



Reviews

Simultaneous multi-vessel coronary thrombosis in patients with ST-elevation myocardial infarction: a systematic review[☆]



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ABSTRACT

Acute ST-elevation myocardial infarction (STEMI) with simultaneous multiple coronary thrombosis has been described, however; the available information about the clinical presentation and management of this condition is scarce. We searched the Medline and Web of Science databases from 1990 until August 2014 for all case reports, case series, and observational studies that reported simultaneous multi-vessel thrombosis at the time of the primary percutaneous coronary intervention (PCI). We excluded the articles that reported an identifiable cause for coronary thrombosis. A total of 29 articles were retrieved yielding 56 patients. Patients were predominantly males (88%) with a mean age of 59 years. Cardiogenic shock was the predominant presentation (41%). Simultaneous thrombosis of the left anterior descending and right coronary arteries was the commonest angiographic finding (50%). Primary PCI was the main treatment modality and an intra-aortic balloon pump was utilized in 38% of the cases. The in-hospital mortality was 5%. Simultaneous multi-vessel thrombosis at the time of STEMI presents a rare condition. The cases reported in the literature presented with a high incidence of cardiogenic shock. Larger studies are needed to address the proper management and evaluate the outcomes associated with this condition.

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1. Introduction

Acute ST-segment elevation myocardial infarction (STEMI) is caused by a complete occlusion of a coronary artery resulting in sudden impairment of perfusion in the territory supplied by the infarct related artery [1]. Simultaneous thrombosis affecting > 1 coronary artery has been reported to occur in about 4.8% of the cases at the time primary percutaneous coronary intervention (PCI) in a single center study [2].

Simultaneous multi-vessel coronary thrombosis can occur secondary to identifiable causes (e.g. coronary vasospasm, cocaine abuse) [3–5]. However, in other cases the underlying etiology remains unidentifiable. Multiple plaque rupture has been postulated as the main theory behind the cases without an identifiable cause [5,6].

Most of the available data about this group of patients with multi-vessel coronary thrombosis are obtained from case reports and series. In a prior study, the authors conducted a systematic review about multi-vessel coronary thrombosis, however; their study was limited by including patients with identifiable causes of thrombosis, and the search was limited to English articles only [2]. In order to better understand the clinical presentation, commonly used management strategies, and outcomes of patients with simultaneous multi-vessel coronary

thrombosis due to unidentifiable causes, we conducted this systematic review of the literature.

2. Materials and methods

A computerized literature search of the Medline and Web of Science databases was conducted without language restriction from January 1990 until August 2014 using the search strategy illustrated in Fig. 1. To ensure that no potentially important studies were missed, the reference lists from the retrieved articles were also reviewed. This review was conducted in concordance with the recommendations of preferred reporting items for systematic reviews and meta-analyses [7].

We included all case reports, case series, and observational studies that reported cases of acute STEMI with multi-vessel thrombosis observed on the coronary angiogram at the time of the primary PCI procedure. We excluded cases with chronic total occlusion, wrap around left anterior descending lesions [8] presentations other than STEMI, identifiable causes of coronary artery thrombosis and PCI or thrombolysis related complications (e.g. hematoma or dissection).

Two authors (AM and MS) independently extracted the data on study type, patients' characteristics, clinical presentation, territory of ST-segment elevation, coronary angiography findings, management, and major outcomes. Any discrepancies were resolved by consensus of the authors. For non-English articles, we used Google Translator (Google, Inc., Mountain View, California).

Simultaneous multi-vessel coronary thrombosis was defined as STEMI associated with direct angiographic visualization of 2 or more

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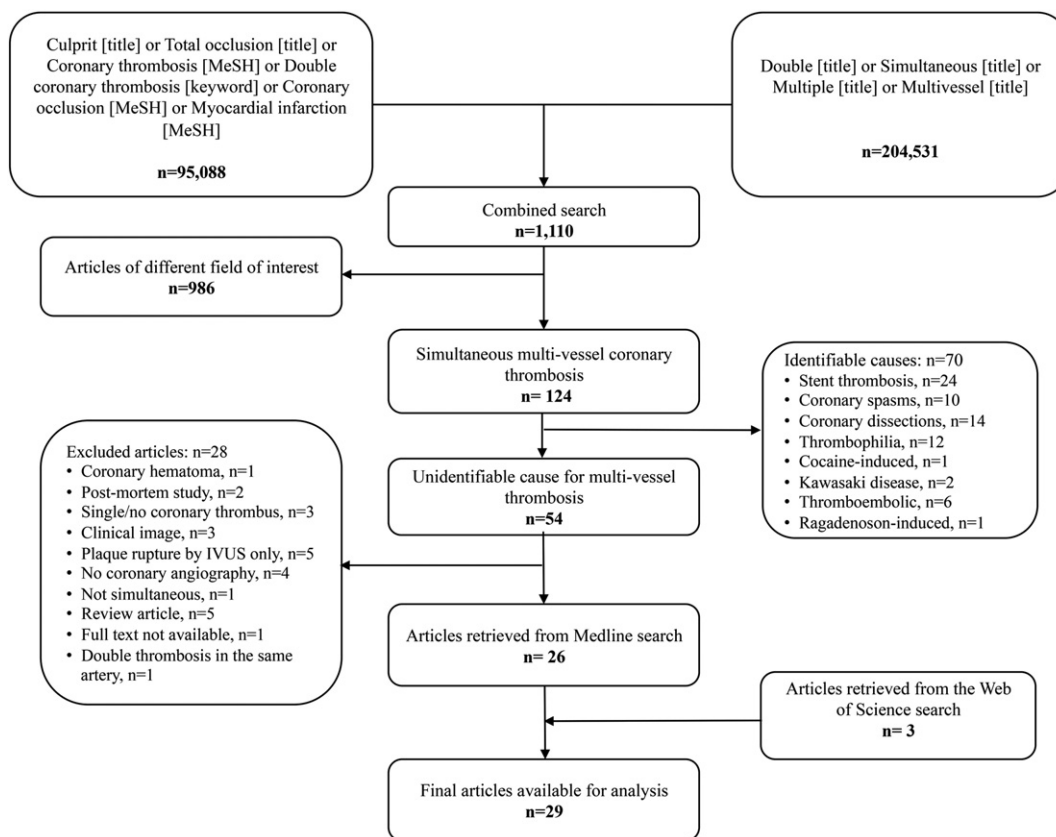


Fig. 1. Study selection flow diagram. Summary of how the systematic search was conducted and eligible studies were identified.

thrombi causing partial or complete occlusion of at least 2 major epicardial coronary arteries. New onset heart failure was defined as a new diagnosis of at least New York Heart Association-Class II heart failure symptoms, a drop in ejection fraction below 45%, initiation of symptomatic heart failure therapy (e.g. furosemide) upon discharge, or readmission with symptomatic heart failure.

We calculated a summation for each individual variable. We also calculated the mean for linear variables and percentages for categorical variables. Data were insufficient to conduct a meta-analysis for the outcomes.

3. Results

Using the search strategy indicated in Fig. 1, a total of 29 articles satisfied our inclusion criteria with a total of 56 patients; 48 patients from 26 case reports and series while 8 patients from 2 prospective studies (Supplementary Table) [2,9–36]. The mean age of the patients was 59 years. Patients were mainly males (88%), current smokers (59%), and with history of hypertension (50%). Two patients had atrial fibrillation on the presentation electrocardiogram (ECG) [2,30], while another patient had history of atrial fibrillation without evidence of atrial fibrillation on ECG upon presentation [11].

Cardiogenic shock was the commonest clinical presentation occurring in 41% of the cases, followed by ventricular arrhythmias (25%). In Table 1, we report the demographics and clinical presentations of the patients while Table 2 summarizes the territory of ST-segment elevation seen on the ECG along with coronary arteries showing the thrombus burden on the coronary angiogram. In one study, the information regarding the culprit vessels and management was lacking [2]. With exclusion of that study, 58% of the patients were found to have total occlusion of all culprit vessels, 26% had partial occlusion of one vessel and total occlusion of the other, while 18% had partial occlusion of all culprit vessels.

Most of the patients were treated with PCI while 2 patients underwent thrombus aspiration [17,27] and 1 patient was referred for urgent coronary artery bypass grafting [25]. In 2 cases, the mode of revascularization was not reported [2]. With exclusion of the previous study [2], 76% of the patients underwent PCI to all culprit lesions during the index procedure, 18% had a single culprit vessel PCI, while 2 patients did not undergo PCI. All patients requiring intervention on more than one culprit vessel, had it performed in the same procedure setting. Nearly two thirds of the patients were given either intracoronary or systemic glycoprotein IIb/IIIa inhibitors during the procedure. 38% of the cases received an intra-aortic balloon pump (IAPB).

Table 1
Patients' demographics and clinical presentation.

A) Demographics	%
Age, years*	32–88 (59)
Male	88
Current smoker	59
Diabetes mellitus	25
Hypertension	50
Hyperlipidemia	21
Family history of CAD	18
Prior history of CAD	16
Previous MI	13
Previous PCI	11
B) Clinical presentation	
Cardiogenic shock	41
Ventricular arrhythmia	25
Bradyarrhythmia	18
Pulmonary edema	11

CAD = coronary artery disease

MI = myocardial infarction

PCI = percutaneous coronary intervention.

* Range and mean were reported

Table 2

Electrocardiogram and coronary angiography findings.

Territory with ST-segment elevation on ECG	%
Inferior	29
Anterior	21
Inferior + anterior	16
Anterior + lateral	11
Inferior + lateral	9
Inferior + posterior	5
Coronary arteries with thrombus burden	
RCA + LAD	50
RCA + LCX	32
LAD + LCX	13

ECG = electrocardiogram

LAD = left anterior descending artery

LCX = left circumflex artery

RCA = right coronary artery

Follow-up duration ranged from hospitalization up to 2 years. 18% of the patients had a new diagnosis of heart failure upon discharge or during the follow-up period. 5% of the patient population died during the index hospitalization while 4% had recurrent myocardial infarction during the follow-up duration. Table 3 reports the management and the outcomes of the patients included in the study.

4. Discussion

In this systematic review, we summarized the common baseline characteristics, clinical presentations, management and outcomes of patients with simultaneous multi-vessel coronary thrombosis, without an identifiable underlying etiology. The etiology behind simultaneous multiple coronary thrombosis can be broadly categorized into identifiable and unidentifiable causes. Identifiable causes include coronary vasospasm [3,4], cocaine abuse [5], increased tendency to thrombosis as in heparin induced thrombocytopenia [6], antithrombin III deficiency [37], idiopathic thrombocytopenic purpura [38], hormonal therapy such as tamoxifen [39] as well as thrombophilias such as antiphospholipid antibodies, factor V Leiden deficiency, essential thrombocythemia and hyperhomocysteinemia [40–44]. We excluded the identifiable causes for thrombosis in an attempt to minimize the confounding influence of such causes on the patient's demographics and management. On the other hand, cases without an identifiable cause have been thought to occur secondary to multiple plaque rupture, which happens mainly in response to the diffuse inflammatory process “panarteritis” involving multiple coronary arteries [22,45], or 2ry to catecholamine surge that causes platelets activation and triggers thrombotic occlusion of multiple coronaries during STEMI [35,46]. Another postulated theory is that complete

atrioventricular block or cardiogenic shock, following single territory STEMI results in impaired blood flow in another coronary artery (with underlying silent stenosis) resulting in coronary thrombosis in that vessel [14,35].

Although the incidence of multi-vessel coronary thrombosis is thought to be low, the incidence of multiple complex plaques seen on coronary angiography in the setting of STEMI has been estimated to be 40–65% [47,48]. Furthermore, autopsy studies demonstrated that thrombosis was evident in more than one coronary artery in up to 50% of the cases of sudden death [49,50]. This discrepancy can be explained by under-reporting of these cases.

There was no difference in the baseline demographics in our patient population when compared to patients presenting with acute STEMI and single vessel thrombosis (i.e. predominantly younger males, hypertensive, and smokers) [51,52]. Cardiogenic shock was the commonest clinical presentation occurring in about 40% of the patients. Most of the patients who presented with cardiogenic shock in our study, received an IABP. This was in concordance with both the American College of Cardiology and European Society of Cardiology guidelines, which recommended the use of IABP in high risk PCI and evidence of cardiogenic shock at the time these cases were published [53,54]. Whether this holds true in the contemporary practice remains unclear, since the more recent randomized clinical trials demonstrated the lack of hard outcome benefits with IABP [55,56].

Primary PCI with either bare-metal or drug eluting stent placement, was the intervention method of choice in most of our patient population, new techniques, including the use of intravascular ultrasound (IVUS) to guide the decision of stent placement and aspiration thrombectomy have been reported successfully as well [17].

The in-hospital mortality for simultaneous multi-vessel coronary thrombosis in our study was 5%, which is lower than the case fatality of STEMI in real world [51,57], especially with the high incidence of cardiogenic shock. This may be explained by report bias since the authors of the original articles reported mainly the patients who survived this event [10–36]. Furthermore, the relatively young age of our patient population along with effective and timely treatment reported in most of the cases might have played a role in the overall lower mortality rate.

Our study has several limitations. First, the majority of the articles that were included in the analysis were case reports and case series that can be prone to bias. Second, the real world incidence and case fatality of this condition might be higher since some cases may not be reported. Third, one of the cases in the study by Pollak et al. was probably cocaine-induced, however, we were not able to exclude it from the study analysis [2]. Finally, we could not perform a meta-analysis for the outcomes since the data were insufficient. Thus, we recommend conducting large cohort studies and prospective registries that would help with better understanding of the incidence of simultaneous multi-vessel coronary thrombosis and capture an accurate picture of outcomes and the optimum method of management of this disease entity.

5. Conclusion

Simultaneous multi-vessel coronary thrombosis is a rare presentation of STEMI and is associated with high incidence of complications including cardiogenic shock and ventricular arrhythmias. Larger studies are needed to address the proper management and evaluate the outcomes associated with this condition.

Supplementary data to this article can be found online at <http://dx.doi.org/10.1016/j.carrev.2015.02.009>.

Disclosures

The authors have no conflicts of interest to disclose.

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Table 3

Management and outcomes of the patients included.

A) Management	%
PCI	91
Glycoprotein IIb/IIIa	64
IABP	38
Transvenous pacemaker	18
Aspiration thrombectomy	14
Systemic thrombolysis	7
Intracoronary thrombolysis	2
B) Outcomes	
New onset heart failure	18
In-hospital mortality	5
Recurrent MI	4
Bleeding	4
Stroke	4

IABP = intra-aortic balloon pump

MI = myocardial infarction

PCI = percutaneous coronary intervention

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