

An Audit of Anticoagulation Practice among UK Cardiothoracic Consultant Surgeons following Valve Replacement/Repair

Paul Vaughan¹, Paul D. Waterworth²

¹Department of Thoracic Surgery, Glenfield Hospital, Leicester, ²Department of Cardiothoracic Surgery, Wythenshawe Hospital, Manchester, UK

Background and aim of the study: In 1998, the American College of Cardiology and The American Heart Association (ACC/AHA) published guidelines for the postoperative anticoagulation of patients who have undergone heart valve replacement. The American College of Chest Physicians made similar recommendations in 2001. The present survey was conducted to review anticoagulation practice among UK consultant cardiac surgeons, and to assess compliance with these guidelines.

Methods: An anonymous postal questionnaire was distributed to 185 adult cardiac surgeons identified from the Society of Cardiothoracic Surgeons of Great Britain and Ireland (SCTS).

Results: The analysis was based upon 97 replies. All consultants use lifelong warfarin after mechanical valve replacement. In general, target INR ranges were lower for aortic valves compared with mitral valves. Some 53% (51/97) of consultants never use warfarin after bioprosthetic aortic valve replacement (AVR), compared with 33% (28/86) after bioprosthetic

mitral valve replacement (MVR). Temporary (≤ 3 months) warfarin is used by 47% (46/97) of consultants after bioprosthetic AVR and by 63% (54/86) after bioprosthetic MVR. Some 64% (52/81) of consultants use warfarin after mitral valve repair, when an annuloplasty ring is inserted. This was always temporary (≤ 6 months). Aspirin is used long term by 54% (44/82) of consultants after mitral valve repair.

Conclusion: All consultant cardiac surgeons adequately anticoagulate their patients after mechanical valve replacement. Only 16% (16/97) of cardiac surgeons follow current guidelines for the postoperative anticoagulation of bioprosthetic AVR. Only 28% (24/86) of consultant cardiac surgeons comply with guidelines for bioprosthetic MVR. No guidelines exist for the anticoagulation of patients after mitral valve repair. Guidelines need to be reviewed for the anticoagulation of patients undergoing bioprosthetic valve replacement and formulated for patients undergoing mitral valve repair.

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Although the use of warfarin in the postoperative management of mechanical valve replacement is beyond doubt, anticoagulation following bioprosthetic valve replacement remains the subject of controversy. The decision whether to use anticoagulation or antiplatelet therapy, and the duration and level of anticoagulation are all areas of debate. Guidelines were published by the American College of Cardiology/American Heart Association (ACC/AHA) in 1998, and have been added to The Society of Cardiothoracic Surgeon's website (1). More recently in 2001, recommendations were made following the Sixth American College of Chest Physicians (ACCP) consen-

sus conference on antithrombotic therapy (2). The European Society of Cardiology is currently updating their 1995 guidelines for the management of patients following heart valve surgery (3).

The present audit was carried out in order to review the anticoagulation regimen used by UK consultant cardiothoracic surgeons in their valve replacement and repair practice. Their compliance with the latest published guidelines was also ascertained.

Materials and methods

A literature search was performed to determine the current guidelines for anticoagulation of mitral valve repair with or without annuloplasty ring. The key words used were: annuloplasty, anticoagulation, guidelines, warfarin, and mitral valve repair.

A postal survey was undertaken to establish the views of all UK cardiothoracic consultants. The object

Address for correspondence:
Mr. P. Vaughan, Department of Thoracic Surgery, Glenfield Hospital,
Groby Road, Leicester LE3 9QP, UK
e-mail: paul_vaughan@hotmail.com

of the survey was to obtain a picture of the current practice of anticoagulation for mechanical valves, bio-prosthetic valves and valve repair. This was then compared against the national/international guidelines for best practice (1-3).

The questionnaire was designed to be easy and quick to complete (see Appendix I). Questionnaires were distributed, enclosing a reply-paid envelope to encourage quick replies and thus increase the response rate. A total of 185 consultants was identified from the Society of Cardiothoracic Surgeon's of Great Britain and Ireland, and sent questionnaires. A second questionnaire was sent to those initial non-responders one month after the first was distributed. The responses were then collated and analyzed. Where published guidelines exist, overall compliance with the guidelines was assessed.

Results

Of the 185 questionnaires distributed, 112 were completed and returned. Of these, a further 15 were excluded (12 thoracic practice only, one retired, one on sick leave, one pediatric surgical practice only). Thus, a total of 97 questionnaires was used in the analysis; this included at least one consultant from every center in the UK (52% response rate).

Mechanical valves

All of the consultants surveyed confirmed that they perform mechanical valve replacement. Some respondents expressed more than one preference, however, with the preferred valve in both the aortic (108 responses) and mitral (103 responses) positions being the Sorin (23% aortic, 25/108; 25% mitral, 26/103). This was followed by St. Jude Medical (19%, 20/108 and 21%, 22/103, respectively) and CarboMedics (17%, 18/108 and 18%, 19/103, respectively).

The remainder of the responses were made up of ATS (n = 17), Medtronic Hall (n = 5), Top Hat (n = 4),

Aortech (n = 4), Ultracor (n = 4), ON-X (n = 4), Starr-Edwards (n = 2), MIRA (n = 2), bileaflet-no preference (n = 2) and others (n = 37).

All 97 consultants started warfarin immediately postoperatively, to be continued for the life of the patient. Aspirin was only used if there had been concomitant procedures performed (e.g. coronary artery bypass graft) or thromboembolic events (e.g. transient ischemic attack) had occurred whilst adequately anticoagulated with warfarin.

The guidelines from the ACC/AHA and ACCP state that, for a mechanical aortic valve replacement (AVR), the INR should be maintained between 2.0 and 3.0 for a bileaflet valve (second generation), and between 2.5 and 3.5 for a first-generation valve (e.g. Starr-Edwards or Björk-Shiley). For both first- and second-generation mechanical mitral valve replacement (MVR), the desired range for the INR is 2.5-3.5.

The desired INR range after mechanical valve replacement, as quoted by the respondents, is illustrated in Figure 1.

Bioprosthetic valves

All 97 consultants confirmed that they perform bioprosthetic AVR, but only 86/97 (89%) perform bioprosthetic MVR. The preferred prosthesis for both positions (some respondents expressed more than one preference) was the Perimount, with 24/107 (22%) for valves in the aortic position and 19/86 (22%) for the mitral position. The Mitroflow (12%, 13/107) and Carpentier Edwards (11%, 12/107) were the other most common choices for bioprosthetic AVR, while the Carpentier Edwards (19%, 16/86) and Medtronic Mosaic (6%, 5/86) were the other choices for bioprosthetic MVR.

The postoperative anticoagulation management of these patients is detailed in Tables I and II, whilst the range of INR values quoted after bioprosthetic valve replacement is illustrated in Figure 2.

The ACC/AHA recommends that for bioprosthetic

Table I: Postoperative anticoagulation regimen following bioprosthetic valve replacement.

Anticoagulation regimen	Aortic valve replacement (n = 97)	Mitral valve replacement (n = 86)
Lifelong warfarin	0	4 (5)
Warfarin + aspirin together	6 (6)	3 (4)
Temporary warfarin, then nil	24 (25)	27 (30)
Temporary warfarin, then aspirin	16 (16)	24 (28)
Aspirin alone	40 (41)	19 (22)
No warfarin, no aspirin	11 (11)	9 (11)

Values in parentheses are percentages.

Table II: Duration of warfarin therapy following bioprosthetic valve replacement.

Duration of therapy	Aortic valve replacement (n = 97)	Mitral valve replacement (n = 86)
Never use warfarin	51 (52)	28 (33)
6 weeks	14 (15)	15 (17)
3 months	30 (31)	36 (42)
6 months	1 (1)	1 (1)
Lifelong	0	4 (5)
Other	1 (1)	2 (2)

Values in parentheses are percentages.

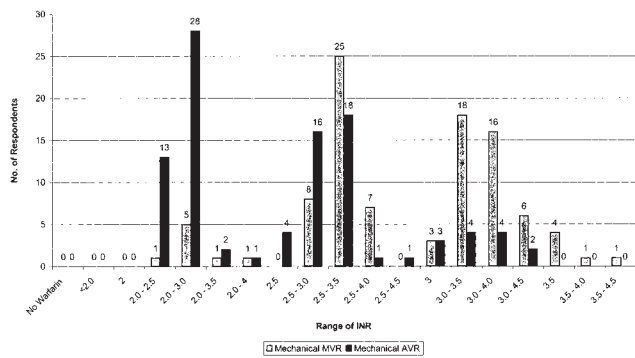


Figure 1: Range of INR for mechanical valve replacement. AVR: Aortic valve replacement; MVR: Mitral valve replacement.

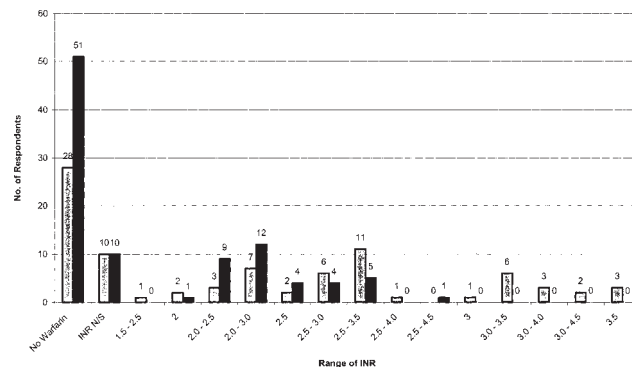


Figure 2: Range of INR for bioprosthetic valve replacement. Abbreviations as Figure 1.

AVR and MVR, without risk factors, warfarin (INR range 2.5-3.5) should be commenced for the first three months postoperatively, after which aspirin alone is sufficient. The ACCP also recommends warfarin initially, followed by aspirin, though the INR range is slightly lower at 2.0-3.0.

It appears that only 16 consultants (17%) are following the above guidelines by using temporary warfarin followed by aspirin in the postoperative management of bioprosthetic AVR. However, 30/46 (65%) consultants who use warfarin postoperatively do so for the appropriate period of time. Of the 46 consultants who prescribe warfarin postoperatively, 35 (76%) would comply with the ACC/AHA guidelines, and 30 (65%) with the ACCP guidelines.

Only 28% of consultants (24/86) who perform bioprosthetic MVR appear to comply with these guidelines by prescribing temporary warfarin followed by aspirin. However, 62% (36/58) use warfarin postoperatively for an appropriate period of time. Of the 58 consultants who prescribe warfarin postoperatively, 41 (71%) would comply with the ACC/AHA guidelines, and 19 (33%) with the ACCP guidelines.

Mitral valve repair with annuloplasty ring

The literature search did not find any published guidelines for the postoperative anticoagulation of mitral valve repair with or without annuloplasty. Thus, the current practice was surveyed.

Most consultants (81/97, 84%) would repair the mitral valve using an annuloplasty ring; 15 would not perform the procedure, and there was a single non-responder. The most common type of ring employed was the Carpentier Edwards (13/81, 16%). Other preferences included Cosgrove (12, 15%), Physio (11, 14%), Duran (4, 5%), Annuloflex (3, 4%) and MVRS (3, 4%). No preference was expressed by 35 respondents.

The postoperative management of these patients is detailed in Tables III and IV.

Mitral valve repair without annuloplasty ring

Unlike the above procedures, only 46/97 (47%) of consultants confirmed that they perform mitral valve repairs without using an annuloplasty ring. The post-operative management of these patients is detailed in Tables III and IV.

Aspirin usage

When aspirin is used in patients who have undergone valve replacement or repair, it tends to be given for the rest of the patient's life; this was the case for 57/97 (59%) of the consultants. However, 33/97 (34%) of the consultants do not use aspirin after any valve replacement or repair. The remaining 7/97 (7%) tend to use it mainly for three months after bioprosthetic replacement.

When recorded (by 64 of 97 consultants), the regimen was uniformly low-dose aspirin, with 41 of the 64 consultants (64%) prescribing 75 mg per day and 18 (28%) prescribing 150 mg per day. The remaining 6% prescribed 300 mg per day.

Discussion

Warfarin is currently one of the most frequently prescribed drugs in the USA. It is used to treat a variety of conditions including deep venous thrombosis, pulmonary embolism and atrial fibrillation, as well as postoperatively for patients undergoing valve replacement. All anticoagulant drugs however have a narrow therapeutic window, below which they are ineffective with associated risks of thromboembolism, and above which there is an increased risk of hemorrhage.

The decision to anticoagulate a patient using warfarin can be multifactorial, especially for bioprosthetic valve replacement, valve repair or annuloplasty, and is based on such factors as age, the presence or absence of atrial fibrillation (AF), the duration of AF, left ventricular dysfunction, left atrial dimensions at echocardiog-

Table III: Postoperative anticoagulation regimen following mitral valve repair.

Anticoagulation regimen	Mitral valve repair	
	Without ring (n = 46)	With ring (n = 81)
Lifelong warfarin	0	0
Warfarin + aspirin together	0	2 (2)
Temporary warfarin, then nil	11 (24)	28 (35)
Temporary warfarin, then aspirin	5 (11)	22 (27)
Aspirin alone	18 (39)	20 (25)
No warfarin, No aspirin	12 (26)	9 (11)

Values in parentheses are percentages.

raphy, previous thromboembolism, and hypercoagulable state. The questionnaire asked the surgeon to assume that the patient is in sinus rhythm and did not undergo any concomitant procedure, thus assessing the anticoagulation requirements based on the type of operative procedure alone, as well as simplifying the whole questionnaire.

However, the anticoagulation regimen vary according to the surgeon's preference, the position of valve replacement and the nature of the valve (mechanical or bioprosthetic), as well as other risk factors including left atrial dimensions and left ventricular function (1).

The use of warfarin in the postoperative management of mechanical valve replacement is beyond doubt. A retrospective study in Denmark where, between 1972 and 1982, 43 patients were anticoagulated for only 12 months, led to unacceptably high levels of thromboembolic events (4).

Both the ACC/AHA and ACCP recommend lifelong oral anticoagulation for all patients with mechanical valves (grade 1 evidence). Unfortunately, determining the optimum INR is more difficult, because the safety and efficacy of a given INR range is reported on the basis of an intention to treat rather than the actual INR achieved. Because most studies are retrospective, the patient's optimal range of INR, according to their individual risk factors, is not taken into account.

For the first three months after valve replacement, the ACC/AHA recommends an INR range of 2.5-3.5 with either type of prosthesis or valve location. This is presumably to counteract the higher risk of embolization, before the valve is fully endothelialized. Both the ACC/AHA and ACCP recommend that, in the long term, for a second-generation mechanical valve, without risk factors, an INR of 2-3 for the aortic valve, and 2.5-3.5 for the mitral valve replacement, is sufficient. In the presence of risk factors and a mechanical aortic prosthesis, the advice is either to increase the INR range to 2.5-3.5, or to add low-dose aspirin (80-100 mg/day).

Table IV: Duration of warfarin therapy following mitral valve repair.

Anticoagulation regimen	Mitral valve repair	
	Without ring (n = 46)	With ring (n = 81)
Never use warfarin	30 (65)	29 (36)
6 weeks	9 (20)	20 (25)
3 months	7 (15)	30 (37)
6 months	0	1 (1)
Lifelong	0	0
Other	0	1 (1)

Values in parentheses are percentages.

The recommendations from the ACC/AHA and ACCP are to commence all bioprosthetic valve patients on warfarin for the first three months (grade 1C+ recommendation for MVR and grade 2C recommendation for AVR). After this period, low-dose aspirin is recommended for thromboembolic prophylaxis. Bioprosthetic valve replacement produced the greatest variety of management techniques, and hence is a source of controversy. According to Heras et al. (5), without anticoagulation, bioprosthetic MVR is associated with a higher incidence of thromboembolism. This is borne out by the higher range of quoted INR and the greater incidence of warfarin usage among UK consultants when mitral valves are replaced compared with aortic valves. The evidence for anticoagulation of bioprosthetic AVR is less compelling. The retrospective study by Moinuddeen et al. (6), reported no advantage in the prevention of ischemic cerebral events, by early anticoagulation after bioprosthetic AVR. This is based on no significant difference being found between patients anticoagulated postoperatively, and those treated with antiplatelet therapy alone. Interestingly, despite the higher rate of early events found by Moinuddeen et al. (2.6%) compared to Heras et al. (1.2%), these groups arrived at opposite conclusions. Ultimately, there is no compelling evidence to support either view, and for bioprosthetic AVR it is likely to continue to be the surgeon's preference.

A literature search of Pubmed and Medline failed to find any guidelines for the postoperative management of mitral valve repair. The management described by Carpentier et al. (7) was to anticoagulate all patients with warfarin for a two-month period postoperatively. Unfortunately, a prothrombin (PT) ratio or INR range was not mentioned. After a ten-year follow up, Carpentier reported a thromboembolic rate of 0.6% per patient-year, all of which were transient, even though 48% of the patients had been without anticoagulation since the end of the two-month postoperative period.

Other studies have since also involved a similar duration of anticoagulation in patients (8). From this it can be inferred that very little anticoagulation is required for patients who have undergone mitral valve repair, in whom there are no risk factors for thromboembolism.

Ultimately the management of patients after heart valve replacement is undertaken by a multidisciplinary team, comprising cardiologists, cardiac surgeons, hematologists and anticoagulation nurses. In the present review, only one facet of this team has been audited, and it is possible that future investigations should be directed at all participants, including the patients.

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Appendix I: Questionnaire.

Please answer all questions regarding your current practice with either a tick or a cross in the appropriate box.

1. Which of the following do you perform?

Procedure	Yes	No	Which is your preferred prosthesis?
Mechanical AVR			
Bioprosthetic AVR			
Mechanical MVR			
Bioprosthetic MVR			
Mitral valve repair without annuloplasty ring			
Mitral valve repair with annuloplasty ring			

2. What is the level of anticoagulation with warfarin for heart valve replacement or repair with your preferred prosthesis? Assume that the patient is in sinus rhythm.

Procedure	Range of INR
Mechanical AVR	
Bioprosthetic AVR	
Mechanical MVR	
Bioprosthetic MVR	
Mitral valve repair without annuloplasty ring	
Mitral valve repair with annuloplasty ring	

3. Do you use any anticoagulant other than warfarin? If so what would you use?

4. What is the duration of anticoagulation with warfarin? Assume that the patient is in sinus rhythm.

Procedure	Never use	6 weeks	3 months	6 months	1 year	Lifelong	Other
Mechanical AVR							
Bioprosthetic AVR							
Mechanical MVR							
Bioprosthetic MVR							
Mitral valve repair without annuloplasty ring							
Mitral valve repair with annuloplasty ring							

5. When do you use aspirin in your heart valve replacement/repair practice?

Assume that the patient is in sinus rhythm.

Procedure	Never	Starting immediately post op	After 6 weeks warfarin	After 3 months warfarin	Other
Mechanical AVR					
Bioprosthetic AVR					
Mechanical MVR					
Bioprosthetic MVR					
Mitral valve repair without ring					
Mitral valve repair with ring					

6. What dose of aspirin would you use?

Procedure	75 mg once/day	150 mg once/day	300 mg once/day	Other
Mechanical AVR				
Bioprosthetic AVR				
Mechanical MVR				
Bioprosthetic MVR				
Mitral valve repair without ring				
Mitral valve repair with ring				

7. Would you ever use other antiplatelet agents such as clopidogrel or dipyridamole instead of aspirin? If so when?

8. Assuming that the patient is in sinus rhythm, for how long do you continue the aspirin?

Procedure	Never use aspirin	6 weeks	3 months	6 months	1 year	Lifelong	Other
Mechanical AVR							
Bioprosthetic AVR							
Mechanical MVR							
Bioprosthetic MVR							
Mitral valve repair without ring							
Mitral valve repair with ring							