Coronary intramural hematomas: a focused review

Intramural hematomas are defined as an accumulation of blood in the media with entry and exit points that may or may not be identifiable. Intramural hematomas can occur during percutaneous coronary interventions and have been reported to occur spontaneously. While a majority of intramural hematomas are identifiable on coronary angiography, intravascular ultrasound should be considered the gold standard for diagnosis given its superior imaging capabilities. Outcomes are variable and there are no guidelines for the treatment of intramural hematomas. Therefore, treatment of intramural hematomas should be based on patient characteristics and clinical scenario.

Keywords: acute coronary syndrome • coronary angiography • coronary dissection • intramural hematoma • intravascular ultrasound • percutaneous coronary intervention

An intramural hematoma is defined as blood accumulation in the media which displaces the internal elastic membrane inward and the external elastic membrane outwards [1]. Entry and exit points may or may not be identifiable. Previous studies have suggested an occurrence rate of 6.7% of percutaneous coronary interventions (PCIs) [2] as demonstrated by intravascular ultrasound (IVUS). Additionally, there have also been reports of spontaneous intramural hematomas presenting as acute coronary syndrome [3,4]. Intramural hematomas are classified as dissections [1] and more commonly occur in de novo lesions, in diabetics and near transitions of arterial walls [2]. This paper will present two cases of intramural hematomas and discuss the proposed pathophysiology, diagnosis, natural history and contemporary treatment of intramural hematomas.

Case 1
A 65-year-old male with hypertension presented with progressive angina symptoms in the outpatient setting. A myocardial perfusion imaging study revealed ischemia in the anterior and lateral walls. A coronary angiogram revealed a high-grade stenosis of the mid left anterior descending artery (LAD), just before a diagonal artery bifurcation and a second high-grade stenosis of the left circumflex artery (LCx). Following balloon angioplasty of the LAD stenosis, there appeared to be a resultant dissection by angiography (Figure 1A), which was successfully covered by stent placement (Figure 1B). An IVUS revealed an intramural hematoma posterior to the stent placement (Figure 2). Following postdilatation with a noncompliant balloon, there was residual contrast staining on angiography in the area that was treated with stent placement (Figure 1B, arrow). However, a repeat IVUS revealed that the stent was well opposed and the intramural hematoma was covered with no evidence of progression. Given the contrast load, we elected to perform a staged intervention of the LCx several weeks later. Repeated angiography at the time of the LCx PCI revealed that the contrast straining posterior to the mid LAD stent had resolved, signifying resolution of the previously seen intramural hematoma.

Case 2
A 48-year-old diabetic female presented to the emergency room with chest pain radiating to the left arm. Emergency cardiac catheterization revealed an acute total occlusion of the proximal right coronary artery. The patient was taken to the catheterization laboratory for primary PCI. A second lesion was identified in the distal left anterior descending artery (LAD) just prior to the bifurcation of the left circumflex artery (LCx). Following direct stenting of the LAD lesion, an intramural hematoma was noted posterior to the stent placement. A repeat IVUS revealed a well-opposed stent with no evidence of progression. Given the contrast load, we elected to perform a staged intervention of the LCx lesion several weeks later. Repeated angiography at the time of the LCx PCI revealed that the contrast straining posterior to the mid LAD stent had resolved, signifying resolution of the previously seen intramural hematoma.

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Figure 1. Intramural hematoma formation following coronary intervention. (A) Coronary angiogram in a 65-year-old male following angioplasty of the mid left anterior descending artery, which reveals a dissection (arrow). Intravascular ultrasound following stent placement revealed an intramural hematoma. (B) Stent placement resulted in an angiographic improvement, but continued contrast staining is noted posterior to the stent from the residual intramural hematoma (arrow).

Figure 2. An intravascular ultrasound of an intramural hematoma following stent placement. By angiography, this appeared to be a dissection following balloon angioplasty. The arrow points to a crescent-shaped, hyperechoic area with discrete echolucent zones behind the stent.

Diagnosis

Coronary angiography can detect a majority of intramural hematomas. However, their angiographic characteristics can vary widely, and may include dissection (a majority of the presentations) (Figure 1), diffuse luminal narrowing (Figure 3), a new lesion following stent deployment, coronary spasm and haziness in the vessel. Additionally, approximately 30% of intramural hematomas are undetected by coronary angiography [3] and thus IVUS should be considered the gold standard for the diagnosis of intramural hematomas.
IVUS can reveal the entry point of the dissection (Figure 4), propagation direction, underlying arterial plaque, severity of the intramural hematoma and luminal compromise. Characteristics of an intramural hematoma on IVUS imaging includes a homogeneous, crescent-shaped, hyperechoic area (Figure 2) [2]. A dramatic increase in backscatter intensity has been reported to occur with stagnant blood flow, presumably from red blood cell aggregation, leading to increased echogenicity [10]. Intramural hematomas can also contain echoluent areas (Figure 2), which presumably represents accumulation of saline or radiographic contrast [2].

Optical Coherence Tomography has also been reported as an important imaging tool in the diagnosis of intramural hematomas [11]. Given its superior resolution, it may provide more insight into the mechanisms of intramural hematomas.

Natural history of intramural hematomas

Literature case reports suggest that the natural history of intramural hematomas is quite variable. Several studies have suggested gradual absorption and resolution without percutaneous intervention [3,11]. However, the propensity for progression of intramural hematomas has also been documented. These include both short-term complications, such as myocardial infarction and repeat revascularization and long-term complications, such as death (2). Stenting intramural hematomas have been reportedly associated with late stent malapposition following the hematoma absorption [12]. Given these unpredictable outcomes and lack of randomized trials, treatment should be considered on a case-by-case basis.

Treatment

Treatment options for intramural hematomas include conservative medical therapy, close angiographic follow-up and percutaneous coronary intervention. The later usually entails stent placement [13], although other techniques have also been reported. A scoring balloon angioplasty was performed after an intramural hematoma did not resolve with stent placement [14]. The scoring balloon was used to create a fenestration between the true and false lumens [14]. Similarly, a cutting balloon was also used to create a fenestration to treat an intramural hematoma [15]. A chronic total occlusion-dedicated guidewire was also used to successfully fenestrate an intramural hematoma [16]. There are currently no guidelines on the treatment of intramural hematomas, and therefore appropriate clinical judgment is imperative as these patients are generally at high risk for adverse outcomes.

Conclusion

Intramural hematomas can occur during PCI and may present as an acute coronary syndrome in spontaneous cases. While a majority of intramural hematomas are identifiable on coronary angiogram, up to 30% are undetectable by angiography only. IVUS should be considered the gold standard in the diagnosis of intramural hematomas and may facilitate management strategies. There is no clear consensus on the treatment of intramural hematomas, therefore, treatment should be individualized based on patient characteristics and the clinical scenario.

Future perspective

In the current era of second generation drug-eluting stents, a randomized clinical trial of stenting versus conservative therapy for intramural hematomas would be difficult to conduct, require a large number of
patients and prolonged follow-up to be clinically relevant. However, continued evaluation and research, through case reports and reviews, is imperative for a better understanding of treatment outcomes.

The initial bioabsorbable stent data have shown promising outcomes with regards to vessel healing and recovery of endothelial function. Therefore, the use of bioabsorbable stents for the treatment of coronary intramural hematomas, especially those that occur in the setting of spontaneous dissections, would make clinical sense as the burden of vessel atherosclerosis is minimal in certain cases. Clinical trials evaluating the role of bioabsorbable stents in the setting of coronary intramural hematomas should be considered.

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Executive summary

Background
- An intramural hematoma is defined as blood accumulation in the media which displaces the internal elastic membrane inward and the external elastic membrane outwards.

Diagnosis
- Intravascular ultrasound should be considered the gold standard for diagnosing intramural hematomas as up to 30% are undetectable by angiography.

Treatment
- There is no clear consensus on the treatment of intramural hematomas, therefore, treatment should be individualized based on patient characteristics and the clinical scenario.

References

Papers of special note have been highlighted as:
• of interest; ** of considerable interest


• Defines what an intramural hematoma is by Intravascular Ultrasound Studies imaging.


• This is the largest reported case series of intramural hematomas following percutaneous coronary intervention.


