



Utility of Peri-Operative Chest Radiographs Prior to Elective Cardiac Valve Replacement Surgery: A Retrospective Cohort Study

John Troupis^{1,2} and Matthew Van Wees^{1*}

¹Monash Imaging, Monash Health, Australia

²Department of Medical imaging and Radiation Services, Monash University, Australia

*Corresponding author: Matthew Van Wees, Doctor, Monash Medical Centre, 246 Clayton Road, Clayton, Melbourne, Vic, Australia, Tel: 95946666; Email: matthew.vanwees@monashhealth.org

Research Article

Volume 6 Issue 1

Received Date: February 15, 2022

Published Date: May 12, 2022

DOI: 10.23880/crij-16000191

Abstract

Purpose: Peri-operative chest radiographs (POCXR) are routinely ordered prior to elective valve replacement but there is currently no data to support this practice. We postulated that surgical management was not altered due to these radiographs.

Method: The medical records of patients 18 years and over admitted to our institution between 2020 and 2015 for isolated valve replacement surgery were inspected to determine if their management was changed (delayed surgery, new pathology not known etc) due to a POCXR, along with demographic data, chest radiograph findings and other imaging modality data.

Results: 208 patients fit the inclusion criteria; all had POCXR. No patients had alteration to surgical timing or procedure based on the POCXR findings. We did find that 4 patients had alterations due to CT findings. 102 patients had CT and POCXR, with 88 patients having a CXR on the same day as or post CT scan. 11 patients had CT findings that warranted further investigation, which was not the case with CXR findings. 4 patients had surgical management altered due to CT scan findings.

Conclusions: Our study demonstrated no utility for pre-operative CXR in elective valve replacement surgery. It is noteworthy that CT scanning did change surgical management and further altered medical management in 15 patients. This warrants further investigation.

Keywords: Peri-Operative; Chest Radiograph; Valve Replacement, Elective Surgery

Introduction

Cardiac valve surgeries are commonly performed procedures in Australia, with over 10,000 such procedures occurring per year, with this number continually increasing [1]. The workup for these patients is extensive, and includes multiple imaging modalities [2]. Echocardiography (ECHO) plays a pivotal role in disease diagnosis and monitoring, whilst computed tomography (CT) and magnetic resonance imaging (MRI) also contribute to surgical planning [2]. Peri-operative chest radiographs (POCXR) however, whilst

still recommended in international guidelines [3], would seem to have decreasing utility as other modalities are increasingly utilised for peri-operative assessment and disease monitoring.

At our institution, POCXR is routinely ordered for patients prior to cardiac valve surgery, and anecdotally has very few findings. A brief literature review indicates that the routine use of pre-operative chest radiographs in patients undergoing other surgical procedures without a clear indication for such are of little value, only altering management of patients in a

minute amount of cases whilst exposing the patient to excess radiation and adding to the healthcare budgetary costs [4-6]. This study aims to determine if there is utility of POCXR prior to elective valve surgery.

Aim

To determine the utility of CXR prior to elective isolated valve replacement surgery in patients over the age of 18 years old.

Design

A single centre, retrospective cohort study of patients over the age of 18 years old undergoing elective isolated valve surgery at a tertiary hospital in Melbourne, Australia.

Inclusion Criteria

To be included in our study, patients must have met the following criteria:

- Only valve surgery undertaken; this may include replacement of multiple valves, replacement and repair of multiple valves
- Only elective procedures
- Patient must have been over 18 years of age at the time of surgery.

Exclusion criteria

Patients were not included in our study if they fit into any of the following criteria

- Under the age of 18
- Presented to the emergency department for admission into the hospital due to new or worsening disease (fevers, infective endocarditis, worsening shortness of breath, chest pain, collapse)
- Underwent valve replacement surgery and coronary artery bypass grafting concurrently
- Underwent emergency valve replacement (for dissection, infective endocarditis)

Methods

Cardiothoracic surgical records were examined to identify patients who underwent isolated valve surgery between June 2020 and August 2015. The medical records of these patients were then accessed to attain demographic data including previous cardiothoracic intervention or previous malignancies, as well as peri-operative imaging choices and their results including CXR, CT, MRI and echocardiography (echo). The patient's medical records were assessed to determine if there was a delay to the surgery following the CXR. These results were then quantitatively analysed. Ethics approval was obtained prior to initiating our study.

Results

332 patients were found who had undergone isolated valve surgery at our institute in the specified period. 124 were removed due to requiring emergency surgery (infective endocarditis, acute presentation to the emergency department for shortness of breath requiring valve replacement, aortic aneurysm dissection), leaving 208 patients for inclusion into this study. The average age was 64.6 years (67 median), and 61% were male. All patients had a POCXR, with the most common findings being a normal study with nil findings (42%), cardiomegaly (22%), calcified atheroma (14%) or a combination of the two (9%). The most common valve involved was the aortic valve (70%), followed by the mitral valve (19%). 8.6% of patients had procedures involving two valves. All patients had pre-operative echocardiograms. 49% of patients had CT scans, with the breakdown of type shown in Table 1. 29 patients had a history of previous cardiothoracic surgery, and of these 55% had a 4D-CT to assess for tethering. MRI was only ordered in 3 patients, all of whom received pulmonary valve replacements, the only three such patients.

Of the 38 patients who had a CTCA, 27 were able to avoid an angiogram, a huge saving to the health budget and avoiding the risks associated with angiography. 4 patients had alterations to surgery due to CT results, changing from TAVI to open procedures.

Characteristics	
Age, median (IQR), years	67 (17)
Sex, No./total (%)	
Male	127/208 (61%)
Female	81/208 (39%)
Prior cardiothoracic intervention, No./total (%)	29/208 (14%)
Underwent 4DCT No./Prior cardiothoracic intervention (%)	16/29 (55%)
Previous malignancy, No./total (%)	28/208
Bowel cancer	8

Haematological	4
Melanoma	4
Prostate	3
SCC	3
Parotid	1
Pituitary	1
RCC	2
Thyoma	1
Bladder	1
Patient with CT imaging (No of patients)	
Any CT	102
CT Coronary angiogram (CTCA)	38
CT angiogram (CTA)	38
4DCT	17
CT chest/HRCT	9
CXR done on day of procedure (No of patients)	9
CXR done day prior to procedure (No patients)	41
CXR and CT done on same day (No patients)	4
CT done prior to CXR (No patients)	84
Average Number of days CT done prior to CXR (average, median)	140, 46
CXR done prior to CT	14
Average number of days CXR done prior to CT	36.5
Patients with MRI, No./total (%)	3/208 (1.5%)
Valve operated on (No patients)	
Aortic	145
Mitral	40
Tricuspid	2
Pulmonary	3
Aortic and mitral	11
Aortic and tricuspid	1
Mitral and tricuspid	5
Pulmonary and tricuspid	1
Smoking status (No patients)	
Smoker	29
Ex-Smoker	76
Non-Smoker	103
Type of surgery	
Open, No./total (%)	204/208 (98%)
TAVI, No./Total (%)	4/208 (2%)
Angiogram prior, no/Total (%)	158 (76%)
Nil CAD	87
Mild-moderate CAD	39
Severe CAD	5

Stents	7
Minimal CAD	20
CXR findings (No patients)	
Calcified Atheroma	29
Cardiomegaly and signs thereof	46
Cardiomegaly and atheroma	19
NAD	87
Pleural changes	10
Thyroid calcifications	1
Hyperinflation	3
ILD	1
Granuloma	1
Aortic dilation	1

Table 1: Patient demographic data and results.

Discussion

No patient in our cohort had surgery delayed due to POCXR results. Of note, one patient had surgery delayed in order to have further respiratory function testing performed at the request of the anaesthetic department. In 24 % of cases the POCXR was performed either the evening prior or morning of the procedure, despite the patient having no symptoms to indicate a need for the investigation (fever, cough, increasing SOB) in the medical notes. This would indicate the pre-test probability of finding pathology that will delay or alter surgical timing is low.

The CXR findings in relation to presence of cardiomegaly and/or atheroma above are not surprising when the pathological process leading to the requirement for valve replacement surgery is considered: calcification leading to stenotic and regurgitant valvular heart disease, which in turn leads to signs and symptoms of cardiac failure. In light of all patients already having ECHO results demonstrated this, the utility of POCXR appears to be redundant from this viewpoint.

Over half of all patients who had previous cardiothoracic surgical intervention had 4D-CT imaging of the chest in order to assess tethering. The findings of these scans will always alter surgical planning and would obviate the need for POCXR given the findings of this study.

37% of CT scans were ordered in the setting of preparing the patient for a possible trans-catheter aortic valve implantation (TAVI) procedure rather than valve replacement via a median sternotomy. In terms of planning for a surgical procedure, this scan offers much more information to the treating team compared to a POCXR and makes the latter

redundant. Our study demonstrated that information gathered from CT scanning was in fact used to change the surgical management in 4 patients in the setting of planning for TAVI. Given that TAVI results in shorter hospitalisation [7] and ICU requirements [8], and potentially has significant downstream implications for likely surgical timing, the use of CT scan to POCXR should be the preferred imaging modality. Furthermore, in two patients, information from CT scans in preparation for TAVI yielded information that altered non-surgical management of the patient. One patient had lung nodules that required regular CT follow up, whilst another patient was lost to follow up after declining fine-needle aspiration of a suspicious thyroid nodule. However, an additional 9 patients had CTA findings that warranted follow up who did not receive that follow up through our health service. It is possible that this occurred through the general practitioner. A further 3 patients were found to have fatty liver disease which would warrant follow up by the patient's general practitioner.

Of the 38 patients who had a CTCA, 27 were able to avoid an angiogram, a huge saving to the health budget and avoiding the risks associated with angiography, a benefit that POCXR is unable to meet.

Overall, over 49% of patients in our study had both POCXR and CT. Our findings that no patients had alteration to therapy based on POCXR, it would indicate that there is no need for a POCXR if a CT scan is being ordered. Given that low dose CT of the chest provides minimal extra radiation compared to a POCXR, we propose that if imaging is to be ordered, that a CT should be used in preference to POCXR.

The number of patients utilising MRI in our study is low, in part due to system constraints and in part due to CT and

echocardiography providing enough information for surgical planning. The patients selected to undergo cardiac MRI workup were younger patients who had congenital structural heart disease and subsequently underwent pulmonary valve replacement. This is not unexpected, as cardiac MRI is recognised as the gold standard for cross sectional imaging assessment of pulmonary valve and right ventricular function. We would expect that in future, this modality will be further utilised in prospective valve replacement surgery, especially as it gives both structural and functional data.

One of the limits of the utility of CXR prior to valve surgery in our study is the population our cohort is drawn from. Whilst the catchment area of our hospital includes a high proportion of migrants, especially from countries where rates of TB are higher than Australia, our result would not be applicable to regions with endemic TB. In these areas, CXR may have greater utility in pre-operative assessment of TB status. However, even in areas where TB is endemic, POCXR has not been shown to alter surgical timing for other surgeries [4].

Conclusion

Our study demonstrates that in planning for elective valvular surgery, a peri-operative chest x-ray does not alter management or delay surgery.

We propose that peri-operative CT scan of the chest is likely to more frequently impact on the patient's care, either by reducing the need for invasive testing, by modifying the surgical approach or by finding non-cardiac pathology that warrants further follow up. In particular we note that CT lung cancer screening is now an accepted investigation for high risk individuals, and we postulate that similar low radiation dose exposure would be of far more clinical benefit obviating the need for a pre-operative CXR. In the event that a CT of the chest has been performed, there is no need to perform a CXR prior additional to the CT prior to surgery.

- The authors do not have any conflicts of interest
- The authors would like to acknowledge the cardiothoracic

surgical department for allowing access to their records

References

1. Government A (2019) Data Tables: Cardiovascular disease, A.I.o.H.a. Welfare, Editor. AIHW: Australia.
2. Chambers JB, Saul G Myerson, Rajani R, Hughes GJM, Marc R Dweck (2016) Multimodality imaging in heart valve disease. *Open Heart* 3(1): e000330.
3. Nishimura RA, Catherine M Otto, Robert O Bonow, Blase A Carabello, John P Erwin, et al. (2014) 2014 AHA/ACC Guideline for the Management of Patients With Valvular Heart Disease: executive summary: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *Circulation* 129(23): 2440-2492.
4. Keshavan V, Swamy C (2016) Pre-operative laboratory testing: A prospective study on comparison and cost analysis. *Indian Journal of Anaesthesia* 60(11): 838-842.
5. Sukanya Dej arkom, Kiatchai T, Siriussawakul A (2016) Prevalence and Characteristics of Abnormal Pre-Operative Chest X-Rays in Patients Undergoing Elective Surgery. *J Med Assoc Thai* 99(5): 491-496.
6. Hwan S Joo, Wong J, Naik VN, Savoldelli GL (2005) The value of screening preoperative chest x-rays: a systematic review. *Can J Anaesth* 52(6): 568-574.
7. Arora S, Strassle PD, Kolte D, Ramm CJ, Falk K, et al. (2018) Length of stay and discharge disposition after transcatheter versus surgical aortic valve replacement in the United States. *Circ Cardiovasc Interv* 11(9): e006929
8. Fairbairn TA, Meads DM, Hulme C, Mather AN, Plein S, et al. (2013) The cost effectiveness of transcatheter aortic valve implantation versus surgical aortic valve replacement in patients with severe aortic stenosis at high operative risk. *Heart* 99(13): 914-920.

