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Intramyocardial dissecting hematoma: A systematic review and pooled analysis of available literature

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Review Article

Abstract

BACKGROUND: The current systematic review and pooled analysis were conducted to answer several questions using findings from case reports and case series as follows: (1) Demographic characteristics; (2) clinical findings; (3) management approach; and (4) prognosis of individuals diagnosed with intramyocardial dissecting hematoma.

METHODS: Electronic databases, including PubMed (Medline), Scopus, and Web of Science, were systematically searched from the earliest available date up to February 2023 using selected keywords. All analyses were performed using SPSS software version 27 (IBM Corp, Armonk, NY, USA), and a P-value less than 0.05 was considered statistically significant.

RESULTS: A total of 77 patients diagnosed with Intramyocardial dissecting hematoma (IDH) comprised the study population, with a mean (standard deviation) age of 58.72 (13.99) years, of which 22.1% were women. Patients of higher age experienced a higher risk for mortality compared to younger subjects (OR=1.05, 95% CI: 1.01, 1.10; P=0.014). In addition, the implementation of angiography (OR=0.25, 95% CI: 0.08, 0.71; P=0.010) and cardiac magnetic resonance (OR=0.19, 95% CI: 0.06, 0.60; P=0.004) in the context of diagnosis reduced the risk of death compared to those who did not receive these interventions. Similarly, the diagnosis of pericardial effusion significantly increased the risk of mortality compared to those without pericardial effusion (OR=3.92, 95% CI: 1.27, 12.07; P=0.017).

CONCLUSION: The authors found that older patients experience a poor prognosis compared to younger ones. In addition, the utilization of angiography and cardiac magnetic resonance improves the prognosis of individuals. Likewise, the diagnosis of pericardial effusion in patients with IDH increases the odds of mortality.

Keywords: Intramyocardial Dissecting Hematoma; Prognosis; Systematic Review

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Introduction

Intramyocardial Dissecting Hematoma (IDH) is a rare form of cardiac rupture that can primarily occur as a complication following Acute Myocardial Infarction (MI) or during the remodeling process[1]. It can also occur following trauma, during Percutaneous Coronary Angioplasty, ablation of Ventricular Tachycardia, and as a complication of cardiac surgery[2]. It is typically caused by a hemorrhagic dissection through the myocardium[1]. The diagnosis of IDH is considered a challenging approach in practical medicine[3]. In most cases, it generally occurs several days following the initiation of symptoms and may lead to a myocardial rupture, termed subacute myocardial rupture, which could be fatal[3]. Up until the 1980s, the diagnosis of IDH mostly relied on the post-mortem approach. The first diagnosis of IDH via echocardiography was reported by Hodsden in 1981[4]. Differential diagnosis includes prominent ventricular trabeculations, intracavitary thrombosis,

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and pseudoaneurysm[5]. With the development of high-resolution echocardiography, more patients were referred for surgery as the diagnosis became possible[5]. Following the introduction of magnetic resonance into clinical practice, the diagnosis of IDH became more accurate[5].

Depending on various pathological and anatomical parameters, IDH may spread out into the pericardium or adjacent cavity, therefore, it may retract with acceptable outcomes or may increase the clinical risk[6-8]. There is no consensus regarding the management of IDH. Two main approaches to IDH treatment include conservative medical therapy or surgical repair. Although IDH is also referred to as subacute rupture, some cases may be managed conservatively, and hence not all patients need to be operated on[9,10].

Despite the growing awareness of clinical practitioners regarding IDH, there are many unknown issues regarding diagnosis, management, and prognosis[11]. Moreover, the authors' understanding is mostly reliant upon case control and case series studies with a limited number of participants. Therefore, the current systematic review and pooled analysis were carried out to answer several questions using findings from case reports and case series as follows: (1) Demographic characteristics; (2) clinical findings; (3) management approach; and (4) prognosis of individuals diagnosed with IDH. The authors' findings may contribute to the existing literature and improve clinical practitioners' understanding of IDH.

Methods and Materials

Search strategy

Electronic databases, including PubMed (Medline), Scopus, and Web of Science, were systematically searched from the earliest available date up to February 2023 using selected keywords. The following keywords were used: "myocardial dissection" OR "myocardial dissecting" OR "myocardial dissecting hematoma" OR "intramyocardial dissecting hematoma" OR "dissection intramyocardial hematoma", and tailored to each database as needed. Google Scholar was manually searched to cover grey literature. The reference list of the enrolled studies was also screened.

Eligibility criteria

All of the search results were exported to the EndNote 20 software (Thomson Corporation, Stamford, USA) to be screened by two independent investigators (R.Z. and A.S.). Original case reports/ series reporting IDH diagnosis and treatment

Table 1. General characteristics of enrolled patients with intramyocardial dissecting hematoma

Variables	Total patients (n=77)	Patients who died (n=26)	Patients who survived (n=51)	P-value
Age [mean ± SD (year)]	58.72 ± 13.99	64.46 ± 11.47	55.80 ± 14.34	0.009[1]
Women [number (%)]	17 (22.1)	7 (26.9)	10 (19.6)	0.464[2]
Due to MI [number (%)]	58 (75.3)	18 (69.2)	40 (78.4)	0.376[2]
ST elevation at ECG [number (%)]	48 (62.3)	17 (65.4)	31 (60.8)	0.694[2]
Angiography [number (%)]	56 (72.7)	14 (53.8)	42 (82.4)	0.008[2]
LVEF [mean ± SD (%)]	31.29 ± 14.08	31.89 ± 14.46	30.93 ± 14.07	0.817[1]
VSD [number (%)]	5 (6.5)	2 (7.7)	3 (5.9)	0.761[2]
Nonhomogeneous mass/cavity [number (%)]	70 (90.9)	22 (84.6)	48 (94.1)	0.170[2]
Pericardial effusion [number (%)]	17 (22.1)	10 (38.5)	7 (13.7)	0.013[2]
CMR [number (%)]	33 (42.9)	5 (19.2)	28 (54.9)	0.003[2]
CT [number (%)]	18 (23.4)	5 (19.2)	13 (25.5)	0.539[2]
Contrast echocardiography [number (%)]	13 (16.9)	4 (15.4)	9 (17.6)	0.802[2]
Surgery [number (%)]	30 (39.0)	8 (30.8)	22 (43.1)	0.293[2]

[1]Calculated by Independent-Samples T test.

[2]Calculated by Chi-square test.

P<0.05 was considered statistically significant.

MI: Myocardial Infarction; ECG: Electrocardiogram; LVEF: Left Ventricular Ejection Fraction; VSD: Ventricular Septal Defect; CMR: Cardiac Magnetic Resonance; CT: Computerized Tomography.

were included if they provided a separate clinical description for each case regarding etiology, diagnosis, management, and prognosis. However, non-English studies were excluded. No exclusion was made regarding the published years of studies.

Data Extraction

The process of data extraction was carried out by two independent investigators (R.Z. and A.S.) using predefined excel sheets. The authors extracted data of interest including patients' sex, and age. Moreover, data regarding the etiology, echocardiographic data, electrocardiographic data, clinical data, management, and outcome, were extracted if available.

Statistical Analysis

All of the analyses were performed using SPSS software version 27 (IBM Corp, Armonk, NY, USA) and a P-value less than 0.05 was considered statistically significant. Continuous outcomes are presented as mean ± standard deviation (SD) and categorical ones as number (percentage). Participants were categorized according to the prognosis of surviving and dying patients. The difference in continuous variables across the two groups was assessed by an independent t-test. Distribution of categorical variables across two groups was investigated via Chi-square test. To examine the influence of each demographic and clinical data on the prognosis of individuals with IDH, binary logistic regression was implemented and odds ratio (OR) with a corresponding 95% confidence interval (CI) was reported.

Results

Following a search of electronic databases, a total of 210 studies were found. After de-duplication, 106 remaining citations were screened for title/abstract by two independent investigators. The remaining 95 articles were assessed for eligibility criteria and finally, 63 citations met the inclusion criteria and were enrolled in the current systematic review and pooled-analysis study. The process of the study selection is presented in Figure 1.

In total, 58 case reports[3,7,12-67] and 5 case series[2,68-71]studies were included. A total of 77 patients diagnosed with IDH comprised the study population, with a mean (SD) age of 58.72 (13.99) years, of which 22.1% were women (n=17). Enrolled patients were categorized according to the prognosis of IDH into those who died (poor prognosis) and those who survived (good prognosis), with a sample size of 26 and 51, respectively. Patients with poor prognoses were older with a mean (SD) age of 64.46 (11.47) compared to those with a good prognosis (P=0.009). Moreover, those with a good prognosis were more likely to undergo angiography (P=0.008) and cardiac magnetic resonance (P=0.003). In addition, individuals who survived, compared to those who died, complained less of pericardial effusion (P=0.013). No other significant difference was observed for studied parameters across patients with good and poor prognoses (all P > 0.05). The general characteristics of the enrolled patients with IDH are indicated in Table 1.

The OR and corresponding 95% CI for the influential factors on the prognosis of patients with IDH are shown in Table 2. Patients of higher age experienced a higher risk for mortality compared to younger subjects (OR=1.05, 95% CI: 1.01, 1.10; P=0.014). In addition, the implementation of angiography (OR=0.25, 95% CI: 0.08, 0.71; P=0.010) and cardiac magnetic resonance (OR=0.19, 95% CI: 0.06, 0.60; P=0.004) in the context of diagnosis reduced the risk of death compared to those who did not receive these interventions. Similarly, the diagnosis of pericardial effusion significantly increased the risk of mortality compared to those without pericardial effusion (OR=3.92, 95% CI: 1.27, 12.07; P=0.017). No other significant relationship was observed between the studied parameters and the risk of mortality in patients with IDH (all P > 0.05).

Discussion

The current systematic review and pooled analysis were conducted to summarize available data regarding the diagnosis, management, and prognosis of IDH using case reports and case series. A total of 63 citations, including 58 case reports and 5 case series, were eligible to be enrolled in the current study. The authors found that older patients experience poor prognoses compared to younger ones. In addition, utilizing angiography and cardiac magnetic resonance improves the prognosis of individuals. Likewise, the diagnosis of pericardial effusion in patients with IDH increases the odds of mortality.

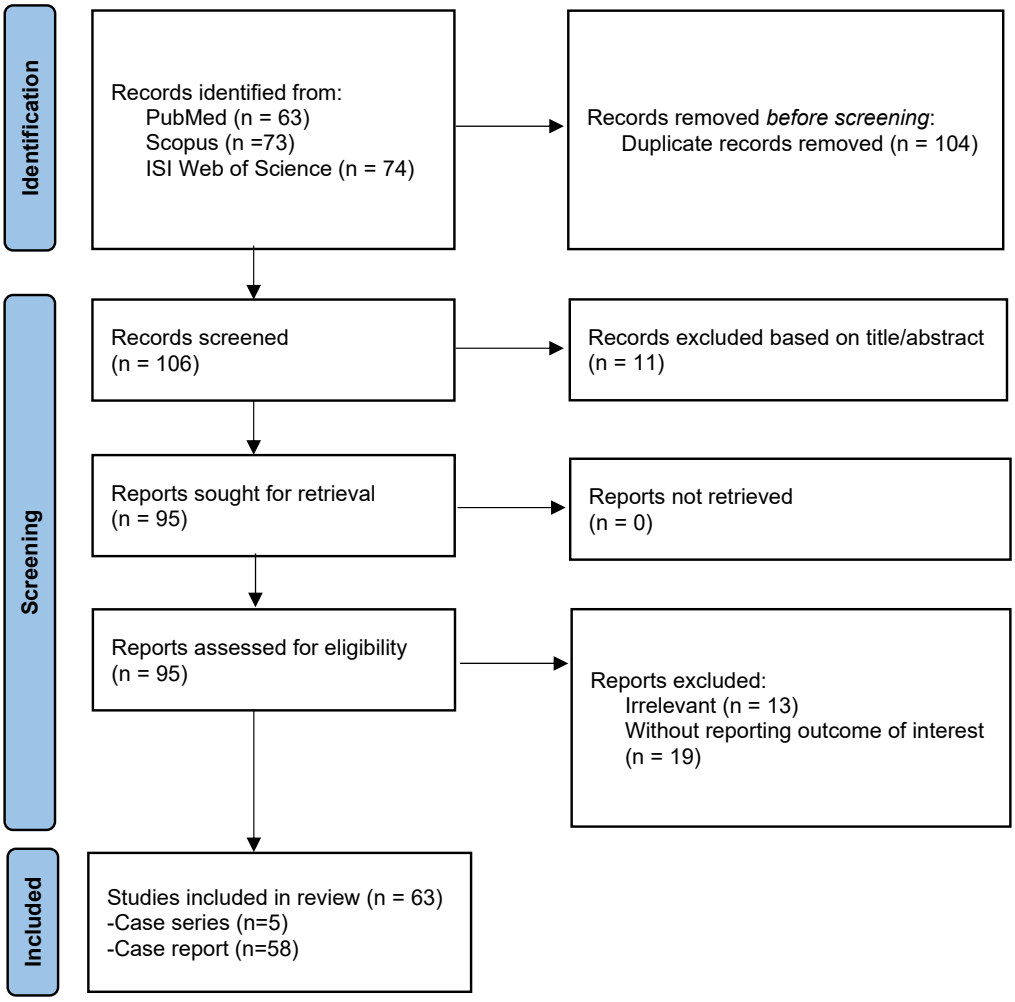

Figure 1. PRISMA flow diagram of the study selection process.

Table 2. OR and 95% confidence interval for influential factors of prognosis in patients with intramyocardial dissecting hematoma

Variables	Good prognosis	Poor prognosis	P-value
Age	Ref	1.05 (1.01, 1.10)	0.014
Women	Ref	1.51 (0.49, 4.57)	0.466
Due to MI	Ref	0.61 (0.21, 1.79)	0.378
ST elevation at ECG	Ref	1.21 (0.45, 3.26)	0.694
Angiography	Ref	0.25 (0.08, 0.71)	0.010
LVEF	Ref	1.005 (0.96, 1.04)	0.813
VSD	Ref	1.33 (0.20, 8.52)	0.761
Nonhomogeneous mass/cavity	Ref	0.34 (0.07, 1.66)	0.185
Pericardial effusion	Ref	3.92 (1.27, 12.07)	0.017
CMR	Ref	0.19 (0.06, 0.60)	0.004
CT	Ref	0.69 (0.21, 2.22)	0.541
Contrast echocardiography	Ref	0.84 (0.23, 3.06)	0.802
Surgery	Ref	0.58 (0.21, 1.59)	0.295

Data are presented as OR (95% confidence interval)

P<0.05 was considered statistically significant.

MI: Myocardial Infarction; ECG: Electrocardiogram; LVEF: Left Ventricular Ejection Fraction; VSD: Ventricular Septal Defect; CMR: Cardiac Magnetic Resonance; CT: Computerized Tomography.

There is limited evidence regarding the diagnosis, management, and prognosis of IDH, and therefore most of the authors' current knowledge is based on case reports. A previous literature review in 2016 among 68 IDH patients revealed that there is no difference between surgical and medical management of IDH concerning survival, although it mentioned that those with right ventricular free wall dissection significantly benefit from surgical repair[71]. Another review in 2018 among 40 individuals with IDH concluded that low ejection fraction and age are both determinants of in-hospital mortality[11]. Hajsadeghi and co-workers in 2020 also reviewed 37 cases of postinfarction IDH and concluded that the mortality rate is higher among those who managed conservatively compared to surgically treated subjects[72]. Although the authors' findings are mostly in agreement with previous reports, some discrepancies are observed mainly due to eligibility criteria and sample size.

IDH is a rare catastrophic complication of myocardial infarction, with over 75% of IDH cases in the authors' study due to myocardial infarction. Becker proposed that a slit-like rupture of the ventricular free wall is linked with collagen breakdown, plasmin generation, and intramyocardial hemorrhage, and may have been exacerbated by previous thrombolytic therapy[73]. It was also suggested that IDH may occur subsequently to inadequate reperfusion[11]. Inadequate blood supply led to necrosis, with a tear of cell membranes, capillaries disruption, and hemorrhage, with hypoxia-induced endothelial disruption proposed as the primary mechanism for hemorrhage[11]. Occlusion of coronary arteries resulted in an inflammatory response, disruption of the endothelial junction, swelling, and increased endothelial stress[74]. In addition, reperfusion leads to extravasation of red blood cells into the tissue interspaces, damage to the endothelial junction, and leakiness. Moreover, activation of metalloproteinases - proteolytic enzymes - disrupts the basal and interstitial membrane collagen matrix and augments hemorrhage[74]. A total of 62.3% of the authors' study population presented persistent ST elevation and clinical evidence of recent myocardial infarction. These subjects are at higher risk for IDH and therefore should be taken into account while managing these patients.

As mentioned in a previous literature review, IDH mostly affects the left ventricle-free wall and to a lesser extent septum and right ventricle-free wall, respectively[71]. Moreover, it frequently occurs within 7-10 days post myocardial infarction; however, the rare cases with old myocardial infarction may also progress to IDH. Therefore, its early and accurate diagnosis needs a high level of suspicion. Echocardiography is one of the first diagnosis approaches demonstrating IDH as a hypoechoic segment or a non-homogeneous neo-cavitation[71]. The authors demonstrated that the presence of pericardial effusion increases the risk of mortality by 3.92 times. Pericardial effusion may be the sign of evolving myocardial rupture, as it demonstrates the communication with the pericardial space. Likewise, the authors showed that a ventricular septal defect may increase the risk of poor prognosis by 1.33 times, although it was statistically non-significant. In those with anterior myocardial infarction, the apical septum is often involved and therefore the presence of a ventricular septal defect may complicate the course[75].

Cardiac Magnetic Resonance (CMR) is considered the gold standard for IDH diagnosis[11]. Additionally, the explanation of Late Gadolinium Enhancement (LGE) and T2-weighted combination with LGE images, rest perfusion, and evaluation of Early Gadolinium Enhancement (EGE) might provide more details and differentiate it from intraluminal thrombus[76]. Accordingly, the authors also revealed that implementing this tool decreased the risk of mortality by 71%. T1 and T2 relaxation approaches usually assist in the diagnosis of IDH due to their sensitivity to blood products[77]. The T1-weighted technique presents hyperintense lesions in the affected areas, which can be inferred in clinical practice as blood products related to subacute hemorrhage[77]. Hyperintense foci that are consistent with fat or edema can be detected via the T2-weighted approach[77].

Patients with IDH can be managed conservatively or surgically considering various factors. Individuals with low ejection fraction, compromised hemodynamics, ventricular septal defect, and the expansion of the dissection on serial echocardiographic studies, especially in those with anterior myocardial infarction, should undergo surgery. IDH limited to the apex has a high probability of spontaneous reabsorption, and an

initial conservative approach may be reasonable. In the absence of a complete tear of the myocardium, conservative management is the recommendation of choice because of the high risk of surgery and the possibility that the myocardium may heal over time. Medical treatment of heart failure and hemodynamic stabilization with close follow up and serial echocardiography are used in these cases. Anticoagulation can be considered to reduce the risk of thromboembolism but its use must be balanced against the risk of progression of dissection and bleeding into the pericardial space[60]. Therefore, patients without dangerous predictors (i.e., pericardial effusion and ventricular septal defect), those with a small lesion localized to the apex, and with stable hemodynamics, especially in subjects whom the culprit artery had been opened, may benefit from conservative management[11,78]. According to the authors' findings, using angiography and CMR may also be considered for these patients in the early stage of diagnosis to improve the prognosis.

Strength and limitation

The current systematic review and pooled analysis can be considered the most updated resource regarding the diagnosis, management, and prognosis of individuals with IDH. Moreover, the authors comprehensively searched various databases to empower the robustness of their findings. However, some limitations warrant consideration. The authors used case reports and case series with known inherent bias and limitations owing to the methodological nature. Moreover, since patients were enrolled from different parts of the world and health centers, imaging of each case, types of surgical intervention, and clinical circumstances, are likely to be different.

Conclusion

IDH is indeed considered a rare complication with a challenging diagnosis. Therefore, a high level of suspicion and awareness among clinical practitioners are vital for early and accurate diagnosis. The authors found that older patients experience a poor prognosis compared to younger ones. In addition, utilizing angiography and CMR improves the prognosis of individuals. Likewise, the diagnosis of pericardial effusion in patients with IDH increases the odds of mortality. These findings highlight the importance of early diagnosis and appropriate management strategies in improving the outcomes for patients with IDH.

Conflict of Interest

The authors declare no conflict of interest.

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Authors' contribution

R.Z. and A.S.: Conceptualization, Methodology, Formal analysis, Writing - Original Draft, Writing - Review & Editing.F. F.: Conceptualization, Writing - Original Draft, Writing - Review & Editing, Supervision. The author(s) read and approved the final manuscript

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