surgical techniques, yielding the most appropriate immediate results. We know that was necessary for mitral valve progress, and in order to progress on the aortic side, we should do the same work and focus on the pathology and the selection of patients and see about what we are talking.

Dr. Elefteriades. Let me ask one more question before I invite each panelist to give his summary. If there is mild or moderate aortic insufficiency after aortic valve repair, are you concerned about that? Are you concerned that it may be dangerous, like what we are seeing for AI after Transcatheter Aortic Valve Implantation (TAVI)?

Dr. De Paulis. In our analysis of the aortic valve sparing operation, the most important finding, or variable, was the AI after operation, meaning that if you accept 2+ AI that is not central, then you will have bad results in the long term.

Dr. Borger. Residual AI is a very suboptimal result, but it does not lead to decreased survival. In TAVI patients, AI does affect survival because the AI is acute. A hypertrophied left ventricle that has been pumping against a stenotic, but not insufficient, valve for the last 20 years very poorly tolerates new AI. It is a dangerous situation for these patients. Patients presenting for aortic valve repair surgery, however, have had AI for many years and therefore mild to moderate AI is not going to have a significant impact on their survival. But it does result in these patients coming back earlier for reoperation. So, that brings us back to the previous question regarding the unknown durability of newer repair techniques. The best way to ensure durability is to make sure you have as little AI as possible at the end of the operation, and then you are more confident that the repair is going to be durable no matter what technique you used to get there. But it involves also learning from our colleagues. Even Joachin Schaefers, who is the world('s) biggest supporter of the Yacoub operation, admits that his colleagues have convinced him that you should not perform a Yacoub operation if the patient's annulus is more than 27 mm. What we learned from Gebrine's group is that if there is residual cusp prolapse, even if the valve is competent, that has a negative effect on durability. So it is a constant learning process and we are also learning from each other.

Prof El Khoury. I totally agree. The big problem is to see what residual regurgitation you have. If we have eccentric regurgitation, we should have zero tolerance for that, if you have an eccentric jet. If you have a central jet with a good coaptation, with a good

Table 1. Overall response from the panelists and the audience. Can the results of aortic valve repair equal the results of a biologic aortic valve replacement?

Mr. Oo	Dr De Paulis:	Prof El Khoury:	Dr Borger:	Dr Bavaria:	Audience:
No	No	Yes	Yes	Yes	No

configuration of the leaflet, I think this one is not so hard for the future. Again we have our echocardiographers, we have our cardiologists in the OR and our anesthesiologists; they should do an excellent echo and the echo should be excellent in the OR, and if you have any eccentric jet you should not accept it. That is really the message.

Mr. Oo. One thing to add though: over the years, in the name of advancement, we've accepted more and more imperfect operations. When we started with TAVI, it was stated that mild paravalvular leak was acceptable, so as with mild and then moderate mitral regurgitation after mitral valve repair. There (is) now evidence of poor prognosis with AI following TAVI. We should not go along with the same statement that aortic valve repair is good (with residual AI). We should not be accepting patients leaving theater with mild to moderate aortic regurgitation as I have no doubt that it will affect left ventricular function over (the) next three to five years.

Dr. Elefteriades. These are all valuable comments. Let me, in concluding, just go down the panel and ask you to give me a "yes" or "no" answer about whether you feel aortic valve repair can equal the results of a biological prosthetic aortic valve. Do you want to start, Mr. Oo and go down the panel can you give me please a yes or no answer and a brief concluding comment? [See Table 1 for the panelists' responses.]

Mr. Oo. Since we cannot categorize different groups in the aortic valve repair patients, I will answer for the repair in general. In my opinion, aortic valve repair cannot be equal to the results of biological valve at this moment in time.

Dr. Elefteriades. What was the answer?

Mr. Oo. No.

Prof El Khoury. (With appropriate) selection of patients and appropriate surgical techniques applied to the patients, I'm convinced that aortic valve repair is even better than bioprosthesis.

Dr. De Paulis. I will say no depending on the age. Let us say at the age of 65-70, I will say repair cannot be equal to a biologic valve replacement; it is not worth it. But in the younger patient population, it is worth a try because techniques are getting close to that point, and any necessary redo operation will be much easier.

Dr. Borger. I say yes if the cusps are pliable and if it is done in a referral center.

Dr. Bavaria. I think anybody who has pure AI, no calcification, bicuspid or tricuspid aortic valve repair is not only equal, but superior at all age groups compared to a biological prosthesis. I remember 20 years ago, 15 years ago when we said "Oh, we are not going to do a mitral valve repair in a 75 year old". That is history.

Prof El Khoury. One last item, maybe we should also talk about the survival of the patients and young patients. The survival when we have a prosthesis is much less than aortic valve repair. We forgot to talk about the survival. When you have a prosthesis—a lot of patients disappear.

Dr. De Paulis. Yes, but I think in survival the conditions of the patients are different, that is what influences the survival. Not the technique, but the general condition of the patients.

Prof El Khoury. The young patients survive better.

Dr. Borger. There is a 10% survival gap in biological valve patients compared to normal age-matched population that nobody can explain. That is, an additional 10% of patients are dead 10 years postoperatively and nobody knows why. And that does not seem to be the case for aortic valve repair or for the Ross operation.

Mr. Oo. May I ask a few questions to the audience, please?

Dr. Elefteriades. Please.

Mr. Oo. You have seen the great surgeon(s) who have developed the techniques on valve repair, operate on two cases. First of all, I would like to know—how many of you perform regular aortic valve

repair? Could you give me a show of hands, please? Maybe 10-12 people in the audience.

Prof El Khoury. Some years ago it was two!

Mr. Oo. And the next question I would like to ask is—how many of you perform more than 20 aortic valve repairs per year? Maybe 10? How many of you perform more than 20 bioprosthetic valve replacements per year? Everybody in the audience. The final question is—if you are 50 year(s) old and have aortic valve disease with some calcification and thickening (like yesterday's first case), would you like your valve to be repaired or replaced? How many in favor of repair? One. How many want valve replacement? Majority. I rest my case.

Dr. Elefteriades. We got some animation from the panel here in this debate. I want to thank all the panelists for sharing their expertise with us. Thank you!

Conflict of Interest

The authors have no conflict of interest relevant to this publication.

Comment on this Article or Ask a Question

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