SYSTEMATIC REVIEW

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# Early Versus Delayed Coronary Angiography After Out-of-Hospital Cardiac Arrest Without ST-Segment Elevation—A Systematic Review and Meta-Analysis of Randomized Controlled Trials

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**OBJECTIVES:** The optimal timing of coronary angiography remains unclear following out-of-hospital cardiac arrest (OHCA) without ST elevation on electrocardiogram. The objective of this systematic review and meta-analysis was to evaluate the efficacy and safety of early angiography versus delayed angiography following OHCA without ST elevation.

**DATA SOURCES:** The databases MEDLINE, PubMed EMBASE, and CINHAL, as well as unpublished sources from inception to March 9, 2022.

**STUDY SELECTION:** A systematic search was performed for randomized controlled trials of adult patients after OHCA without ST elevation who were randomized to early as compared to delayed angiography.

**DATA EXTRACTION:** Reviewers screened and abstracted data independently and in duplicate. The certainty of evidence was assessed for each outcome using the Grading Recommendations Assessment, Development and Evaluation approach. The protocol was preregistered (CRD 42021292228).

**DATA SYNTHESIS:** Six trials were included ($n = 1,590$ patients). Early angiography probably has no effect on mortality (relative risk [RR] 1.04; 95% CI 0.94–1.15; moderate certainty) and may have no effect on survival with good neurologic outcome (RR 0.97; 95% CI 0.87–1.07; low certainty) or ICU length of stay (LOS) (mean difference 0.41 days fewer; 95% CI −1.3 to 0.5 d; low certainty). Early angiography has an uncertain effect on adverse events.

**CONCLUSIONS:** In OHCA patients without ST elevation, early angiography probably has no effect on mortality and may have no effect on survival with good neurologic outcome and ICU LOS. Early angiography has an uncertain effect on adverse events.

**KEY WORDS:** coronary angiography; meta-analysis; non-ST elevated myocardial infarction; out-of-hospital cardiac arrest; randomized controlled trials

Out-of-hospital cardiac arrest (OHCA) remains a leading cause of death worldwide, and survival to hospital discharge is less than 10% (1–3). Even among those with return of spontaneous circulation (ROSC) and who are admitted to hospital, survival to discharge is less than 40% (3). Among the principles of postcardiac arrest care are the identification and treatment of the underlying cause for arrest (4). However, the etiology is not always immediately clear, and this can lead to delays in cause-directed treatment.

Cardiac disease is the most common cause of OHCA in adults, of which acute coronary occlusion is a common etiology (5). Acute coronary occlusion is found



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## KEY POINTS

**Question:** In a systematic review and meta-analysis of randomized controlled trials, what are the differences in efficacy and safety outcomes for early versus delayed coronary angiography strategies for patients without ST elevation after out-of-hospital cardiac arrest?

**Findings:** Five studies with 1,524 patients were included. Compared with delayed angiography, early angiography probably has no effect on mortality and may have no effect on survival with good neurologic outcome. Early angiography has an uncertain effect on most adverse events.

**Meanings:** There is probably no benefit to an early compared with delayed angiography strategy for patients without ST elevation after out-of-hospital cardiac arrest.

in a substantial proportion of patients post ROSC with ST-segment elevation on initial electrocardiogram (ECG), and early coronary angiography and revascularization is associated with improved survival in this population (6–8). Multiple guidelines strongly recommend early angiography after OHCA with ST elevation post ROSC (4, 9, 10). However, in patients without ST elevation post ROSC, the incidence of acute coronary occlusion is much lower, and the potential benefits of early angiography are less clear (8, 11). The proportion of patients following OHCA without ST elevation is much larger and includes noncardiac causes of cardiac arrest, such as pulmonary embolism, hypoxia, and intoxication. Despite a more heterogenous population, including patients without coronary occlusion, observational studies have suggested that patients without ST elevation post ROSC may still benefit from early angiography (6, 7, 12), although the results are based on very low certainty of evidence (13). A number of recently published randomized controlled trials (RCTs) have investigated the benefit of early coronary angiography in patients without ST elevation on ECG after ROSC (14–18), and some of these studies have been summarized in a recent systematic review (19). However, this review included both post hoc observational data and RCTs, did not include two more recent RCTs (18, 20), and did not assess the certainty of their summarized evidence (19). As such, the objective of this study was to conduct an updated systematic review and meta-analysis of RCTs to evaluate the safety and efficacy of early versus delayed angiography in patients without ST elevation post ROSC.

## METHODS

The protocol for this systematic review was registered on the International Prospective Register of Systematic Reviews (PROSPERO) (CRD42021292228) on November 19, 2021. Any deviations from the published protocol are highlighted with an accompanying explanation. The updated Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) statement was used to guide the design and reporting of our systematic review and meta-analysis (21) (see **supplementary appendix for PRISMA Checklist, Appendix 7**, http://links.lww.com/CCX/B149).Given the study was a systematic review of previously published data, it was exempt from review from our Institutional Review Board.

### Systematic Search

We conducted a comprehensive search of MEDLINE, PubMed EMBASE, CINHAL, and unpublished sources including World Health Organization ICTRP, ClinicalTrials.gov, and the Cochrane trial registry from inception until March 9, 2022. We searched for RCTs investigating early versus delayed coronary angiography for OHCA patients in the absence of STEMI. We did not apply language restrictions. We developed the search strategy with the assistance of an expert medical librarian and included three search terms: "Coronary angiography," "Out of hospital cardiac arrest," and "Non-ST-segment elevation MI" (see **supplementary appendix for search strategy, Appendices 1–5**, http://links.lww.com/CCX/B149). We used the Medical Subject Headings database for identification of synonyms. We examined the reference list of full-text articles for additional relevant studies. We also searched conference proceedings within the last 2 years for the Society of Critical Care Medicine, the European Society of Intensive Care and Emergency Medicine, American Heart Association, the American College of Cardiology, the European Society of Cardiology, and the Canadian Cardiovascular Society.

### Study Selection

We included RCTs if they examined patients with OHCA who were randomized to early coronary

angiography as compared with delayed angiography. We included studies of adults who had been successfully resuscitated after OHCA in the absence of ST-segment elevation on post ROSC ECG. We included studies reporting on the following outcomes: mortality at longest follow-up, disability (as measured by the Cerebral Performance Category [CPC] or another validated scale as per the individual study), duration of mechanical ventilation, ICU length of stay (LOS), hospital LOS, and adverse events including ventricular arrhythmias, major bleeding (as defined by study authors), acute kidney injury (as defined by study authors), and need for renal replacement therapy. For outcomes reported at multiple timepoints, we used the longest reported follow-up.

After implementation of the search strategy, two reviewers screened potentially relevant citations independently and in duplicate. Citations deemed potentially relevant by either screener were advanced to full-text review. Full texts were subsequently reviewed for eligibility, with disagreements resolved by consensus, and third-party adjudication if required. We captured reasons for exclusion at the full-text screening stage.

### Data Extraction and Quality Assessment

Reviewers extracted data independently and in duplicate using prepiloted data abstraction forms. We extracted the following information from included studies: study title, first author, demographic data, details of the intervention, control, outcome data, and risk of bias (RoB) for each study. We contacted study authors for clarification when the population characteristics, method of follow-up, or outcome data were unclear or not reported. We assessed RoB, independently and in duplicate using a modified Cochrane RoB 2 tool (22) for which each domain is rated as "low," "probably low," "high," or "probably high." We examined the following RoB domains: bias arising from the randomization process, bias due to protocol deviations, bias due to missing outcome data, bias in outcome measurement, and bias due to selective outcome reporting. We rated the overall RoB for an individual trial close to the highest risk attributed to any domain.

We assessed the overall certainty of evidence for each outcome using the Grading Recommendations Assessment, Development and Evaluation (GRADE) approach (23). We resolved disagreements for RoB and GRADE assessment by consensus. We used the Guideline Development Tool (www.gradepro.org) to build the Summary of Findings table. For LOS outcomes, a clinically important difference was considered one day. Results were contextualized using GRADE narrative statements (24).

### Statistical Analysis

We used DerSimonian and Laird random-effects models (25) to conduct the meta-analysis using RevMan 5.4 (Cochrane Collaboration, Oxford, United Kingdom) software. We generated study weights using the inverse variance method for continuous outcomes and dichotomous outcomes. We present results as relative risks (RRs) and risk difference (RD) for dichotomous outcomes and mean difference (MD) for continuous outcomes, all with 95% CIs. We calculated absolute effects using the pooled baseline prevalence from the control arm of included trials. The Hozo model was used to convert median and range to mean and variance when required (26). We assessed heterogeneity between trials using visual inspection of the forest plots, the chi-square test for homogeneity (where $p < 0.1$ indicates important heterogeneity), and the $I^2$ statistic (for which 50% or greater was considered reflective of potentially important heterogeneity) (27). Although planned, we did not construct funnel plots to assess for publication bias as these are inaccurate when less than 10 trials are included in the analysis (28). We planned to perform predefined subgroup analysis comparing studies of 1) high RoB compared with those at low RoB, 2) patients with initial shockable rhythm compared with nonshockable rhythm, 3) patients with known coronary artery disease compared with no known coronary artery disease, and 4) patients with duration of arrest greater than or equal to 20 minutes compared with less than 20 minutes. For subgroup findings that were significant, we planned to use the Instrument for assessing the Credibility of Effect Modification Analyses (ICEMAN) tool to judge subgroup credibility (29).

## RESULTS

Of the 383 citations identified in the search (**Fig. 1**), we excluded 97 duplicates and a further 234 citations after

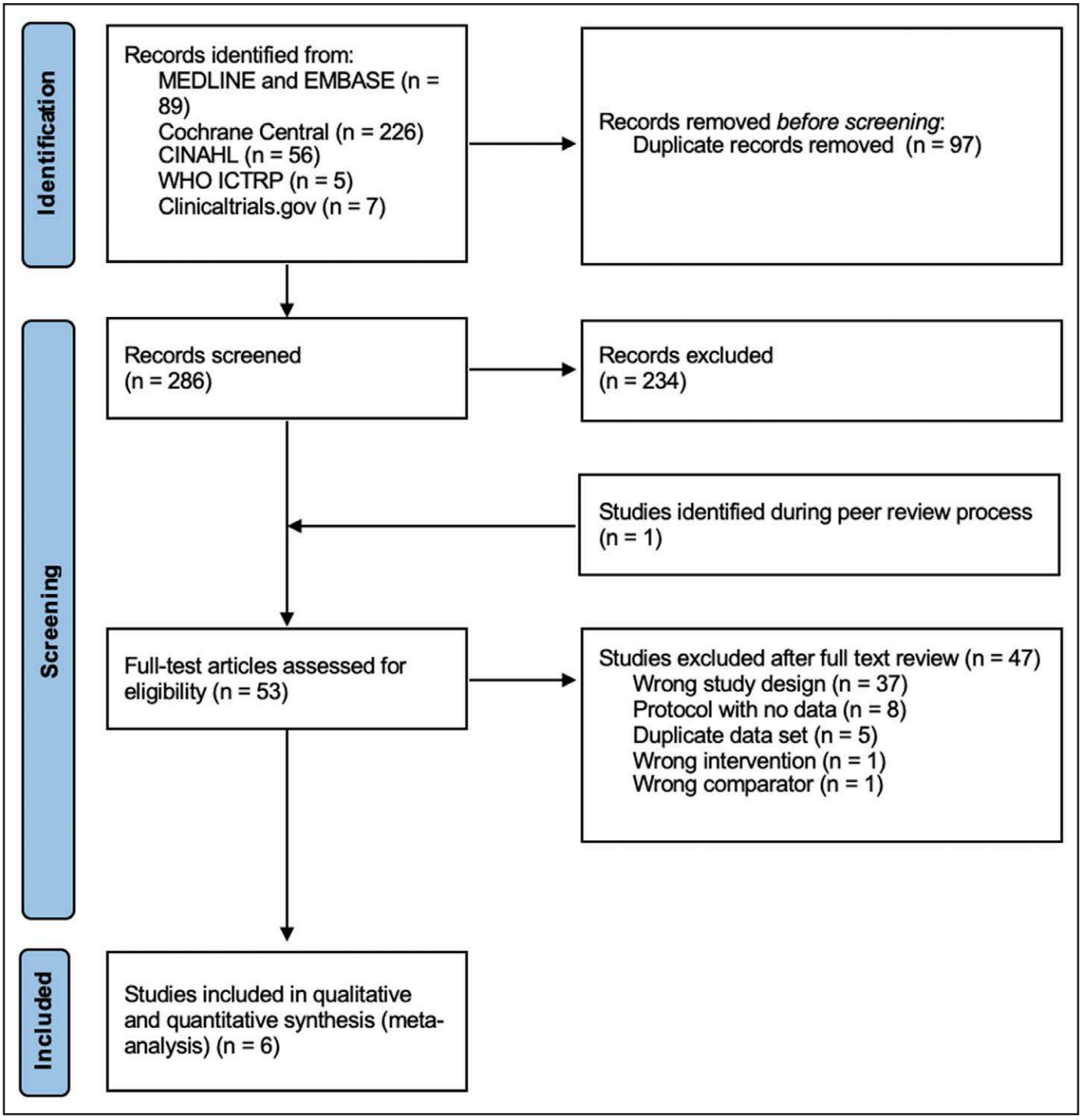


**Figure 1.** Study flowchart.

title and abstract screening, and we assessed 47 full texts. We included six RCTs ($n$ = 1,590 patients) in the review (14–18, 20). Baseline characteristics of included trials are summarized in **Appendix 8, Supplemental Table 1** (http://links.lww.com/CCX/B149). One trial was originally included as an abstract; however, upon publication of the article after our search was completed, we did a full text review and included this trial in our analysis (18). A further recent RCT was published during the peer review process and was included in our analysis (20).

## Description of Included Studies

All included RCTs were multicenter studies. The mean age of participants ranged from 65 to 71 years.

Five trials included adults greater than or equal to 18 years; one trial included adults greater than or equal to 30 years (14). All trials included patients with OHCA presumed to be cardiac in origin and excluded patients who had an obvious or suspected noncardiac etiology of the cardiac arrest. One trial only included patients with initial shockable arrest rhythm (17). The timing of early angiography varied among studies: immediately after randomization in two trials (16, 18), within 1 hour of patient presentation in one trial (14), and within 2 hours of patient presentation in three trials (15, 17, 20). In the trials with early angiography immediately after presentation, one did not provide time from arrest to angiography (16), whereas the other trial had a median time from arrest to angiography of 2 hours (18). The timing of delayed angiography ranged between 6 hours and 4 days following hospital presentation. The decision to perform angiography, however, was subject to neurologic recovery or discretion of the treating physician in three trials (14, 15, 17).

Patients randomized to the delayed angiography group were initially managed with usual care in the ICU; however, all included trials provided opportunity to expedite to urgent angiography if patients deteriorated, with evidence of unstable electrical activity, concerning ECG changes, cardiogenic shock, new significant echocardiographic findings, or refractory hemodynamic instability. Across included studies, of the patients randomized to early angiography, 763 of 798 (95.6%) received angiography, whereas 473 of 792 patients (59.7 %) assigned to delayed angiography received an angiogram during their index hospitalization (14–18, 20). The duration of follow-up ranged between 3 months and 1 year. Severity of coronary artery disease was reported in five trials (included in Appendix 8, Supplemental Table 1, http://links.lww.com/CCX/B149). Overall, an acute unstable coronary lesion was identified in 65 of 437 patients (14.9%) in one trial (17), and a culprit coronary lesion in 225 of 566 patients (39.8%) in four trials (14–16, 20). Culprit or unstable lesion was not described in one trial, but percutaneous coronary intervention was performed in 55 of 200 patients (27.5%) receiving angiography (18). Five of the included trials were judged to be at probably low RoB (14, 15, 17, 18, 20) and one trial at high RoB (16) (see **Table 1** for RoB judgments).

**TABLE 1.**
**Risk of Bias Determination Using Modified Cochrane Risk of Bias 2 Tool**

| References | Bias Arising From the Randomization Process | Bias Due to Deviations From Intended Interventions | Bias Due to Missing Outcome Data | Bias in Measurement of the Outcome | Bias in Selection of the Reported Result | Overall ROB |
|---|---|---|---|---|---|---|
| Lemkes et al [17] (COACT) | Low | Probably low | Low | Low | Low | Probably low |
| Elfwen et al. [16], (DISCO) | Low | High | Low | Low | Low | High |
| Kern et al [15] (PEARL) | Low | Probably low | Low | Low | Low | Probably low |
| Desch et al [14] (TOMAHAWK) | Low | Probably low | Low | Low | Low | Probably low |
| Hauw-Berlemont et al [18] (EMERGE) | Low | Probably low | Low | Low | Low | Probably low |
| Viana-Tejedor et al [20] (COUPE) | Low | Probably low | Low | Low | Low | Probably low |

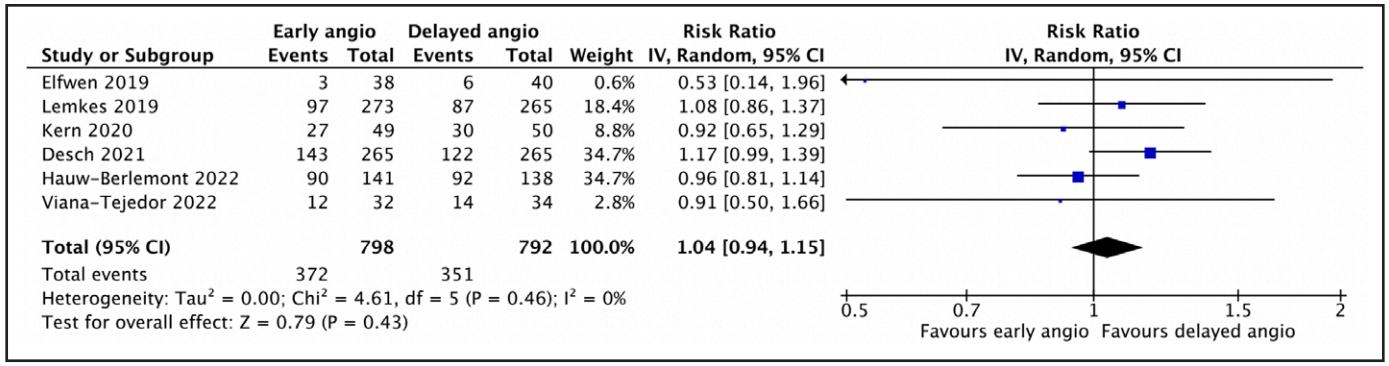


**Figure 2.** Forest plot comparing early versus delayed angiography after out-of-hospital cardiac arrest without ST-segment elevation for mortality at longest point of follow-up. df = degrees of freedom.

## Efficacy Outcomes

**Appendix 8, Supplemental Table 2** (http://links.lww.com/CCX/B149) shows the summary of findings for all outcomes including the certainty of evidence. Pooled analysis found that in patients with OHCA without ST elevation, early angiography probably has no effect on mortality at the longest follow-up (RR 1.04; 95% CI 0.94–1.15; RD 1.8% increase; 95% CI, 2.7% reduction to 6.6% increase; moderate certainty) (**Fig. 2**) and may have no effect on survival with good neurologic outcome as assessed with the CPC score of 2 or less (RR 0.97; 95% CI 0.87–1.07; RD 1.4% reduction; 95% CI, 6.1% reduction to 3.3% increase; low certainty) (**Fig. 3**). Early angiography may have no effect on ICU LOS (MD 0.41 d fewer; 95% CI –1.3 to 0.5 d; low certainty) (**Appendix 6, Supplemental Fig. 1**, http://links.lww.com/CCX/B149). Early angiography may have no effect on duration of mechanical ventilation (MD 0.29 d fewer; 95% CI –1.2 to 0.6 d; low certainty) (**Appendix 6, Supplemental Fig. 2**, http://links.lww.com/CCX/B149) and may have no effect on hospital LOS (MD 0.82 d fewer; 95% CI –3.9 to 2.3 d; low certainty) (**Appendix 6, Supplemental Fig. 3**, http://links.lww.com/CCX/B149).

## Safety

Early angiography has an uncertain effect on major bleeding (RR 0.95, 95% CI 0.55–1.62; RD 0.2% decrease, 2.0% decrease to 2.7% increase; very low certainty) (**Appendix 6, Supplemental Fig. 4**, http://links.lww.com/CCX/B149), acute kidney injury (RR 1.18, 95% CI 0.33–4.20; RD 1.7% increase, 95% CI 6.4% decrease to 30.3% increase; very low certainty) (**Appendix 6, Supplemental Fig. 5**, http://links.lww.com/CCX/B149), or need for renal replacement therapy (RR 1.10, 95% CI 0.78–1.57; RD 0.9% increase, 95% CI 2.0% decrease to 5.2% increase; very low certainty) (**Appendix 6, Supplemental Fig. 6**, http://links.lww.com/CCX/B149). Furthermore, early angiography has an uncertain effect on the incidence of ventricular arrhythmia (RR 0.75, 95% CI 0.30–1.90; RD 2.0% decrease, 95% CI 5.6% decrease to 7.2% increase; very low certainty) (**Appendix 6, Supplemental Fig. 7**, http://links.lww.com/CCX/B149). The CIs for all safety outcomes were wide and did not rule out the potential for harm (**Appendix 8, Supplemental Table 3**, http://links.lww.com/CCX/B149).

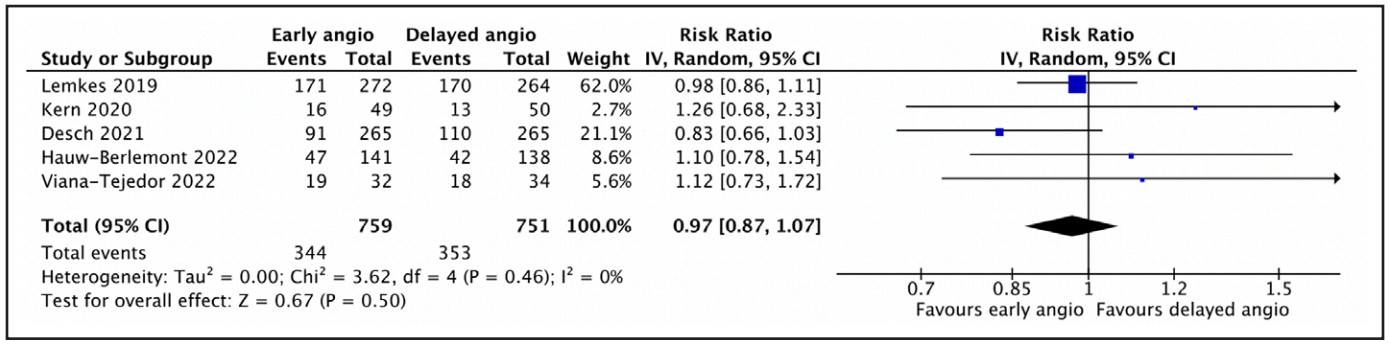


**Figure 3.** Forest plot comparing early versus delayed angiography after out-of-hospital cardiac arrest without ST-segment elevation for survival with good neurological outcome as defined by Cerebral Performance Score of 2 or less. df = degrees of freedom.

### Sensitivity and Subgroup Analysis

Subgroup analyses comparing mortality in high RoB studies versus low RoB studies or based on initial shockable rhythm did not demonstrate effect modification for mortality at longest follow-up ($p$ value for subgroup interaction < 0.05) (**Appendix 6, Supplemental Figs. 7** and **8**, http://links.lww.com/CCX/B149). Although planned, lack of data did not allow for other subgroup analyses.

## DISCUSSION

This systematic review and meta-analysis of RCTs demonstrates that compared with delayed or no angiography, early angiography probably has no effect on mortality and may have no effect on survival with good neurologic outcome and ICU LOS for patients without ST elevation post OHCA. Furthermore, early angiography may have no effect on duration of mechanical ventilation and hospital LOS and has an uncertain effect on most adverse events.

The lack of benefit of early angiography post OHCA may be due to the heterogenous population included in this group without ST elevation post ROSC. The hypothesized benefit of early angiography is the identification and subsequent revascularization of an acute coronary occlusion. However, patients without ST elevation after OHCA often do not have an acute coronary occlusion, with an incidence of only 15–40% from trials included within this review. In contrast, in patients with ST elevation after OHCA, 70–90% have an acute coronary occlusion (8). Early angiography will likely not benefit patients with other causes of cardiac arrest and may even delay identification and treatment of noncardiac causes of arrest. The trials included in this meta-analysis selected patients most likely to benefit from early angiography by excluding patients with obvious or presumed noncardiac causes of cardiac arrest (14–18). Despite this enrichment strategy, early angiography was not found to be beneficial.

The results of this analysis are consistent with a previous meta-analysis of RCTs addressing the question that did not include the most recently published RCTs (19). That being said, by including the Emergency versus Delayed Coronary Angiogram in Survivors of OHCA Without ST-Segment Elevation trial ($n$ = 279) and the Coronary Angiography in Patients Without ST-segment Elevation Following OHCA trial ($n$ = 66), which were not included in the previous review (18, 20), we have achieved a higher degree of precision in findings which may provide stronger conclusions. Other incremental additions of this review compared with previous meta-analyses on the topic include using the GRADE approach to assess certainty in estimates of effect and excluding two studies which had been included in previously published meta-analysis but which were deemed ineligible for this meta-analysis (30, 31). Of these two that were excluded, one was a post hoc observational study of the targeted temperature management RCT (30), where the decision for timing of angiography was determined by the treating clinician and was not done in a randomized fashion. The second study was an RCT comparing expedited transfer to a specialized postcardiac arrest center for early angiography, versus transfer to the nearest geographical center where the decision to perform angiography in this group was left to the discretion of the treating clinician (31). Of concern, 14 of 18 patients in the control group received angiography with a median time from arrest to angiogram of 132 minutes, versus a median time of 100 minutes in early angiography group. We decided to exclude this study given this strategy does not reflect our comparator of interest but rather is comparing early angiography at a specialized cardiac arrest center versus early angiography at the geographically nearest hospital to the arrest.

It is still possible that certain subgroups of patients without ST elevation may benefit from early angiography; unfortunately, we did not have sufficient trial level data to perform many preplanned subgroup analyses. Large ongoing RCTs are comparing early angiography versus delayed or no angiography and can hopefully better delineate these subgroups of interest and provide more precision to best inform clinical decisions (32). Further consideration of clinical history of preceding chest pain, non-ST elevation ECG changes, echocardiographic findings demonstrating new regional wall motion abnormalities, and elevated troponin values could identify OHCA patients who may benefit from an early angiography strategy (33–35). Another OHCA population not captured in any of the published RCTs is noncomatose patients, a population with a better prognosis than comatose patients, and one which will be studied in the upcoming DISCO-NO-COMA trial (36–38). It is hypothesized that in the noncomatose population, early angiography may prevent progressive myocardial injury leading to rearrest, compared with comatose patients who most

often die from neurologic injury or withdrawal of life-sustaining therapies due to anticipated poor prognosis and whose prognosis may not change with coronary revascularization (39).

Multiple international guidelines addressing cardiopulmonary resuscitation have deemphasized the role of early angiography after OHCA in patients without ST elevation post ROSC (4, 10) since the results of the Coronary Angiography after Cardiac Arrest without ST-Segment Elevation trial published in 2019 (17). However, the results of the most recent RCTs were not available during the development of those guidelines. As such, this systematic review and meta-analysis will provide further granularity and stronger conclusions for future guidelines to consider when balancing the potential benefits, harms, as well as values and preferences, and costs in developing clinical recommendations for angiography strategies for patients after OHCA without ST elevation.

This systematic review has several strengths, including adherence to a preregistered protocol, a comprehensive literature search including unpublished sources, duplicate and independent screening and data abstraction, application of the GRADE approach to assess certainty in pooled estimates of effect, and the inclusion of the most recent published RCTs. There are also limitations. First, we were unable to perform many of the preplanned subgroup analyses due to insufficient trial level data. Second, there was important heterogeneity in outcome definitions between studies, which may have contributed to serious imprecision in reporting of outcomes; however, this clinical heterogeneity did not translate into statistical heterogeneity for outcomes of interest. Third, the timing of delayed angiography varied between trials.

## CONCLUSIONS

In OHCA patients without ST elevation, early angiography probably has no effect on mortality. Early angiography may have no effect on survival with good neurologic outcome, hospital LOS, and ICU LOS and has an uncertain effect on most adverse events.

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## REFERENCES

1. Daya MR, Schmicker RH, Zive DM, et al: Out-of-hospital cardiac arrest survival improving over time: Results from the Resuscitation Outcomes Consortium (ROC). *Resuscitation* 2015; 91:108–115
2. Grunau B, Kime N, Leroux B, et al: Association of intra-arrest transport vs continued on-scene resuscitation with survival to hospital discharge among patients with out-of-hospital cardiac arrest. *JAMA* 2020; 324:1058–1067
3. Yan S, Gan Y, Jiang N, et al: The global survival rate among adult out-of-hospital cardiac arrest patients who received cardiopulmonary resuscitation: A systematic review and meta-analysis. *Crit Care* 2020; 24:61
4. Panchal AR, Bartos JA, Cabañas JG, et al: Part 3: adult basic and advanced life support: 2020 American Heart Association guidelines for cardiopulmonary resuscitation and emergency cardiovascular care. *Circulation* 2020; 142(16_suppl_2):S366–S468
5. Geri G, Passouant O, Dumas F, et al: Etiological diagnoses of out-of-hospital cardiac arrest survivors admitted to the intensive care unit: Insights from a French registry. *Resuscitation* 2017; 117:66–72
6. Dumas F, Cariou A, Manzo-Silberman S, et al: Immediate percutaneous coronary intervention is associated with better survival after out-of-hospital cardiac arrest: Insights from the PROCAT (Parisian Region Out of hospital Cardiac ArresT) registry. *Circ Cardiovasc Interv* 2010; 3:200–207
7. Vyas A, Chan PS, Cram P, et al: Early coronary angiography and survival after out-of-hospital cardiac arrest. *Circ Cardiovasc Interv.* 2015; 8:e002321

8. Yannopoulos D, Bartos JA, Aufderheide TP, et al: The evolving role of the cardiac catheterization laboratory in the management of patients with out-of-hospital cardiac arrest: A scientific statement from the American Heart Association. *Circulation* 2019; 139:e530–e552
9. Wong GC, Diepen S van, Ainsworth C, et al: Canadian Cardiovascular Society/Canadian Cardiovascular Critical Care Society/Canadian Association of Interventional Cardiology position statement on the optimal care of the postarrest patient. *Can J Cardiol* 2017; 33:1–16
10. Nolan JP, Sandroni C, Böttiger BW, et al: European Resuscitation Council and European Society of Intensive Care Medicine guidelines 2021: Post-resuscitation care. *Intensive Care Med* 2021; 47:369–421
11. Radsel P, Knafelj R, Kocjancic S, et al: Angiographic characteristics of coronary disease and postresuscitation electrocardiograms in patients with aborted cardiac arrest outside a hospital. *Am J Cardiol* 2011; 108:634–638
12. Garcia S, Drexel T, Bekwelem W, et al: Early access to the cardiac catheterization laboratory for patients resuscitated from cardiac arrest due to a shockable rhythm: the Minnesota resuscitation consortium twin cities unified protocol. *J Am Heart Assoc* 2670; 5:e00
13. Welsford M, Bossard M, Shortt C, et al: Does early coronary angiography improve survival after out-of-hospital cardiac arrest? A systematic review with meta-analysis. *Can J Cardiol*. 2018;34:180–194
14. Desch S, Freund A, Akin I, et al: Angiography after out-of-hospital cardiac arrest without ST-segment elevation. *N Engl J Med* 2021; 385:2544–2553
15. Kern KB, Radsel P, Jentzer JC, et al: Randomized pilot clinical trial of early coronary angiography versus no early coronary angiography after cardiac arrest without ST-segment elevation: The PEARL study. *Circulation* 2020; 142:2002–2012
16. Elfwén L, Lagedal R, Nordberg P, et al: Direct or subacute coronary angiography in out-of-hospital cardiac arrest (DISCO)—An initial pilot-study of a randomized clinical trial. *Resuscitation* 2019; 139:253–261
17. Lemkes JS, Janssens GN, van der Hoeven NW, et al: Coronary angiography after cardiac arrest without ST-segment elevation. *N Engl J Med* 2019; 380:1397–1407
18. Hauw-Berlemont C, Lamhaut L, Diehl JL, et al: Emergency vs delayed coronary angiogram in survivors of out-of-hospital cardiac arrest: Results of the randomized, multicentric EMERGE trial. *JAMA Cardiol* 2022
19. Abusnina W, Al-Abdouh A, Latif A, et al: Timing of coronary angiography in patients following out-of-hospital cardiac arrest without ST-segment elevation: A systematic review and meta-analysis of randomized trials. *Cardiovasc Revasc Med* 2021
20. Viana-Tejedor A, Andrea-Riba R, Scardino C, et al: Coronary angiography in patients without ST-segment elevation following out-of-hospital cardiac arrest. *Rev Espanola Cardiol Engl Ed* 2022; S1885-5857:00122–00120
21. Page MJ, McKenzie JE, Bossuyt PM, et al: The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ* 2021; 372
22. Sterne JAC, Savović J, Page MJ, et al: RoB 2: A revised tool for assessing risk of bias in randomised trials. *BMJ* 2019; 366
23. Guyatt GH, Oxman AD, Vist GE, et al: GRADE: An emerging consensus on rating quality of evidence and strength of recommendations. *BMJ* 2008; 336:924–926
24. Santesso N, Glenton C, Dahm P, et al: GRADE guidelines 26: Informative statements to communicate the findings of systematic reviews of interventions. *J Clin Epidemiol* 2020; 119:126–135
25. DerSimonian R, Laird N: Meta-analysis in clinical trials. *Control Clin Trials* 1986; 7:177–188
26. Hozo SP, Djulbegovic B, Hozo I: Estimating the mean and variance from the median, range, and the size of a sample. *BMC Med Res Methodol* 2005; 5:13
27. Higgins JPT, Thompson SG, Deeks JJ, et al: Measuring inconsistency in meta-analyses. *BMJ* 2003; 327:557–560
28. Egger M, Davey Smith G, Schneider M, et al: Bias in meta-analysis detected by a simple, graphical test. *BMJ* 1997; 315:629–634
29. Schandelmaier S, Briel M, Varadhan R, et al: Development of the instrument to assess the credibility of effect modification analyses (ICEMAN) in randomized controlled trials and meta-analyses. *CMAJ* 2020; 192:E901–E906
30. Dankiewicz J, Nielsen N, Annborn M, et al: Survival in patients without acute ST elevation after cardiac arrest and association with early coronary angiography: A post hoc analysis from the TTM trial. *Intensive Care Med* 2015; 41:1177856–1171177
31. Patterson T, Perkins A, Perkins GD, et al: Rationale and design of: A randomized trial of expedited transfer to a cardiac arrest center for non-ST elevation out-of-hospital cardiac arrest: The ARREST randomized controlled trial. *Am Heart J* 2018; 204:92–101
32. Lagedal R, Elfwén L, James S, et al: Design of DISCO—Direct or subacute coronary angiography in out-of-hospital cardiac arrest study. *Am Heart J* 2018; 197:53–61
33. Garcia-Tejada J, Jurado-Román A, Rodríguez J, et al: Post-resuscitation electrocardiograms, acute coronary findings and in-hospital prognosis of survivors of out-of-hospital cardiac arrest. *Resuscitation* 2014; 85:1245–1250
34. Lee SE, Uhm JS, Kim JY, et al: Combined ECG, echocardiographic, and biomarker criteria for diagnosing acute myocardial infarction in out-of-hospital cardiac arrest patients. *Yonsei Med J* 2015; 56:887–894
35. Dumas F, Manzo-Silberman S, Fichet J, et al: Can early cardiac troponin I measurement help to predict recent coronary occlusion in out-of-hospital cardiac arrest survivors? *Crit Care Med* 2012; 40:1777–1784
36. Terkelsen CJ: Direct or Subacute Coronary Angiography in Patients With Out of Hospital Cardiac Arrest Without Coma. A Prospective Randomized Study, 2021. Report No: NCT04876222. Available at: https://clinicaltrials.gov/ct2/show/NCT04876222. Accessed February 10, 2022
37. Pleskot M, Hazukova R, Stritecka H, et al: Long-term prognosis after out-of-hospital cardiac arrest with/without ST elevation myocardial infarction. *Resuscitation* 2009; 80:795–804
38. Sandroni C, D'Arrigo S, Nolan JP: Prognostication after cardiac arrest. *Crit Care* 2018; 22:150
39. Laver S, Farrow C, Turner D, et al: Mode of death after admission to an intensive care unit following cardiac arrest. *Intensive Care Med* 2004; 30:2126–2128