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Original article

Aspiration Thrombectomy for Treatment of ST-segment Elevation Myocardial Infarction: a Meta-analysis of 26 Randomized Trials in 11 943 Patients

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ABSTRACT

Introduction and objectives: There is continued debate about the routine use of aspiration thrombectomy in patients with ST-segment elevation myocardial infarction. Our aim was to evaluate clinical and procedural outcomes of aspiration thrombectomy-assisted primary percutaneous coronary intervention compared with conventional primary percutaneous coronary intervention in patients with ST-segment elevation myocardial infarction.

Methods: We performed a meta-analysis of 26 randomized controlled trials with a total of 11 943 patients. Clinical outcomes were extracted up to maximum follow-up and random effect models were used to assess differences in outcomes.

Results: We observed no difference in the risk of all-cause death (pooled risk ratio = 0.88; 95% confidence interval, 0.74-1.04; $P = .124$), reinfarction (pooled risk ratio = 0.85; 95% confidence interval, 0.67-1.08; $P = .176$), target vessel revascularization (pooled risk ratio = 0.86; 95% confidence interval, 0.73-1.00;$P = .052$), or definite stent thrombosis (pooled risk ratio = 0.76; 95% confidence interval, 0.49-1.16; $P = .202$) between the 2 groups at a mean weighted follow-up time of 10.4 months. There were significant reductions in failure to reach Thrombolysis In Myocardial Infarction 3 flow (pooled risk ratio = 0.70; 95% confidence interval, 0.60-0.81; $P < .001$) or myocardial blush grade 3 (pooled risk ratio = 0.76; 95% confidence interval, 0.65-0.89; $P = .001$), incomplete ST-segment resolution (pooled risk ratio = 0.72; 95% confidence interval, 0.62-0.84; $P < .001$), and evidence of distal embolization (pooled risk ratio = 0.61; 95% confidence interval, 0.46-0.81; $P = .001$) with aspiration thrombectomy but estimates were heterogeneous between trials.

Conclusions: Among unselected patients with ST-segment elevation myocardial infarction, aspiration thrombectomy-assisted primary percutaneous coronary intervention does not improve clinical outcomes, despite improved epicardial and myocardial parameters of reperfusion.

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Trombectomía por aspiración para el tratamiento del infarto agudo de miocardio con elevación del segmento ST: un metanálisis de 26 ensayos aleatorizados con 11.943 pacientes

Palabras clave:
Infarto de miocardio
Aspiración de trombo
Metanálisis

RESUMEN

Introducción y objetivos: Hay un debate permanente respecto al uso sistemático de la trombectomía por aspiración en los pacientes con infarto agudo de miocardio con elevación del segmento ST. El objetivo de este estudio es comparar los resultados de la intervención y los resultados clínicos en pacientes tratados con intervención coronaria percutánea primaria asistida mediante trombectomía por aspiración con los de una intervención coronaria percutánea primaria convencional en el contexto de infarto agudo de miocardio con elevación del segmento ST.

Métodos: Se realizó un metanálisis de 26 ensayos controlados y aleatorizados con un total de 11.943 pacientes. Los resultados clínicos se extrajeron durante el periodo máximo de seguimiento y se utilizaron modelos de efectos aleatorios para evaluar las diferencias de los resultados.

Resultados: No se observaron diferencias en el riesgo de muerte por cualquier causa (razón de riesgos combinada = 0,88; intervalo de confianza del 95%, 0,74-1,04; p = 0,124), reinfarto (razón de riesgos

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combinada = 0,85; intervalo de confianza del 95%, 0,67-1,08; p = 0,176), revascularización de vaso diana (razón de riesgos combinada = 0,86; intervalo de confianza del 95%, 0,73-1,00; p = 0,052) o trombosis de *stent* definitiva (razón de riesgos combinada = 0,76; intervalo de confianza del 95%, 0,49-1,16; p = 0,202) entre los dos grupos tras una media ponderada de tiempo de seguimiento de 10,4 meses. Se produjeron reducciones significativas de no lograr flujo *Thrombolysis In Myocardial Infarction* 3 (razón de riesgos combinada = 0,70; intervalo de confianza del 95%, 0,60-0,81; p < 0,001), el grado 3 de opacificación *(blush)* miocárdica (razón de riesgos combinada = 0,76; intervalo de confianza del 95%, 0,65-0,89; p = 0,001), resoluciones del segmento ST incompletas (razón de riesgos combinada = 0,72; intervalo de confianza del 95%, 0,62-0,84; p < 0,001) y los signos de embolización distal (razón de riesgos combinada = 0,61; intervalo de confianza del 95%, 0,46-0,81; p = 0,001) con la trombectomía por aspiración, pero las estimaciones fueron heterogéneas entre los ensayos.

Conclusiones: En pacientes con infarto agudo de miocardio con elevación del segmento ST no seleccionados, la intervención coronaria percutánea primaria asistida mediante trombectomía por aspiración no mejora los resultados clínicos pese a la mejora de los parámetros de reperfusión epicárdicos y miocárdicos.

Abbreviations

AT: aspiration thrombectomy
iSTR: incomplete ST-segment resolution
MBG: myocardial blush grade
PPCI: primary percutaneous coronary intervention
STEMI: ST-segment elevation myocardial infarction

INTRODUCTION

Primary percutaneous coronary intervention (PPCI) is the standard of care for patients with ST-segment elevation myocardial infarction (STEMI).[1,2] Compared with fibrinolysis, PPCI is associated with improved patency of the infarct-related artery, a lower risk of reocclusion and reinfarction, faster and more complete resolution of ST-segment elevation, and improved epicardial (Thrombolysis In Myocardial Infarction [TIMI] flow 3) and myocardial reperfusion myocardial blush grade [MBG] 3).[3] In aggregate, these benefits translate into reduced infarct size and improved survival.[4]

Nevertheless, up to one-fourth of reperfused coronary arteries show evidence of impaired flow at the myocardial level (MBG < 2) after PPCI,[5] commonly referred to as no-reflow phenomenon and associated with increased infarct size and reduced survival.[6] Among several causes, embolization of thrombotic material and plaque debris into the microcirculation during stent implantation is an important putative mechanism of reperfusion injury,[7] which has led to the development of dedicated devices to further improve on results.[8]

Although distal protection devices failed to improve epicardial and myocardial reperfusion or infarct size, aspiration thrombectomy (AT) has yielded some positive results.[9] The procedure is technically simple, not time demanding, and can be easily performed in nearly all anatomies.[10] Several studies and systematic reviews have reported improved parameters of reperfusion following AT.[10–14] However, a survival benefit has not been consistently observed.[8,15–17] In view of the recently reported 1-year outcomes of the large-scale Thrombus Aspiration in ST-Elevation myocardial infarction in Scandinavia (TASTE) trial, we performed a meta-analysis to assess the clinical value of AT in the management of STEMI.

METHODS

Search Strategy

We searched MEDLINE and EMBASE through OvidSp, PubMed, and the Cochrane Central Register of Controlled Trials (CENTRAL) with a combination of words and keywords related to "thrombectomy," "thrombus," and "myocardial infarction," with no restrictions for language. Published meta-analyses and reference lists of the finally eligible trials were reviewed. We provided our list of identified randomized clinical trials to experts in the field with a request to provide us citations to randomized clinical trials not yet identified. The searches were performed on September 5, 2014 (Tables 1 and 2 of the supplementary material).

Eligibility Criteria

Included trials met the following criteria: *a)* investigated AT-assisted PPCI in the setting of STEMI, and *b)* patients were randomly allocated to PPCI with or without AT within 24 hours of symptom onset. Aspiration thrombectomy included all manual thrombectomy devices and vacuum aspiration devices. Trials that randomized rescue PCI patients were included, but not those that tested facilitated PCI with fibrinolysis. We excluded studies not providing any prespecified outcome, studies using mechanical thrombectomy devices, studies of thrombectomy in saphenous vein grafts, those comparing different thrombectomy devices with each other, and combined strategies (ie, with additional antithrombotic therapy or protection devices). Two investigators (Ernest Spitzer and Stefan Stortecky) independently performed the screening, reviewed articles, and determined their eligibility through the web-based software EROS (Early Review Organizing Software). Discrepancies were resolved by consensus.

Data Extraction and Pre-specified Outcomes

We extracted characteristics of trials, patients and interventions, including study design, length of follow-up, details on methodological quality, source of funding, time of randomization, age, sex, diabetes, ischemic time (Table 3 of the supplementary material), use of enteral and parenteral antithrombotic agents, multivessel disease, myocardial infarction involving the left anterior descending artery territory, and visualization of thrombus as a prerequisite prior to randomization.

Procedural outcomes extracted included a surrogate marker of epicardial reperfusion, namely failure to reach TIMI flow grade 3[18]; 2 surrogate markers of myocardial reperfusion, namely failure to reach MBG grade 3,[19] and incomplete ST-segment elevation resolution (iSTR, resolution of < 70% of the sum of the initial ST-segment elevation)[20]; as well as absence of direct stenting,[21] and evidence of distal embolization.[7]

Prespecified clinical endpoints included all-cause death, reinfarction, target vessel revascularization, definite stent thrombosis, and stroke. Data on all-cause death was not available in