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Prevalence of wound infection following right anterolateral thoracotomy and median sternotomy for resection of benign atrial masses that induce heart failure, arrhythmia, or thromboembolic events: A meta-analysis

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Abstract

Background:
A meta-analysis study to assess the prevalence of wound infection (WI) following right anterolateral thoracotomy (RAT) and median sternotomy (MS) for resection of benign atrial masses (BAM) that induce heart failure, arrhythmia, or thromboembolic events.

Methods:
A comprehensive literature examination till February 2023 was implemented and 296 linked studies were appraised. The 4 picked studies contained 206 subjects with BAM that induce heart failure, arrhythmia, or thromboembolic events in the picked studies' baseline, 116 of them were using RAT, and 90 were using MS. Odds ratio (OR) in addition to 95% confidence intervals (CIs) were used to calculate the consequence of the prevalence of WI following RAT and MS for resection of BAM that induces heart failure, arrhythmia, or thromboembolic events by the dichotomous and continuous styles and a fixed or random model.

Results:
No significant difference was observed between RAT and MS in postoperative surgical site WI (OR, 0.18; 95% CI, 0.02-1.77, p=0.14) with no heterogeneity (I^2 = 0%) in subjects with BAM that induce heart failure, arrhythmia, or thromboembolic events.

Conclusions:
No significant difference was observed between RAT and MS in postoperative surgical site WI in subjects with BAM that induce heart failure, arrhythmia, or thromboembolic events though precautions should be taken when commerce with the consequences since a low number of selected studies was picked for comparisons in this meta-analysis and all the selected studies were with low sample size.

Keywords: benign atrial mass; wound infection; median sternotomy; right anterolateral thoracotomy

Introduction

Primary cardiac tumors are a relatively uncommon disease entity, occurring in the general population at a rate of about 0.02%. [1] The majority of these tumors come from the atria, primarily the left atrium, and are benign. On clinical investigation, cardiac myxomas are the most frequently found entity malignancies among these benign masses. [1] Moreover, the spectrum of benign cardiac tumors includes lipoma, papillary fibroelastoma, fibroma, and hemangioma. [2]

Myxoma typically has no symptoms, affects females more frequently than males, and develops at a relatively young age (mean age 56 years). [3] The symptoms that patients can experience are numerous and can range from mild fatigue to severe dyspnea, arrhythmia, and even stroke. [4] Although cardiac tumors are frequently discovered incidentally in asymptomatic patients, surgical excision is typically advised due to the possibility that they may cause heart failure, arrhythmia, and thromboembolic events. [5] Unfortunately, due to a lack of comparable data, guidelines for surgical indications, treatment, and recommended techniques are inadequate. [6] In the past, median sternotomy (MS) has been the go-to method for removing these tumors. For several cardiac treatments, including surgery for arrhythmia, aortic valve replacement, and mitral valve replacement, minimally invasive cardiac surgery has become a widely accepted method. [7] The potential advantages of minimally invasive cardiac surgery, such as shorter stays in intensive care units and hospitals, less trauma during surgery, less need for blood transfusions, less wound infection (WI), and better cosmetic and psychological outcomes for patients, have largely been responsible for its rise in popularity. The benefits of minimally invasive cardiac surgery have primarily been investigated in mitral valve surgery, where comparable efficacy without a reduction in patient safety was shown. [8] According to these data, it would be fair to speculate that patients having atrial masses removed may also benefit from minimally invasive cardiac surgery, especially given the anticipated quick recovery period. The paucity of evidence for the possible superiority of such a technique is due to the low incidence of benign cardiac masses and single-center experiences with relatively small patient cohorts. The current meta-analysis is to assess the prevalence of WI following right anterolateral thoracotomy (RAT) and MS for resection of benign atrial masses (BAM) that induce heart failure, arrhythmia, or thromboembolic events.

Methods

Eligibility criteria

The studies showing the prevalence of WI following RAT and MS for resection of BAM that induce heart failure, arrhythmia, or thromboembolic events were chosen to construct a summary. [9]

Information sources

Figure 1 depicts the entire study. The subsequent literature was incorporated into the study once the inclusion criteria were met:

1. The study was observational, randomized controlled trial (RCT), prospective, or retrospective study.
2. Subjects with BAM that induce heart failure, arrhythmia, or thromboembolic events were the nominated subjects.
3. The intervention encompassed RAT or MS.
4. The study differentiated the outcome of the prevalence of WI following RAT and MS for resection of BAM that induces heart failure, arrhythmia, or thromboembolic events.

The studies that were excluded were those where the significance of the comparison was not emphasized in it, studies that did not inspect the properties of the prevalence of WI following RAT and MS for resection of BAM that induces heart failure, arrhythmia, or thromboembolic events, and research on MS subjects' post-surgery wounds without RAT.

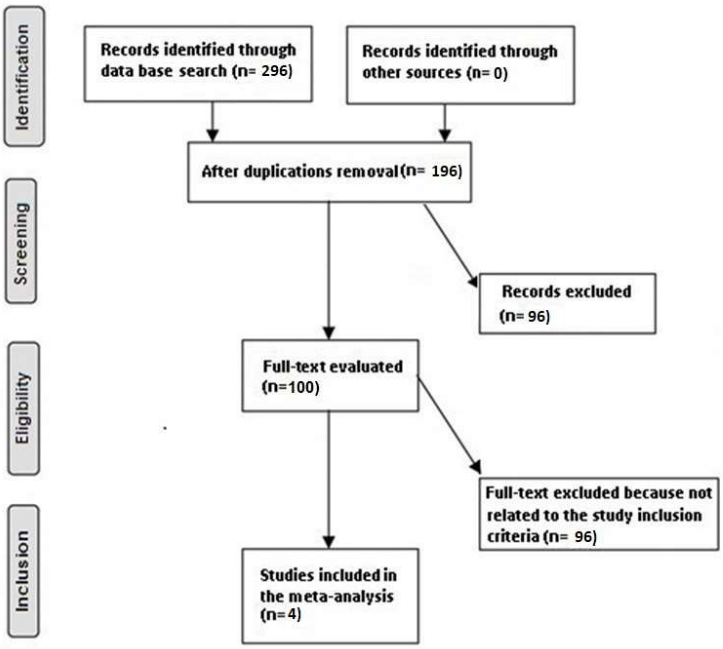

Figure 1. shows a flowchart of the study process.

Search strategy

A search protocol methodologies were established based on the PICOS perception, and we characterized it as next: topics for BAM that induce heart failure, arrhythmia, or thromboembolic events subjects, P; RAT or MS is the "intervention" or "exposure," while the "comparison" was RAT compared to MS; WI was the "outcome" and lastly, there were no boundaries on the study's proposal. [10]

We have done a full search of Google Scholar, Embase, Cochrane Library, PubMed, and OVID databases till February 2023 using an organization of keywords and linked terms for benign atrial mass; wound infection; median sternotomy; and right anterolateral thoracotomy as shown in Table 1. To evade studies that did not show a joining between the outcomes of the prevalence of WI following RAT and MS for resection of BAM that induces heart failure, arrhythmia, or thromboembolic events, papers were united into one EndNote file, replications were omitted, and the titles and abstracts were checked over and revised.

Table 1. Search Strategy for Each Database

Database	Search strategy
Pubmed	#1 "right anterolateral thoracotomy"[MeSH Terms] OR "wound infection"[All Fields] [All Fields] #2 "median sternotomy"[MeSH Terms] OR "benign atrial mass"[MeSH Terms] [All Fields] #3 #1 AND #2
Embase	' right anterolateral thoracotomy '/exp OR 'wound infection' #2 'median sternotomy'/exp OR 'benign atrial mass' #3 #1 AND #2
Cochrane library	(right anterolateral thoracotomy):ti,ab,kw (wound infection):ti,ab,kw (Word variations have been searched) #2 (median sternotomy):ti,ab,kw OR (benign atrial mass) :ti,ab,kw (Word variations have been searched) #3 #1 AND #2

Selection process

Following the epidemiological statement, a method was created, which was then organized and analyzed in the arrangement of a meta-analysis.

Data collection process

The primary author's name, study date, year of study, nation or province, populace type, medical and management physiognomies, categories, the qualitative and quantitative valuation technique, the data source, the result assessment, and statistical analysis were among the criteria used to gather data. [11]

Data items

We independently gathered the information if there were variable consequences from a study according to the appraisal of the prevalence of WI following RAT and MS for resection of BAM that induces heart failure, arrhythmia, or thromboembolic events.

Study risk of bias assessment

To define whether there was a chance that each study might have been biased, two authors independently assessed the chosen papers' methodologies. The "risk of bias tool" from the Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0 was used to weigh the methodological quality. Each study was denoted one risk of bias of those listed below after being classified according to the appraisal criteria: low: If the entire quality necessities were encountered, a study was considered as having a low bias risk; if one or more necessities weren't encountered or weren't included, a study was classified as having a medium bias risk. In the occasion that one or more quality necessities were not encountered at all or were only partially encountered, the study was considered as having a high bias risk.

Effect measures

Sensitivity studies were only performed on studies that evaluated and reported the prevalence of WI following RAT and MS for resection of BAM that induce heart failure, arrhythmia, or thromboembolic events. To compare the effects of RAT to MS on WI sensitivity, a subclass analysis was used.

Synthesis methods

The odds ratio (OR) in addition to a 95% confidence interval (CI) was calculated using a random- or fixed-effect

model using dichotomous or continuous methods. The I2 index, between 0 and 100%, was calculated. Heterogeneity was absent, low, moderate, and high for the values at 0%, 25%, 50%, and 75%, respectively. [12] To ensure that the right model was being used, additional traits that exhibit a high degree of resemblance among the involved research were also examined. If I2 was 50% or higher, the random effect was taken into consideration; if I2 was < 50%, the prospect of using fixed-effect increased. [12] By stratifying the first evaluation according to the earlier-mentioned results categories, a subclass analysis was finished. The analysis employed a p-value of <0.05 to denote statistical significance for differences amid subcategories.

Reporting bias assessment

Using the Egger regression test and funnel plots that show the ORs' logarithm vs. their standard errors, studies bias was evaluated both qualitatively and quantitatively (studies bias was judged present if p≥0.05). [13]

Certainty assessment

All of the p-values were examined using two-tailed testing. Utilizing Reviewer Manager Version 5.3, the graphs and statistical analyses were produced (The Nordic Cochrane Centre, The Cochrane Collaboration, Copenhagen, Denmark).

Results

From a total of 296 linked investigation that was inspected, 4 articles published between 2015 and 2023 fit the inclusion criteria and were selected and involved in the study. [14-17] Table 2 offerings the verdicts from these studies. 206 subjects with BAM that induce heart failure, arrhythmia, or thromboembolic events were in the picked studies' baseline, 116 of them were RAT, and 90 were MS. The sample size ranged between 43 and 66 subjects.

No significant difference was observed between RAT and MS in postoperative surgical site WI (OR, 0.18; 95% CI, 0.02-1.77, p=0.14) with no heterogeneity (I^2 = 0%) in subjects with BAM that induce heart failure, arrhythmia, or thromboembolic events as shown in Figure 2.

Due to a paucity of data, stratified models could not be used to investigate the impact of specific variables, e.g. gender, ethnicity, and age on comparison results. Figure 3,s visual interpretation of the funnel plot and quantitative evaluations by the Egger regression test exposed no indication of study bias (p = 0.88). However, it was shown that the mainstream of the involved RCTs had poor methodological quality and no bias in selective reporting.

Table 2. Characteristics of the selected studies for the meta-analysis

Study	Country	Total	Right anterolateral thoracotomy	Median sternotomy
Sawaki, 2015 [14]	Japan	51	35	16
Ellouze, 2018 [15]	Canada	43	20	23
Dong, 2018 [16]	China	66	30	36
Liu, 2023 [17]	China	46	31	15
	Total	**206**	**116**	**90**

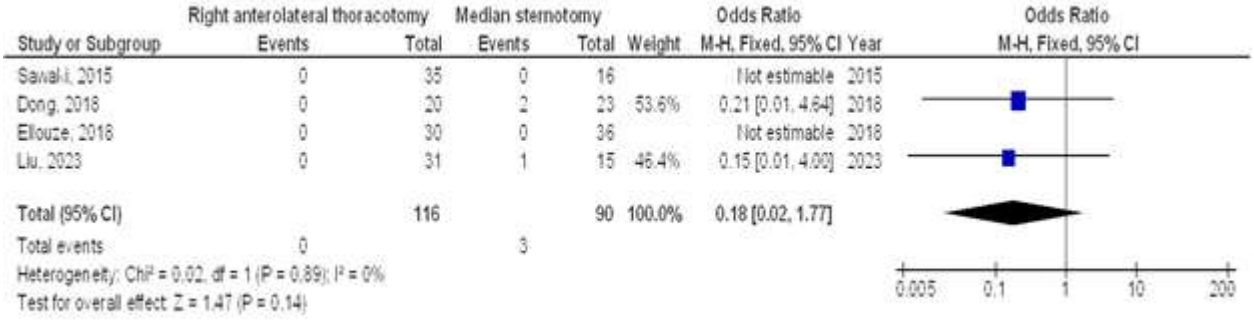

Figure 2. The effect's forest plot of the outcome of RAT on postoperative surgical site WI compared to MS in subjects with BAM

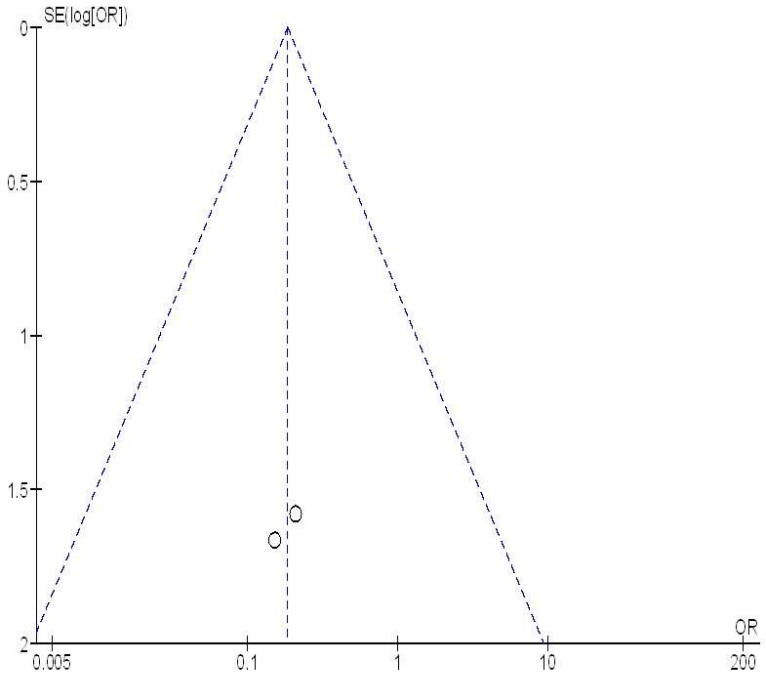

Figure 3. The outcome's funnel plot of RAT on postoperative surgical site WI compared to MS in subject with BAM

Discussion

In the studies nominated for the meta-analysis, 206 subjects with BAM that induce heart failure, arrhythmia, or thromboembolic events were in the picked studies' baseline, 116 of them were RAT, and 90 were MS. [14-17] No significant difference was observed between RAT and MS in postoperative surgical site WI in subjects with BAM that induce heart failure, arrhythmia, or thromboembolic events Though precautions should be taken when commerce with the consequences since a low number of selected studies was picked for comparisons in this meta-analysis and all the selected studies were with low sample size (all<100 subjects). Increasing the number of studies in such a comparison would affect the p-value and the level of confidence in the comparison.

A less intrusive surgical technique should not generally be used at the expense of safety and effectiveness. Safety in the context of myxoma resection was characterized in many studies by mortality and morbidity, whilst efficacy can be characterized by recurrence rate but no meta-analysis has evaluated the WI. WI is a very important complication but was not efficiently studied that might be because patients with benign cardiac tumors are typically rather young, which emphasizes the significance of a speedy recovery and return to work. Prior research comparing minimally invasive techniques to median sternotomies for mitral valve surgery, however, has shown that individuals treated in this way have higher rates of independent ambulation and quicker returns to work or school. [18] In light of this, using a RAT method to remove benign masses may improve surgical proficiency for additional minimally invasive cardiac surgeries. Minimally invasive mitral valve surgery is the most common cardiac surgical treatment performed using a right-sided minimally invasive approach with peripheral cardiopulmonary bypass. Although the learning curve for this treatment is relatively long, it is expected that it will take between 75 and 125 operations to get through it. [19] The implementation of this procedure in the learning curve for minimally invasive mitral valve surgery could potentially reduce the case volume load required to pass the earlier perceived threshold due to the similarity in both approaches for myxoma resection and minimally invasive mitral valve surgery, as well as the short aortic cross-clamp and cardiopulmonary bypass times associated with myxoma resection through a RAT approach. Finally, we want to make it clear that we do not support using a minimally invasive procedure for every patient having an atrial tumor removed. Cannulation for peripheral cardiopulmonary bypass, in particular, may not be appropriate for some individuals with severe peripheral artery disease. We believe patient selection for a minimally invasive approach is crucial for success and should depend on surgical experience, patient characteristics, and anatomical eligibility. [20] Due to the retrospective technique used in these studies, none of them mentioned the inclusion criteria for assigning patients to minimally invasive treatment.

This meta-analysis verified the outcome of the prevalence of WI following RAT and MS for resection of BAM that induces heart failure, arrhythmia, or thromboembolic events. More examination is still desirable to elucidate these probable connections. Bigger, more homogeneous samples are mandatory for this examination. This was also emphasized in preceding studies that employed a linked meta-analysis technique and found equivalent consequences of the influence. [21, 22] Well-led RCTs are necessary to weigh these features as well as the blend of

diverse ethnicities, ages, gender, and other parameters of subjects since the meta-analysis could not define whether differences in them are linked to the outcomes studied. In conclusion, no significant difference was observed between RAT and MS in postoperative surgical site WI in subjects with BAM that induce heart failure, arrhythmia, or thromboembolic events

Limitations

There may have been selection bias because a number of the studies involved in the meta-analysis were not covered. However, the excluded publications did not meet the criteria for enclosure in the meta-analysis. Also, we were incompetent to ascertain whether variables like ethnicity, age, and gender influenced results. The purpose of the study was to measure the prevalence of WI following RAT and MS for resection of BAM that induces heart failure, arrhythmia, or thromboembolic events. Due to the inclusion of missing or erroneous data from prior studies, bias may have been increased. The individuals' nutritional state as well as their age and gender characteristics were potential sources of bias. Undesirably, some unpublished work and insufficient data can skew the consequence under investigation.

Conclusions

No significant difference was observed between RAT and MS in postoperative surgical site WI in subjects with BAM that induce heart failure, arrhythmia, or thromboembolic events Though precautions should be taken when commerce with the consequences since a low number of selected studies was picked for comparisons in this meta-analysis and all the selected studies were with low sample size (all<100 subjects). Increasing the number of studies in such a comparison would affect the p-value and the level of confidence in the comparison.

References

1. McAllister Jr, H.A., R.J. Hall, and D.A. Cooley, *Tumors of the heart and pericardium.* Current problems in cardiology, 1999. **24**(2): p. 59-116.
2. Kassop, D., M.S. Donovan, M.K. Cheezum, B.T. Nguyen, N.B. Gambill, R. Blankstein, and T.C. Villines, *Cardiac masses on cardiac CT: a review.* Current cardiovascular imaging reports, 2014. **7**: p. 1-13.
3. Cetin, G., M. Gursoy, M. Ugurlucan, I. Uzunhasan, A.C. Hatemi, E. Tireli, S. Kucukoglu, and E. Kansiz, *Single-institutional 22 years experience on cardiac myxomas.* Angiology, 2010. **61**(5): p. 504-509.
4. Cohen, R., G. Singh, D. Mena, C.A. Garcia, P. Loarte, and B. Mirrer, *Atrial myxoma: a case presentation and review.* Cardiology Research, 2012. **3**(1): p. 41.
5. Disesa, V.J., J.J. Collins Jr, and L.H. Cohn, *Considerations in the surgical management of left atrial myxoma.* Journal of Cardiac Surgery, 1988. **3**(1): p. 15-22.
6. Shah, I.K., J.A. Dearani, R.C. Daly, R.M. Suri, S.J. Park, L.D. Joyce, Z. Li, and H.V. Schaff, *Cardiac myxomas: a 50-year experience with resection and analysis of risk factors for recurrence.* The Annals of thoracic surgery, 2015. **100**(2): p. 495-500.
7. Vos, L.M., D. Kotecha, G.S. Geuzebroek, F.N. Hofman, W.J.P. van Boven, J. Kelder, B.A. de Mol, and B.P. van Putte, *Totally thoracoscopic ablation for atrial fibrillation: a systematic safety analysis.* Ep Europace, 2018. **20**(11): p. 1790-1797.
8. Misfeld, M., M. Borger, J.G. Byrne, W.R. Chitwood, L. Cohn, A. Galloway, J. Garbade, M. Glauber, E. Greco, and C.W. Hargrove, *Cross-sectional survey on minimally invasive mitral valve surgery.* Annals of Cardiothoracic Surgery, 2013. **2**(6): p. 733.
9. Stroup, D.F., J.A. Berlin, S.C. Morton, I. Olkin, G.D. Williamson, D. Rennie, D. Moher, B.J. Becker, T.A. Sipe, and S.B. Thacker, *Meta-analysis of observational studies in epidemiology: a proposal for reporting.* Jama, 2000. **283**(15): p. 2008-2012.
10. Liberati, A., D.G. Altman, J. Tetzlaff, C. Mulrow, P.C. Gøtzsche, J.P. Ioannidis, M. Clarke, P.J. Devereaux, J. Kleijnen, and D. Moher, *The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration.* Journal of clinical epidemiology, 2009. **62**(10): p. e1-e34.
11. Gupta, S., G. Rout, A.H. Patel, M. Mahanta, N. Kalra, P. Sahu, R. Sethia, A. Agarwal, G. Ranjan, and S. Kedia, *Efficacy of generic oral directly acting agents in patients with hepatitis C virus infection.* Journal of viral hepatitis, 2018. **25**(7): p. 771-778.
12. Sheikhbahaei, S., T.J. Trahan, J. Xiao, M. Taghipour, E. Mena, R.M. Connolly, and R.M. Subramaniam, *FDG-PET/CT and MRI for evaluation of pathologic response to neoadjuvant chemotherapy in patients with breast cancer: a meta-analysis of diagnostic accuracy studies.* The oncologist, 2016. **21**(8): p. 931-939.
13. Higgins, J.P., S.G. Thompson, J.J. Deeks, and D.G. Altman, *Measuring inconsistency in meta-analyses.* Bmj, 2003. **327**(7414): p. 557-560.
14. Sawaki, S., T. Ito, A. Maekawa, S. Hoshino, Y. Hayashi, J. Yanagisawa, M. Tokoro, and T. Ozeki, *Outcomes of video-assisted minimally invasive approach through right mini-thoracotomy for resection of benign cardiac masses; compared with median sternotomy.* General thoracic and cardiovascular surgery, 2015. **63**: p. 142-146.
15. Ellouze, M., M. Pellerin, H. Jeanmart, J.-S. Lebon, and D. Bouchard, *Mini right anterior thoracotomy approach versus sternotomy for resection of intracardiac myxoma.* Innovations, 2018. **13**(4): p. 292-295.

16. Dong, N.G., K.L. Zhang, L. Wu, and H. Hong, *Right anterolateral minithoracotomy versus median sternotomy approach for resection of left atrial myxoma.* The Thoracic and Cardiovascular Surgeon, 2018. **66**(02): p. 193-197.
17. Liu, Y., Z. Liu, X. Li, Y. Jiang, C. Lu, C. Zhang, and S. Ge, *A comparison of total thoracoscopic versus robotic approach for cardiac myxoma resection: a single-center retrospective study.* Journal of Robotic Surgery, 2023: p. 1-8.
18. Liu, J., B. Chen, Y.-Y. Zhang, L.-Z. Fang, B. Xie, H.-L. Huang, J. Liu, C. Lu, W.-D. Gu, and Z. Chen, *Mitral valve replacement via minimally invasive totally thoracoscopic surgery versus traditional median sternotomy: a propensity score matched comparative study.* Annals of translational medicine, 2019. **7**(14).
19. Holzhey, D.M., J. Seeburger, M. Misfeld, M.A. Borger, and F.W. Mohr, *Learning minimally invasive mitral valve surgery: a cumulative sum sequential probability analysis of 3895 operations from a single high-volume center.* Circulation, 2013. **128**(5): p. 483-491.
20. Heuts, S., J.G. Maessen, and P. Sardari Nia, *Preoperative planning of left-sided valve surgery with 3D computed tomography reconstruction models: sternotomy or a minimally invasive approach?* Interactive Cardiovascular and Thoracic Surgery, 2016. **22**(5): p. 587-593.
21. Olsthoorn, J.R., J.H. Daemen, E.R. de Loos, J.F. Ter Woorst, A.H. van Straten, J.G. Maessen, P. Sardari Nia, and S. Heuts, *Right Anterolateral Thoracotomy Versus Sternotomy for Resection of Benign Atrial Masses: A Systematic Review and Meta-Analysis.* Innovations, 2021. **16**(5): p. 426-433.
22. Sá, M.P., L.R.P. Cavalcanti, J. Van den Eynde, A. Amabile, A.C.E. Neto, A.M. Perazzo, A. Weymann, A. Ruhparwar, S. Sicouri, and G. Bisleri, *Respect versus resect approaches for mitral valve repair: a study-level meta-analysis.* Trends in Cardiovascular Medicine, 2022.