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Research Article

# Evaluate The Clinical Outcomes Of Postoperative Atrial Fibrillation In Patients With Cardiac Surgery: Systematic Review And Meta-Analysis

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**Abstract**

**Background and aim:** the aim of current Systematic review and meta-analysis study was evaluate the clinical outcomes of postoperative atrial fibrillation in patients with cardiac surgery.
**Methods:** From the electronic databases, PubMed, Scopus, Web of Science, EBSCO and Embase have been used to perform a systematic literature over the last ten years between 2011and September 2021. Odds ratio with 95% confidence interval (CI), fixed effect model and Mantel-Haenszel method were calculated. The Meta analysis have been evaluated with the statistical software Stata/MP v.16 (The fastest version of Stata).
**Results:** 2153 studies were selected to review the abstracts, the full text of 124 studies was reviewed. Finally, thirteen studies were selected. One-year, five years and ten years mortality in patients with postoperative atrial fibrillation was 14.09%, 8.43% and 17.65%; Odds ratio of overall mortality and Overall stroke was (OR, 0.76 95 % CI 0.67, 0.05; p=0.00) and (OR, 1.40 95 % CI 0.26, 2.53; p=0.02), respectively.
**Conclusions:** In patients with cardiac surgery that after surgery develop POAF, in the first year, the risk of death and stroke is much higher than patients without POAF. As a result, POAF is a significant change in the outcome of heart surgery.
**Keywords:** postoperative atrial fibrillation, cardiac surgery, stroke, mortalit

## Introduction

Common, expensive and potentially morbid complication in cardiac surgery is postoperative atrial fibrillation (POAF) (1, 2). POAF is the most common perioperative arrhythmia and its reported incidence ranges from 0.4%–26% (3, 4). Long-term consequences after cardiac surgical intervention in effect POAF is not fully understood (5) and is associated with prolonged hospital stays and an increased risk of hospital death (6). Moreover, 25 to 80% of patients will restore sinus rhythm within 24 hours

with or without medications (7). Historical assumptions that POAF is both self-limited and benign have been challenged by new evidence that patients with POAF after cardiac surgical intervention have a 5-fold increased risk of permanent atrial fibrillation (8). It seems that the study of this issue is of great importance therefore the aim of current Systematic review and meta-analysis study was evaluate the clinical outcomes of postoperative atrial fibrillation in patients with cardiac surgery.

## Methods

### *Search strategy*

From the electronic databases, PubMed, Scopus, Web of Science, EBSCO, and Embase have been used to perform a systematic literature over the last ten years between 2011 and September 2021. The reason for choosing studies in the last ten years is to be able to provide sufficient evidence in this area and use newer studies. Therefore, a software program (Endnote X8) has been utilized for managing the electronic titles.

Searches were performed with mesh terms:

("Cardiac Surgical Procedures"[Mesh] OR "Thoracic Surgery"[Mesh]) AND "Atrial Fibrillation"[Mesh]) AND ( "Coronary Artery Bypass"[Mesh] OR "Coronary Artery Bypass, Off-Pump"[Mesh] )) AND ( "Postoperative Period"[Mesh] OR "Postoperative Complications"[Mesh] )) OR "Muscular Atrophy, Spinal"[Mesh]) AND "Death"[Mesh]) AND "Stroke"[Mesh]) AND "Cohort Studies"[Mesh]) OR "Case-Control Studies"[Mesh]).

This systematic review has been conducted on the basis of the key consideration of the PRISMA Statement–Perfumed Reporting Items for the Systematic Review and Meta-analysis(9), and PICO strategy (Table1).

### *Selection criteria*

Inclusion criteria: prospective and retrospective cohort studies, Case-Control Studies; adults≥18 years old; in English. In vitro studies, case studies, case reports and reviews were excluded from the study.

**Table 1. PICO OR PECO strategy.**

| PICO strategy | Description |
|---|---|
| P | Population/ Patient: patients following cardiac surgery |
| I | Intervention: cardiac surgical intervention |
| C | Comparison: postoperative atrial fibrillation vs no postoperative atrial fibrillation |
| O | Outcome: clinical outcome |

### *Data Extraction and analysis method*

The data were extracted from the research included years, study design, sample size, Types of surgery, POAF definition, outcome, Follow-up.

The quality of non-randomized studies included was assessed using Newcastle-Ottawa Scale (NOS) (10) used to assessed quality of the cohort studies and case-control studies, This scale measures three dimensions (selection, comparability of cohorts and outcome) with a total of 9 items. In the analysis, any studies with NOS scores of 1-3, 4-6 and 7-9 were defined as low, medium and high quality, respectively.

For Data extraction, two reviewers blind and independently extracted data from abstract and full text of studies that included. Prior to the screening, kappa statistics was carried out in order to verify the agreement level between the reviewers. The kappa values were higher than 0.80.
Odds ratio and hazard ratio with 95% confidence interval (CI), fixed effect model and Inverse-variance or Mantel-Haenszel method were calculated.
Random effects were used to deal with potential heterogeneity and $I^2$ showed heterogeneity. $I^2$ values above 50% signified moderate-to-high heterogeneity. The Meta analysis have been evaluated with the statistical software Stata/MP v.16 (The fastest version of Stata).

**Results**

In the review of the existing literature using the studied keywords, 2153 studies were found. In the initial review, duplicate studies were eliminated and abstracts of 2101 studies were reviewed. At this stage, 1977 studies did not meet the inclusion criteria, so they were excluded, and in the second stage, the full text of 124 studies was reviewed by two authors. At this stage, 111 studies were excluded from the study due to incomplete data, inconsistency of results in a study, poor studies, lack of access to full text, inconsistent data with the purpose of the study. Finally, thirteen studies were selected (Figure1).

***Characteristics***

Thirteen studies (seven Prospective and six retrospective cohort studies) have been included in present article. The number of patients with cardiac surgery a total was 36266. In eleven studies the type of surgery was Coronary artery bypass grafting. Other characteristics of study were reported in Table 2.

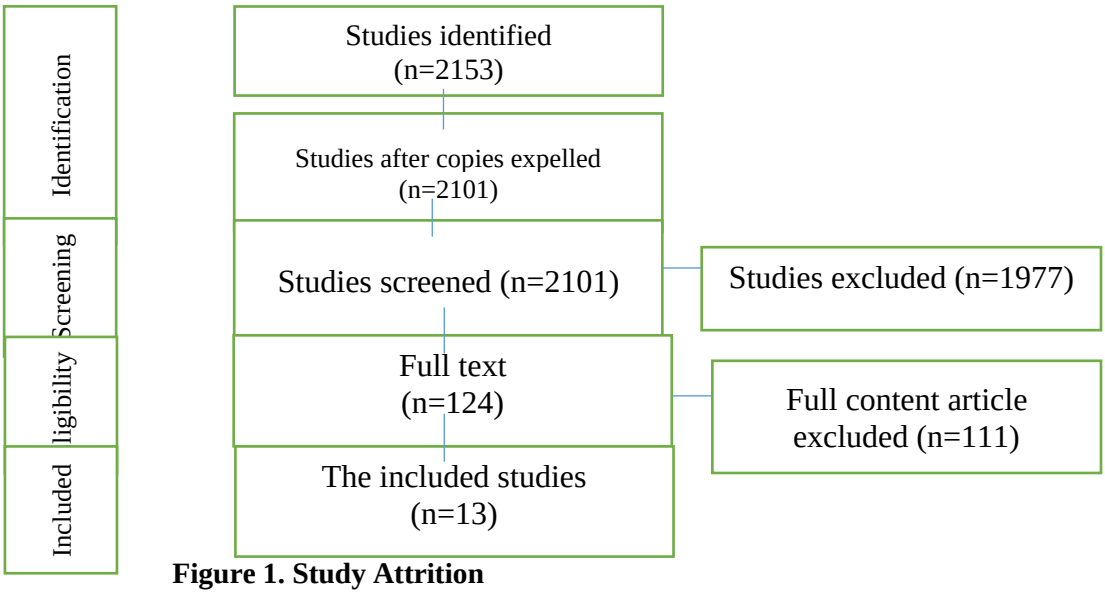


**Figure 1. Study Attrition**

***Bias assessment***

According to NOS tool, one study had a total score of 7/9, nine studies had a total score of 8/9 and three studies had a total score of 9/9; all studies had high quality or low risk of bias (Table3).

***Overall death***

Odds ratio of overall mortality was 0.76 (OR, 0.76 95 % CI 0.67, 0.05; p=0.00) among eight studies with high heterogeneity ($I^2$ = 85.33%; p=0.00) (Figure2). There was statistically significant difference of Overall death in patients with and without postoperative atrial fibrillation; Overall death was significantly higher in patients with POAF.

Table 2. Studies were selected for systematic review and meta-analysis.

| N | Studies. Years | Study design | Number of Patients | Types of surgery | POAF Definition | Outcome | Follow-up (years) |
|---|---|---|---|---|---|---|---|
| 1 | Filardo et al.,2020 (11) | Retrospective | 9203 | CABG | AF requiring treatment during hospitalization | Death, stroke, permanent AF | 12 |
| 2 | Carter-Storch et al.,2019 (12) | Prospective | 96 | Cardiac surgery | AF requiring treatment during hospitalization | Death, permanent AF | 3 |
| 3 | Schwann et al., 2018 (13) | Retrospective | 8807 | CABG | AF requiring treatment within 30 days of | Death | 9 |
| 4 | Swinkels et al., 2017 Swinkels | Retrospective | 569 | CABG | AF during hospitalization | Death | 17.8 |
| 5 | Fensgrud et al.,2017 (14) | Prospective | 571 | CABG | AF >60 s within 7 d of surgery | Death | 15 |
| 6 | Ivanovic et al., 2017 (15) | Prospective | 477 | CABG | AF requiring treatment during hospitalization | MACCE | 3.7 |
| 7 | Konstantino et al., 2016 (16) | Prospective | 136 | CABG | Any AF | Death, stroke, permanent AF | 8.5 |
| 8 | Melduni et al.,2015 (17) | Prospective | 603 | CABG | AF >30 s within 30 days of surgery | Death, permanent AF | 8.3 |
| 9 | Tsai et al., 2015 (18) | Retrospective | 266 | CABG | Any AF | Incidence of POAF, death | 3 |
| 10 | Saxena et al., 2014 (19) | Prospective | 2028 | CABG | AF requiring treatment during hospitalization | Not reported | 3.1 |
| 11 | Al-Shaar et al.,2014 (20) | Prospective | 6305 | CABG | AF requiring treatment during hospitalization | Death | 9.7 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 12 | Thoren et al., 2014 (21) | Retrospective | 6821 | CABG | AF >30 s during hospitalization | Death | 9.8 |
| 13 | Weidinger et al., 2014 (22) | Retrospective | 384 | TECAB | AF requiring treatment during hospitalization | Incidence of POAF, death | Unclear |

CABG: Coronary artery bypass grafting; TECAB: totally endoscopic coronary artery bypass;

**Table4. Risk of bias assessment (NOS tool)**

| Study. Years | **Selection (5 score)** | | | | **Comparability (2 score)** | **Outcome (2 score)** | | Total score |
|---|---|---|---|---|---|---|---|---|
| | representative sample | Sample size | Non respondents | Ascertainment of the exposure | Based on design and analysis | Assessment of outcome | Statistical test | |
| Filardo et al.,2020 (11) | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 8 |
| Carter-Storch et al.,2019 (12) | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 8 |
| Schwann et al., 2018 (13) | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 8 |
| Swinkels et al., 2017 Swinkels | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 8 |
| Fensgrud et al.,2017 (14) | 1 | 2 | 1 | 1 | 2 | 1 | 0 | 8 |
| Ivanovic et al., 2017 (15) | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 9 |
| Konstantino et al., 2016 (16) | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 8 |
| Melduni et al.,2015 (17) | 1 | 2 | 1 | 1 | 2 | 1 | 0 | 8 |
| Tsai et al., 2015 (18) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| Saxena et al., 2014 (19) | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 9 |
| Al-Shaar et al.,2014 (20) | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 9 |
| Thoren et al., 2014 (21) | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 8 |
| Weidinger et al., 2014 (22) | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 8 |

***Death at 1 year, 5 years, and 10 years***

*Sub group meta-analysis:*

One-year, five years and ten years mortality in patients with postoperative atrial fibrillation was 14.09%, 8.43% and 17.65%; One-year, five years and ten years mortality in patients without postoperative atrial fibrillation was 11.64%, 3.41% and 9.37%;
Odds ratio of death at one year was 0.22 (OR, 0.22 95 % CI 0.01, 0.46; p=0.00) among two studies with low heterogeneity ($I^2$ <0%; p=0.54) (Figure3); There was statistically significant difference of death at 1 year in patients with and without postoperative atrial fibrillation;
Odds ratio of death at five years was 0.98 (OR, 0.98 95 % CI 0.81, 1.15; p=0.00) among five studies with low heterogeneity ($I^2$ =44.51%; p=0.13) (Figure3); There was statistically significant difference of death at five year in patients with and without postoperative atrial fibrillation;
Odds ratio of death at ten years was 0.76 (OR, 0.76 95 % CI 0.65, 0.82; p=0.00) among three studies with high heterogeneity (I2 =88.39%; p=0.00) (Figure3); There was statistically significant difference of death at ten year in patients with and without postoperative atrial fibrillation;
Test of group differences showed there was statistically significant difference between group (death at 1 year, 5 years, and 10 years).

***Overall stroke***

Odds ratio of Overall stroke was 1.40 (OR, 1.40 95 % CI 0.26, 2.53; p=0.02) among one study. There was statistically significant difference of Overall stroke in patients with and without postoperative atrial fibrillation; Overall stroke was significantly higher in patients with POAF.

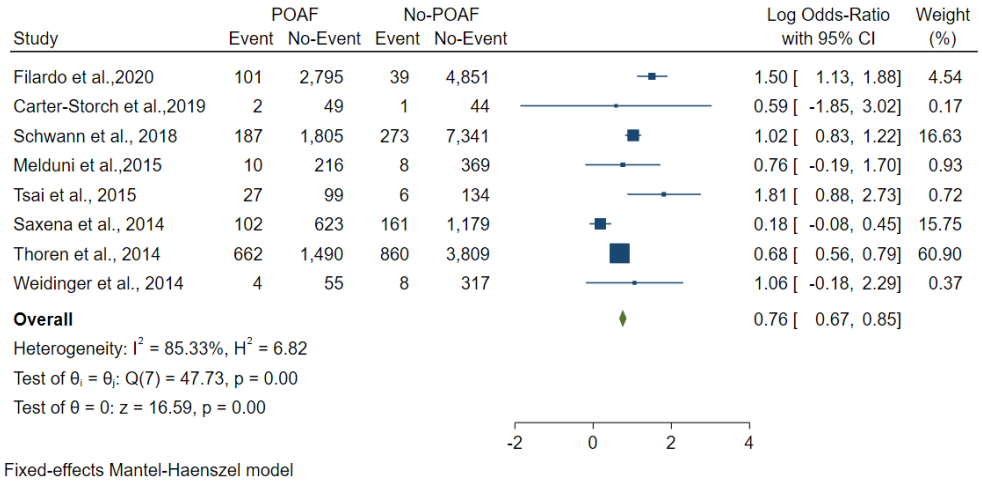


**Figure2. The Forest plot showed Overall death between patients with POAF and without POAF**

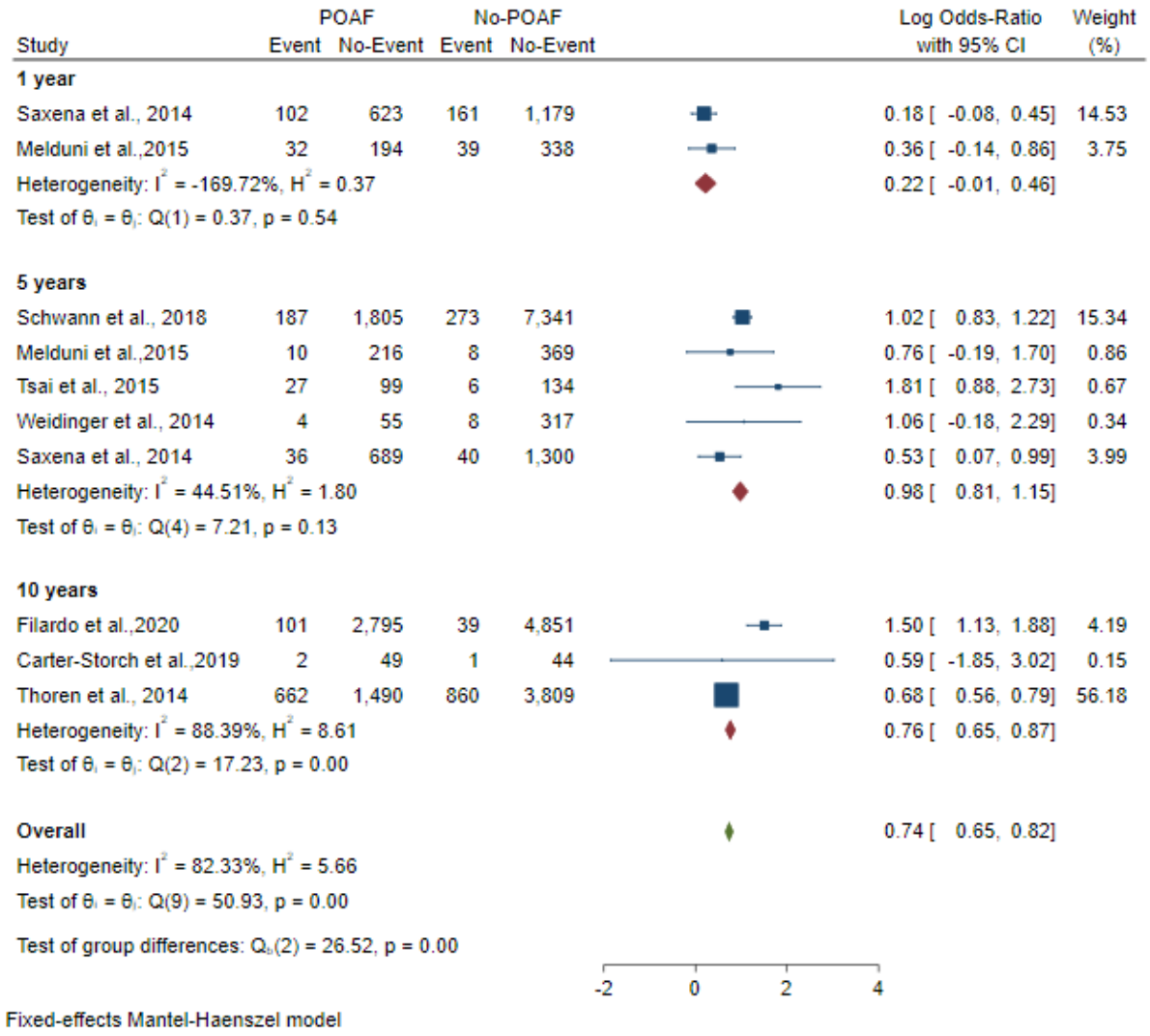


**Figure3. The Forest plot showed death at 1 year, 5 years, and 10 years**

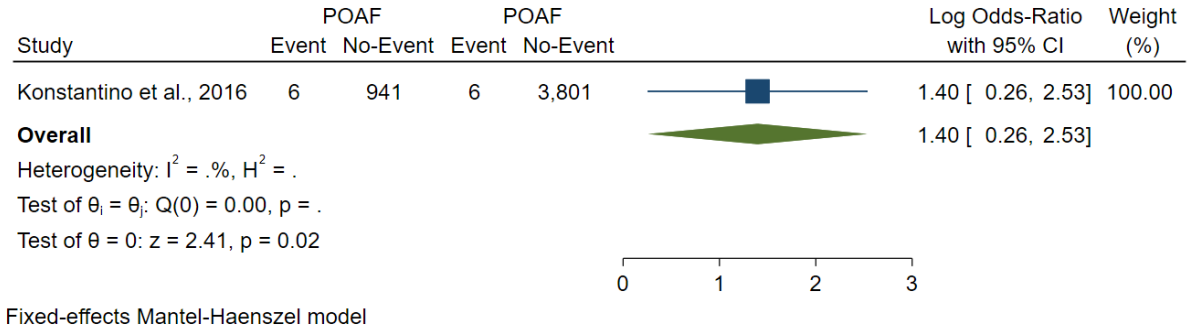


**Figure4. The Forest plot showed Overall stroke in patients with POAF and without POAF**

## Discussion

The aim of current Systematic review and meta-analysis study was evaluate the clinical outcomes of postoperative atrial fibrillation in patients with cardiac surgery. In the present study, 36,266 patients were studied. A meta-analysis showed that patients with POAF had higher mortality and stroke rates than patients without POAF. The findings show that POAF can no longer be understood as a benign and self-limiting complication of cardiac surgery.

Better understanding of the pathophysiology of POAF may provide the basis for more accurate risk prediction models, both for POAF and for complications and death after cardiac surgery. POAF has been reported to increase mortality and myocardial infarction through persistent atrial fibrillation. Lowres et al., 2018 (23) in a systematic review and meta-analysis showed POAF recurs in 25% of patients 4 to 6 weeks after discharge. Kaw et al., 2011 (24) and Megens et al.,2017 (25)in a systematic review and meta-analysis reported There was an association between POAF and stroke risk at 6 months or more after surgery. If a recurrence of POAF causes an increase in stroke and long-term death, then anticoagulants should reduce the incidence of these side effects. A study was not found to evaluate anticoagulant levels before and after surgery and to suggest that they may affect the clinical outcome of patients with POAF. El-Chami et al., 2010 found a 22% relative reduction in mortality in warfarin-treated patients after adjusting for age, sex, and medical comorbidities(26).

Different clinical factors have also been described that might contribute to the development of POAF. They range from preoperative (hypertension, myocardial ischemia, valvular abnormalities), through perioperative (surgical trauma, local inflammation, large fluid shifts, electrolyte disturbances), to postoperative conditions and events (inotropic drugs, atrial pacing, pneumonia)(7, 27, 28). Thus, the combination of predisposing substrates for the natural development of AF with perioperative events would then increase the risk of POAF. This conceptual model could explain the differences between classic surgery and trans catheter aortic valve implantation for aortic valve replacement (29)and the significant rate of POAF in no cardiac surgery(30). Due to the potential negative effects of POAF, patients may be reluctant to do so and doctors may refuse to recommend surgery. However, it is important to note that current symptoms of heart surgery often have no alternative (e.g., endocarditis), and the results are often still relative to their current intervention (trans-catheter aortic valve implantation) or conservative alternatives. According to the long-term perspective (31). The present study had limitations, including the fact that only one study was found to examine the association between POAF and stroke; the heterogeneity between the results of the studies was high; Studies included different cases of POAF.

## Conclusion

In patients with cardiac surgery that after surgery develop POAF, in the first year, the risk of death and stroke is much higher than patients without POAF, and during 5 and 10 years of follow-up, the mortality rate in these patients was higher. As a result, POAF is a significant change in the outcome of heart surgery.

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