


Left ventricle pedunculated thrombi risks and outcomes: a case report and literature review

*Riscos e desfechos de trombos pedunculados no ventrículo esquerdo:
relato de caso e revisão da literatura*

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Abstract

A 42-year-old male with ischemic cardiomyopathy presented with acute bilateral femoral artery embolization. After management with embolectomy and fasciotomy in both femoral arteries, transthoracic echocardiography revealed two pedunculated highly mobile left ventricle (LV) thrombi. Given the procedural risk, anticoagulation therapy was recommended over surgery. However, the bleeding risk impeded the continuation of anticoagulation, which increased the thrombus size. Multiorgan failure and disseminated intravascular coagulopathy followed and the patient died. We also systematically reviewed the PubMed and Scopus databases for pedunculated LV thrombi cases and retrieved 74 and 63 reports respectively. Of these, 37 relevant reports (45 cases) plus 11 reports from the manual search were included for data extraction, a total of 56 cases besides our case. Based on the etiologies and risks, LV thrombi are predictable and preventable, especially after ischemic events. A clear diagnostic algorithm and vigilant follow-up are needed as well as multidisciplinary management once a diagnosis is confirmed.

Keywords: left ventricle; myocardial infarction; thrombosis; emboli; risks; outcomes.

Resumo

Relatamos o caso de um homem de 42 anos com cardiomiopatia isquêmica que apresentou embolização aguda bilateral das artérias femorais. Embolectomia das artérias femorais e fasciotomia foram realizadas bilateralmente e, posteriormente, o ecocardiograma transtorácico revelou a presença de dois trombos pedunculados altamente móveis no ventrículo esquerdo (VE). Diante do risco associado à abordagem cirúrgica, recomendou-se terapia anticoagulante. No entanto, o risco de sangramento impediu a continuação da anticoagulação, o que levou ao aumento dos trombos. Posteriormente, o paciente evoluiu com falência de múltiplos órgãos e coagulação intravascular disseminada, vindo a óbito. Além do relato de caso, realizamos buscas sistemáticas nas bases de dados PubMed e Scopus por casos de trombos pedunculados no VE. Foram recuperados 74 e 63 relatos, respectivamente, dos quais 37 relatos relevantes (45 casos) e 11 da busca manual foram selecionados para extração de dados, totalizando 56 casos além do nosso. Com base nas etiologias e nos riscos, os trombos no VE são previsíveis e evitáveis, especialmente após eventos isquêmicos. Isso requer um algoritmo diagnóstico claro e acompanhamento vigilante, bem como manejo multidisciplinar após confirmação do diagnóstico.

Palavras-chave: ventrículo esquerdo; infarto do miocárdio; trombose; embolia; riscos; desfechos.

How to cite: Ali AA, Sakr EE. Left ventricle pedunculated thrombi risks and outcomes: a case report and literature review. *J Vasc Bras.* 2024;23:e20230124. <https://doi.org/10.1590/1677-5449.20230124>

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Financial support: None.

Conflicts of interest: No conflicts of interest declared concerning the publication of this article.

Submitted: October 15, 2023. Accepted: January 21, 2024.

The study was carried out at Mataria Teaching Hospital, Cairo, Egypt.



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■ INTRODUCTION

A left ventricle (LV) thrombus is defined as an echo-dense mass near an akinetic or hypokinetic ventricular wall that is visible in at least two different views.¹ LV thrombi formation following acute myocardial infarction (MI) or dilated cardiomyopathy (DCM) is predisposed by Virchow's triad (MI-induced endothelial injury and the subsequent elevation of catecholamine levels,² inflammation-triggered hypercoagulability, and blood stasis due to segmental wall motion).³ About 6.3% of ST-segment elevation MI (STEMI) cases and 19.2% of anterior STEMI cases with LV ejection fraction (EF) <50% are complicated with LV thrombus formation within two weeks to three months of the onset of myocardial injury. Other risk factors of LV thrombus formation are dilated heart failure, hypercoagulable states, nonischemic cardiomyopathy, and Takotsubo cardiomyopathy.⁴ LV thrombi develop in 1.3%⁵ to 2.2%⁴ of patients with acute Takotsubo cardiomyopathy and are significantly associated with the presence of both apical ballooning and high troponin level >10 ng/mL. Pedunculated LV thrombi have a higher embolic potential than mural thrombi, depending on the extent of protrusion into the left ventricle, mobility, and the pedunculated shape. There is no theory explaining the exact mechanism or combination of factors that favor the formation of pedunculated thrombi. Nonetheless, the literature has reported many mural thrombi that partially detached and transformed into pedunculated thrombi during follow-up or hospitalization.⁶⁻⁸ Herein, we depict a case of pedunculated LV thrombus that presented with bilateral acute lower limb ischemia and review the literature for similar case presentations highlighting the main risks and outcomes.

■ METHODOLOGY

We searched PubMed and Scopus databases using the keyword search terms “left ventricle OR left ventricular” AND pedunculated AND “thrombus OR thrombi”. All published reports presenting cases of pedunculated left ventricular thrombus were included with no restriction on age or year of publication.

■ RESULTS

Presentation of case

A man in his 40s with a history of diabetes mellitus, systemic arterial hypertension (SAH), and ischemic heart disease with resultant ischemic heart failure presented with bilateral lower limb pain and loss of motor and sensory activity. The patient was evaluated in the emergency department and the evaluation revealed acute bilateral lower limb ischemia that prompted an immediate surgical intervention.

Five years before the current presentation, the patient reportedly had extensive anterior STEMI (Figure 1) that was treated with streptokinase and rescue percutaneous intervention (PCI). Coronary angiography showed 80% stenosis of the proximal left anterior descending (LAD) artery, for which a drug-eluting stent was deployed. The patient's transthoracic echocardiography (TTE) showed an EF of 45% with an akinetic apical and mid septum, apical and mid anterior, and apical inferior segments; normal LV dimensions; and dilated left atrium. Over four years, the patient had deteriorating heart failure with EF 30%, akinetic anteroseptal and mid to apical septal segments, a restrictive pattern of diastolic function, dilated LV and left atrium, and mild mitral regurgitation.

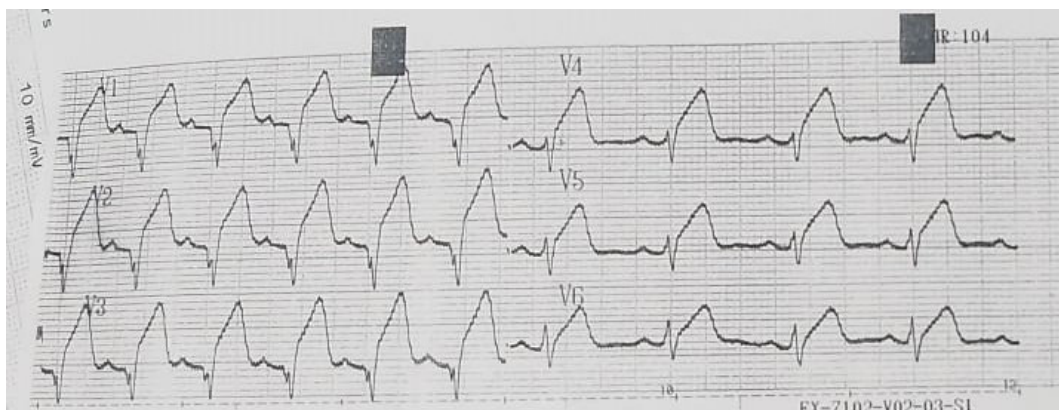


Figure 1. Electrocardiogram of the patient five years before his recent presentation showing ST-segment elevation myocardial infarction in leads V1-6 after receiving thrombolysis (streptokinase), which failed.

On examination, the vital parameters recorded systolic blood pressure of 90 mmHg, heart rate of 89/min, respiratory rate of 18/min, and temperature of 36. Laboratory investigations were notable for leukocytosis (15,300 cells/microliter), elevated cardiac enzymes (CK-MB 130 U/L; troponin I 71, 6-fold the upper normal limit), and an international normalized ratio (INR) of 1. Other laboratory test results were normal (hemoglobin, platelets, serum creatinine, serum urea, arterial blood gas). Arterial duplex revealed bilaterally damped monophasic flow across the external iliac artery down to the superficial femoral artery. Furthermore, there was no detectable flow distally down to the infra-popliteal arteries. The patient's acute limb ischemia was managed surgically by bilateral mechanical thrombectomy and fasciotomy.

A TTE was obtained after the operation and elucidated decreased EF (20%, measured by M-mode) with global hypokinesia and a large pedunculated irregular hypermobile LV thrombus at the LV apex measuring 4.32*2.82 cm (Figure 2). An electrocardiogram revealed left bundle branch block and prolonged QT interval.

Cardiothoracic surgery consultation refused the surgery for the procedural risks and, because of this, anticoagulation treatment (with warfarin 5 mg once daily and enoxaparin sodium 100 mg twice daily) was decided on after counseling with the patient. Soon after the operation, the patient's condition deteriorated and required endotracheal intubation. The deterioration entailed circulatory collapse and multiorgan failure (acute kidney injury, ischemic/shocked liver, and disturbed consciousness level). Furthermore, the patient exhibited a bleeding tendency (hematemesis, melena, and nasal bleeding), which necessitated discontinuation of the anticoagulation. As a consequence, the thrombus increased in size to measure 4.7*3.9 cm (Figure 3) by TTE. The laboratory test results were then notable for low hemoglobin (7.4 g/dl), low platelets ($87 \times 10^3/\text{UL}$), elevated renal function test values (serum creatinine 6 mg/dl; urea 267 mg/dl); elevated liver function test values (AST 1145; ALT 1063), and elevated serum potassium (6.5 mmol/dl). The patient eventually died. This manuscript conforms to the Helsinki Declaration and local ethical guidelines.

Systematic review of literature

Searches of PubMed and Scopus databases retrieved 74 and 63 articles, respectively. After removing duplicates, 90 records were eligible for title and abstract screening, which revealed 66 reports to be eligible for full-text screening. Only cases reporting pedunculated thrombus/thrombi at the first assessment for any



Figure 2. Transthoracic echocardiography; a four-chamber view of the heart after the bilateral mechanical thrombectomy and fasciotomy showing a pedunculated mass (thrombus) measuring 4.32*2.82 cm.

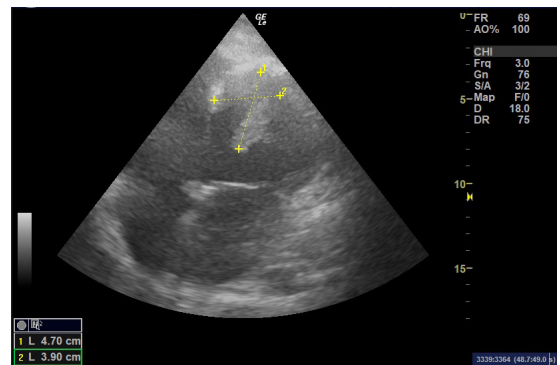


Figure 3. A four-chamber view of the patient's heart a few days after admission showing enlarging thrombus size (4.7*3.9 cm).

etiology were included; records with irretrievable data were excluded; reports of mural thrombus/thrombi that transformed into pedunculated thrombi during follow-up were also excluded for carrying different risks. Only 45 cases from 37 papers met our inclusion and exclusion criteria. A manual search revealed 11 more pertinent cases. Our report was included in the analysis (Figure 4/ flowchart), reaching a final total of 57 cases analyzed.

Baseline demographic and clinical data, management, and outcome are summarized in the Appendix, Table 1. Overall, the mean age of all the cases was 50.5 ± 15.6 years, and 66.6% (38/57) were male. Based on etiology, 41.1% of cases (N=24) were attributed to old (N=12) or acute (N=12) MI;

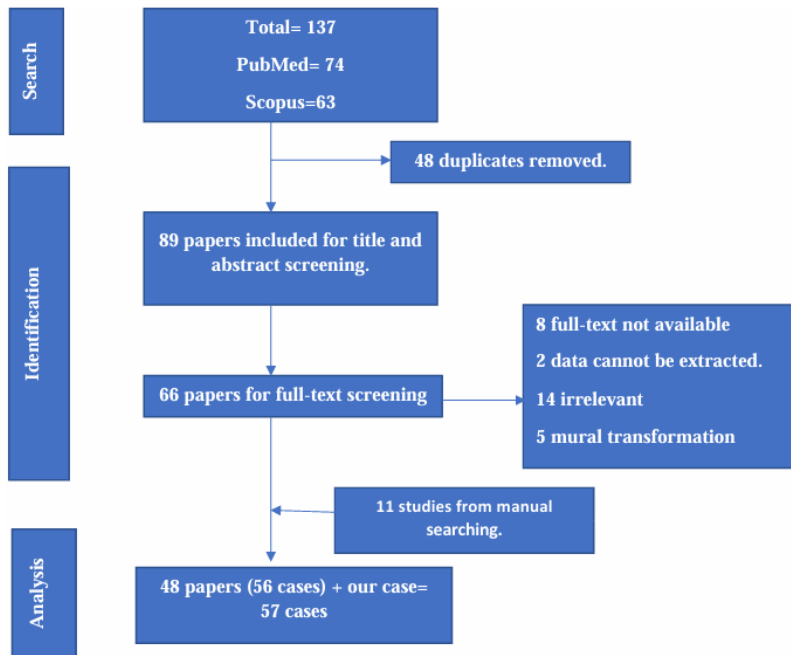


Figure 4. Flowchart of selection and screening of relevant studies.

17.5% (N=10) to cardiomyopathy (non-ischemic DCM, Takotsubo cardiomyopathy, peripartum, or idiopathic cardiomyopathy); and 7% (N=4) were due to heart failure. Other etiologies were ulcerative colitis (N=2), COVID-19 infection (N=2), and coagulopathy (N=6). About 17.5% (N=10) developed idiopathic LV thrombi. Combined etiologies were also found.^{59,60}

Twelve (21%) of the cases had a previous coronary artery disease, 11 (19.2%) had SAH, seven (12.2%) had a smoking history, and three (5.1%) had a history of substance abuse (alcohol, anabolic androgenic steroids, and cocaine). Furthermore, seven (12.2%) had diabetes mellitus, five (8.7%) had coagulopathy (essential thrombocytopenia, polycythemia vera, and cystic fibrosis for example), and four (7%) had hyperlipidemia. Of note, seven cases (12.2%) had no identifiable risk factors.

The vast majority of LV thrombi were located at the apex (73.6%; 42/57) followed by the interventricular septum (8.7%; 5/57). However, some cases exhibited more than one thrombus at two or more sites and three cases did not report the thrombus site (Table 2). About 16 (28%) cases developed LV thrombus despite having normal systolic function on presentation. The etiology of the LV thrombus was idiopathic in 10/16 of these cases, due to a hypercoagulable state in two cases, and due to ulcerative colitis inflammatory condition in two cases. It is worth stating that SAH was a risk factor in 4/16 (25%), and the ECG showed abnormal changes in only 3/16 (18.7%) of these cases.

Thirty-three patients (57.8%) developed distal emboli at different sites, the most common of which was the brain (N=14), followed by the arterial system of the lower limb (N=13). Other sites are listed in Table 1 (see the Appendix). The definitive treatment for most cases was surgical removal (75.4%; N=43). Furthermore, three cases responded well to oral anticoagulation with warfarin. While five cases responded well to heparin infusion, four did not show any improvement, and the management plan was changed to surgery, tirofiban, recombinant tissue plasminogen activator (RTPA), or streptokinase.

DISCUSSION

Despite the absence of histopathological confirmation, our patient was diagnosed with LV thrombus because of his associated factors (history of anterior STEMI with reduced EF) and current presentation. Surgical removal is the definitive management for mobile pedunculated masses because of their high embolization risk.⁶¹ Alternatively, for cases that refused surgery or were deemed to be unfit for surgery, direct oral anticoagulants were non-inferior to vitamin K antagonist (warfarin) for treating LV thrombus.⁶¹ Based on our review, surgical removal was almost always successful, whereas oral and intravenous anticoagulation was relatively less successful (5/12; 41.6% failure rate). Furthermore, the three cases that died, including our case, were managed using anticoagulation and did not proceed to surgery.

There are no clinical trials assessing the efficacy of thrombolysis via streptokinase, RTPA, or urokinase. Nonetheless, thrombolysis carries a high embolic and hemorrhagic risk despite the potential for successfully dissolving the LV thrombus.⁶² The deterioration of the LVEF seen in our patient can be explained by the thrombus, given that the LVEF improves or even normalizes after LV thrombus removal or dissolution in some other patients.⁶³⁻⁷⁰ This finding has been confirmed earlier where the LAD/anterior wall infarctions were significantly associated with contractile dysfunction at the apex and with decrements in the peak systolic function.⁷¹

Four-dimensional magnetic resonance imaging (4D MRI) for intracardiac hemodynamic assessment was tested in anterior MI cases, which is the most reported risk for LV thrombi. It revealed reduced peak systolic flow in the mid ventricle and apex and reduced peak diastolic flow in the apex in anterior acute MI.⁷² This explains the occurrence of apical thrombi in anterior/LAD MI. However, there is no reported prophylactic anticoagulation strategy to date. Accordingly, any use of prophylactic anticoagulation should be tailored on a patient-by-patient basis. Notably, prophylactic anticoagulation in LV thrombus was a class IIb recommendation according to the 2013 ACC/AHA STEMI guidelines.⁷³ Low-dose anticoagulation with rivaroxaban 2.5 mg BID for 30 days, besides dual antiplatelet therapy (DAPT), has been tested recently.⁷⁴ The low-dose rivaroxaban plus DAPT cohort had a lower incidence of LV thrombus formation than the DAPT alone cohort (0.7% and 8.6%, respectively; hazard ratio 0.08). On the other hand, anticoagulation has no role in preventing LV thrombus formation in DCM with sinus rhythm.⁷⁵ The Heart Failure Long-Term Antithrombotic Study (HELAS) trial has also compared the incidence of thromboembolism with warfarin, aspirin®, or placebo in chronic heart failure.⁷⁶ There was no significant difference in the incidence between the three groups.

TTE was the major diagnostic tool used in the literature cases and also in our case. Noting the difficulty of diagnosing mural thrombi and their potential of transformation into pedicled thrombi, routine assessment of patients following MI (particularly anterior MI with reduced LVEF) or cardiomyopathy diagnosis is advised for early diagnosis and management. Delayed enhancement cardiac magnetic resonance imaging (DE-CMRI) was revealed to be the most sensitive imaging modality for detecting LV thrombi and distinguishing them from the normal myocardium.⁷⁷ It had a significantly higher performance than both the standard TTE and cine-CMRI for detecting LV thrombi.⁷⁸ DE-CMRI has a 100% negative predictive

value and 100% sensitivity.⁷⁹ The absence of vascularity in the thrombi prevents late gadolinium enhancement on CMRI from increasing the sensitivity and specificity of the modality. Nonetheless, DE-CMRI cannot be afforded for all acute MI patients. So, an algorithm entailing routine non-contrast echocardiography for stratifying patients based on apical wall motion score was proposed; the presence of apical wall motion then warrants performing DE-CMRI.

Strengths and limitations: the strengths of this article lie in the complicated presentation and review of all the previously reported cases of pedunculated LV thrombi. The evidence level of each of the records from which data were extracted is given in the Appendix, Table 1, according to the Oxford Center for Evidence-based Medicine.⁸⁰ In our case, the main limitation was the delayed access to TTE, which was only performed after the operation. The delayed diagnosis of the LV thrombus prevented early multidisciplinary management and early discussion between the vascular and cardiothoracic teams to decide on the optimum management plan.

CONCLUSION

This report highlights a pedunculated LV thrombus in a case of ischemic cardiomyopathy with a previous history of acute anterior MI. Multidisciplinary management is a cornerstone in managing similar complicated cases. Early surgical management of pedunculated LV thrombi is the management of choice and it should be considered to avoid the failure rates of anticoagulation and thrombolytic medications. A clear diagnostic algorithm should be adopted for early diagnosis and for avoiding embolic presentations. Similarly, screening algorithms should also be developed for patients with non-ischemic cardiomyopathies and those liable to LV thrombosis with normal LV function - inflammatory bowel disease, and hypercoagulable states, for example. Furthermore, large clinical trials of the efficacy of prophylactic anticoagulation following acute MI, specifically anterior/LAD MI, are needed.

REFERENCES

1. Lattuca B, Bouziri N, Kerneis M, et al. Antithrombotic therapy for patients with left ventricular mural thrombus. *J Am Coll Cardiol.* 2020;75(14):1676-85. <http://doi.org/10.1016/j.jacc.2020.01.057>. PMID:32273033.
2. Johansson PI, Bro-Jeppesen J, Kjaergaard J, Wanscher M, Hassager C, Ostrowski SR. Sympathoadrenal activation and endothelial damage are inter correlated and predict increased mortality in patients resuscitated after out-of-hospital cardiac arrest. a post Hoc sub-study of patients from the TTM-trial. *PLoS One.* 2015;10(3):e0120914. <http://doi.org/10.1371/journal.pone.0120914>. PMID:25789868.

3. Camaj A, Fuster V, Giustino G, et al. Left ventricular thrombus following acute myocardial infarction: JACC state-of-the-art review. *J Am Coll Cardiol.* 2022;79(10):1010-22. <http://doi.org/10.1016/j.jacc.2022.01.011>. PMID:35272796.
4. Santoro F, Stiermaier T, Tarantino N, et al. Left ventricular thrombi in Takotsubo syndrome: incidence, predictors, and management: results from the GEIST (German Italian Stress Cardiomyopathy) Registry. *J Am Heart Assoc.* 2017;6(12):e006990. <http://doi.org/10.1161/JAHA.117.006990>. PMID:29203578.
5. Templin C, Ghadri JR, Diekmann J, et al. Clinical features and outcomes of takotsubo (stress) cardiomyopathy. *N Engl J Med.* 2015;373(10):929-38. <http://doi.org/10.1056/NEJMoa1406761>. PMID:26332547.
6. Kuh JH, Seo Y. Transatrial resection of a left ventricular thrombus after acute myocarditis. *Heart Vessels.* 2005;20(5):230-2. <http://doi.org/10.1007/s00380-004-0811-7>. PMID:16160906.
7. Glikson M, Agranat O, Ziskind Z, Kaplinski E, Vered Z. From swirling to a mobile, pedunculated mass—the evolution of left ventricular thrombus despite full anticoagulation: echocardiographic demonstration. *Chest.* 1993;103(1):281-3. <http://doi.org/10.1378/chest.103.1.281>. PMID:8417899.
8. Tsukube T, Okada M, Ootaki Y, Tsuji Y, Yamashita C. Transaortic video-assisted removal of a left ventricular thrombus. *Ann Thorac Surg.* 1999;68(3):1063-5. [http://doi.org/10.1016/S0003-4975\(99\)00662-1](http://doi.org/10.1016/S0003-4975(99)00662-1). PMID:10510010.
9. Kumar USD, Shetty SP, Sujay KR, Wali M. Left ventricular mass: a tumor or a thrombus diagnostic dilemma. *Ann Card Anaesth.* 2016;19(4):728-32. <http://doi.org/10.4103/0971-9784.191551>. PMID:27716707.
10. Grewal HK, Bansal M, Garg A, Kasliwal RR, Bhan A, Gautam D. Left ventricular thrombus and cardioembolic stroke in a patient with ulcerative colitis: a case report. *Saudi J Med Med Sci.* 2021;9(1):67-70. http://doi.org/10.4103/sjmms.sjmms_525_19. PMID:33519347.
11. Garg A, Hakeem H, Chennu G, et al. Left ventricular mural thrombi with multisystem thrombosis in patients with COVID-19 and myocardial injury: a case series. *Eur Heart J Case Rep.* 2021;5(6):ytab239. <http://doi.org/10.1093/ehjcr/ytab239>. PMID:34263128.
12. Cousin E, Scholfield M, Faber C, Caldeira C, Guglin M. Treatment options for patients with mobile left ventricular thrombus and ventricular dysfunction: a case series. *Heart Lung Vessel.* 2014;6(2):88-91. PMID:25024990.
13. Kanazawa H, Kashima I, Mochizuki Y, et al. A “bowing” pedunculated large thrombus in the left ventricle and its formation. *Int J Cardiol.* 2016;222:841-3. <http://doi.org/10.1016/j.ijcard.2016.08.035>. PMID:27522386.
14. Allende NG, Sokn F, Borracci R, et al. Giant pedunculated thrombus with normal left ventricular systolic function mimicking myxoma. *Echocardiography.* 2011;28(2):E31-3. <http://doi.org/10.1111/j.1540-8175.2010.01262.x>. PMID:21198822.
15. Lutz CJ, Bhamidipati CM, Ford B, et al. Robotic-assisted excision of a left ventricular thrombus. *Innovations (Phila).* 2007;2(5):251-3. <http://doi.org/10.1097/imi.0b013e31815cea73>. PMID:22437135.
16. Nili M, Deviri E, Jortner R, Strasberg B, Levy MJ. Surgical removal of a mobile, pedunculated left ventricular thrombus: report of 4 cases. *Ann Thorac Surg.* 1988;46(4):396-400. [http://doi.org/10.1016/S0003-4975\(10\)64651-6](http://doi.org/10.1016/S0003-4975(10)64651-6). PMID:3178348.
17. Kharwar RB, Chandra S, Dwivedi SK, Saran RK. A pedunculated left ventricular thrombus in a woman with peripartum cardiomyopathy: evaluation by three dimensional echocardiography. *J Cardiovasc Ultrasound.* 2014;22(3):139-43. <http://doi.org/10.4250/jcu.2014.22.3.139>. PMID:25309691.
18. Ito H, Besho S, Nakamura B, Toba S, Shomura Y, Takao M. Transmitral extraction of a huge left ventricular mural thrombus using a novel mitral leaflet retractor. *Clin Case Rep.* 2022;10(2):e05427. <http://doi.org/10.1002/ccr3.5427>. PMID:35369383.
19. Singal AK, Deepti S, Sharma G, Kothari SS. Herculean mistake: mephentermine associated cardiomyopathy. *Phys Sportsmed.* 2021;49(1):116-22. <http://doi.org/10.1080/00913847.2020.1763146>. PMID:32404042.
20. Tanaka D, Unai S, Diehl JT, Hirose H. Surgical removal of a large mobile left ventricular thrombus via left atriotomy. *World J Clin Cases.* 2014;2(2):32-5. <http://doi.org/10.12998/wjcc.v2.i2.32>. PMID:24579068.
21. Jeganathan R, Ralph-Edwards A. Left apical pedunculated thrombus with normal ventricular function mimicking an intracardiac tumor. *J Card Surg.* 2011;26(6):614-6. <http://doi.org/10.1111/j.1540-8191.2011.01304.x>. PMID:21951172.
22. Janula M, Navarro A, Bonello J, Schembri K, Borg A. Trans-aortic left ventricular thrombo-embolectomy following COVID-19 infection. *J Surg Case Rep.* 2021;(9):rjab426. <http://doi.org/10.1093/jscr/rjab426>. PMID:34594494.
23. Marchini JFM, Rodrigues AJ, Schmidt A. A ventricular thrombus mimicking a tumour. *BMJ Case Rep.* 2009;2009:bcr06.2009.1944. <http://doi.org/10.1136/bcr.06.2009.1944>. PMID:21886661.
24. Mukai S, Fuseno H, Nakamura M, Yoshikawa J, Shomura T. Dilated cardiomyopathy complicated by a pedunculated and mobile left ventricular thrombus on ruptured false tendons. *Chest.* 1991;99(4):1042-3. <http://doi.org/10.1378/chest.99.4.1042>. PMID:2009765.
25. Park JE, Kim WJ, Choi DS, Suh SK, Whang JW, Kim HM. A large pedunculated left ventricular thrombus with recurrent systemic thromboembolism in a young man. *Korean J Intern Med (Korean Assoc Intern Med).* 1986;1(2):254-8. <http://doi.org/10.3904/kjim.1986.1.2.254>. PMID:3154622.
26. Bakhtiar RE, Khaledifar A, Kabiri M, Danesh Z. Mobile pedunculated left ventricular masses in a man with recurrent emboli. *Heart Views.* 2012;13(4):146-8. <http://doi.org/10.4103/1995-705X.105734>. PMID:23439797.
27. Chen CC, Webster GW, Morganroth J. Large mobile pedunculated left ventricular thrombus: Identification by two-dimensional echocardiography. *Clin Cardiol.* 1981;4(4):189-92. <http://doi.org/10.1002/clc.4960040407>. PMID:7273502.
28. Rester BT, Warnock JL, Patel PB, McMullan MR, Skelton TN, Collop NA. Lysis of a left ventricular thrombus with recombinant tissue plasminogen activator. *Chest.* 2001;120(2):681-3. <http://doi.org/10.1378/chest.120.2.681>. PMID:11502681.
29. Azari A, Amini O, Lakzian R, Sarchahi Z. Mesenteric ischemia following large left ventricular fibroid thrombosis due to myocardial infarction: a case report. *Int J Surg Case Rep.* 2021;81:105833. <http://doi.org/10.1016/j.ijscr.2021.105833>. PMID:33887862.
30. Chen Z, Robinson N, Harkness A. Pedunculated left ventricular thrombus presenting with acute ischaemic limb. *Emerg Med J.* 2008;25(4):216. <http://doi.org/10.1136/emj.2007.049585>. PMID:18356352.
31. Kumar P, Rao MS, Lalani K, Paramasivam G, Devasia T, Parikh P. Dabigatran for intracardiac thrombus, yet another promising role of a direct oral anticoagulant: a case report and short review of literature. *Arch Clin Cases.* 2022;9(2):75-9. <http://doi.org/10.22551/2022.35.0902.10207>. PMID:35813493.
32. Eren NK, Emren SV, Duygu H, Kocabas U. Left ventricular thrombus formation in a patient with normal ejection fraction. *Turk Kardiyol Dern Ars.* 2013;41(7):625-8. <http://doi.org/10.5543/tkda.2013.71598>. PMID:24164994.

33. Daley P, Ptacin M, Horwitz M, Werner P, Almagro U, Bamrah V. Left ventricular thrombus in agnogenic myeloid metaplasia. *Cardiology*. 1987;74(1):53-7. <http://doi.org/10.1159/000174175>. PMID:3815454.
34. John RM, Sturridge MF, Swanton RH. Pedunculated left ventricular thrombus--report of two cases. *Postgrad Med J*. 1991;67(791):843-5. <http://doi.org/10.1136/pgmj.67.791.843>. PMID:1946132.
35. Lewin RF, Vidne B, Sclarovsky S, Agmon J. Two-dimensional real-time echocardiographic detection of a left ventricular aneurysm associated with mobile pedunculated thrombi. *Chest*. 1980;77(5):704-6. <http://doi.org/10.1378/chest.77.5.704>. PMID:7363697.
36. Shetty K, Sunkara N, Ahsan C. Recurrent intra-cardiac thrombosis—A unique presentation of prothrombin G20210 mutation. *J Cardiol Cases*. 2011;3(3):e129-32. <http://doi.org/10.1016/j.jccase.2011.02.002>. PMID:30524602.
37. Steve AV, Kevin RF, James GK 3rd. Left ventricular thrombus in the absence of detectable heart disease. *Chest*. 1989;96(2):426-7. <http://doi.org/10.1378/chest.96.2.426>. PMID:2752829.
38. Lew AS, Federman J, Harper RW, et al. Operative removal of mobile pedunculated left ventricular thrombus detected by 2-dimensional echocardiography. *Am J Cardiol*. 1983;52(8):1148-9. [http://doi.org/10.1016/0002-9149\(83\)90554-4](http://doi.org/10.1016/0002-9149(83)90554-4). PMID:6637840.
39. Chamsi-Pasha MA, Anwar AM, Nosir YF, Chamsi-Pasha H. Hanging by a thread" left ventricular thrombus in an asymptomatic soldier. *Saudi Med J*. 2009;30(3):436-8. PMID:19271079.
40. Early GL, Ballenger M, Hannah H 3rd, Roberts SR. Simplified method of left ventricular thrombectomy. *Ann Thorac Surg*. 2001;72(3):953-4. [http://doi.org/10.1016/S0003-4975\(00\)02607-2](http://doi.org/10.1016/S0003-4975(00)02607-2). PMID:11565702.
41. Wohlfarter T, Hopferwieser T, Schwaighofer H, et al. An idiopathic floating left-ventricular thrombus. *Dtsch Med Wochenschr*. 1991;116(21):808-11. <http://doi.org/10.1055/s-2008-1063682>. PMID:2032531.
42. Palazzuoli V, Mondillo S, D'Aprile N, Faglia S, Palazzuoli A. Heparin treatment and resolution of left ventricular thrombosis. *Int J Cardiol*. 1994;43(3):338-40. [http://doi.org/10.1016/0167-5273\(94\)90217-8](http://doi.org/10.1016/0167-5273(94)90217-8). PMID:8181893.
43. Jeon GJ, Song BG, Park YH, Kang GH, Chun WJ, Oh JH. Acute stroke and limb ischemia secondary to catastrophic massive intracardiac thrombus in a 40-year-old patient with dilated cardiomyopathy. *Cardiol Res*. 2012;3(1):37-40. <http://doi.org/10.4021/cr142w>. PMID:28357023.
44. Chirillo F, Furlanetto A, Bruni A, Martines M, Stritoni P. Atypical electromechanical dissociation in a patient with recurrent pulmonary embolism. *Chest*. 1996;109(2):562-3. <http://doi.org/10.1378/chest.109.2.562>. PMID:8620738.
45. DeWitt LD, Pessin MS, Pandian NG, Paulker SG, Sonnenberg FA, Caplan LR. Benign disappearance of ventricular thrombus after embolic stroke. A case report. *Stroke*. 1988;19(3):393-6. <http://doi.org/10.1161/01.STR.19.3.393>. PMID:3354027.
46. Hwang MH, Pacold I, Loeb HS. Acute anterior myocardial infarction complicated by mural thrombus and peripheral thromboembolism despite anticoagulation. *Cathet Cardiovasc Diagn*. 1985;11(4):417-22. <http://doi.org/10.1002/ccd.1810110411>. PMID:4042158.
47. Çil H, Yavuz C, Atilgan ZA, Gunduz E, Soydisc S. Complete resolution of the left ventricular pedunculated thrombus with tirofiban infusion in a patient with severe left ventricular dysfunction. *Hong Kong J Emerg Med*. 2013;20(5):305-8. <http://doi.org/10.1177/102490791302000508>.
48. Seitz MJ, McLeod MK, O'Keefe MD, Seah PW. A rare cause of Takotsubo cardiomyopathy related left ventricular apical thrombus requiring surgery. *Heart Lung Circ*. 2012;21(4):245-6. <http://doi.org/10.1016/j.hlc.2011.07.004>. PMID:21840755.
49. Manasrah N, Abdel-Qader A, Al Sbihi A, et al. Left ventricular thrombus formation in a structurally and functionally normal heart: a case report and literature review. *J Investig Med High Impact Case Rep*. 2022;10:23247096221101852. <http://doi.org/10.1177/23247096221101852>. PMID:35619244.
50. Jeganathan R, Ralph-Edwards A. Left apical pedunculated thrombus with normal ventricular function mimicking an intracardiac tumor. *J Card Surg*. 2011;26(6):614-6. <http://doi.org/10.1111/j.1540-8191.2011.01304.x>. PMID:21951172.
51. Erkal Z, Bayar N, Arslan Ş. A case of thrombus formation in a patient with preserved left ventricle ejection fraction and development of peripheral embolization. *Cyprus J Med Sci*. 2017;2(2):38-9. <http://doi.org/10.5152/cjms.2017.158>.
52. Maruri-Sánchez R, Diego-Nieto G, Monguió-Santín ME, Calle-Valda CM, Reyes-Copa G, Alfonso F. An intraventricular thrombus of unknown origin. *Arch Cardiol Mex*. 2019;89(3):267-9. PMID:31967595.
53. Müller S, Bartel T, Laube H. Left ventricular thrombus after pregnancy: choice of surgical access using dynamic three-dimensional echocardiography. *Echocardiography*. 1996;13(3):293-6. <http://doi.org/10.1111/j.1540-8175.1996.tb00899.x>. PMID:11442934.
54. Lin CP, Tsai FC, Chu PH, et al. Acute myocardial infarction in a young man complicated with left ventricular thrombi. *Jpn Heart J*. 2004;45(6):1029-35. <http://doi.org/10.1536/jhj.45.1029>. PMID:15655278.
55. Kuroki K, Murakami T. Thoracoscopy-assisted removal of left ventricular thrombus via minithoracotomy. *Asian Cardiovasc Thorac Ann*. 2012;20(1):77-9. <http://doi.org/10.1177/0218492311424466>. PMID:22371951.
56. Rao PV, Roussak JB, Hershman MJ, Venn GE, Taylor KM. An unusual left ventricular mass. *J R Soc Med*. 1990;83(10):650-1. <http://doi.org/10.1177/014107689008301019>. PMID:2286968.
57. Zaikokuji K, Sawazaki M, Tomari S, Uemura T. Mitral thrombectomy to treat a patient with Takotsubo cardiomyopathy. *Asian Cardiovasc Thorac Ann*. 2018;26(3):236-8. <http://doi.org/10.1177/0218492317729618>. PMID:28870088.
58. Ho JK, Dhamija N, Yezbick A, Mahajan A, Marijic J. Left ventricular mass: intraoperative transesophageal echocardiography for evaluation and management. *Anesth Analg*. 2008;107(4):1153-4. <http://doi.org/10.1213/ane.0b013e3181806681>. PMID:18806017.
59. Mukai S, Fuseno H, Nakamura M, Yoshikawa J, Shomura T. Dilated cardiomyopathy complicated by a pedunculated and mobile left ventricular thrombus on ruptured false tendons. *Chest*. 1991;99(4):1042-3. <http://doi.org/10.1378/chest.99.4.1042>. PMID:2009765.
60. Allende NG, Sokn F, Borracci R, et al. Giant pedunculated thrombus with normal left ventricular systolic function mimicking myxoma. *Echocardiography*. 2011;28(2):E31-3. <http://doi.org/10.1111/j.1540-8175.2010.01262.x>. PMID:21198822.
61. Levine GN, McEvoy JW, Fang JC, et al. Management of patients at risk for and with left ventricular thrombus: a scientific statement from the American heart association. *Circulation*. 2022;146(15):e205-23. <http://doi.org/10.1161/CIR.0000000000001092>. PMID:36106537.
62. Keren A, Goldberg S, Gottlieb S, et al. Natural history of left ventricular thrombi: their appearance and resolution in the posthospitalization period of acute myocardial infarction. *J Am Coll Cardiol*. 1990;15(4):790-800. [http://doi.org/10.1016/0735-1097\(90\)90275-T](http://doi.org/10.1016/0735-1097(90)90275-T). PMID:2307788.
63. Zaikokuji K, Sawazaki M, Tomari S, Uemura T. Mitral thrombectomy to treat a patient with Takotsubo cardiomyopathy.

- Asian Cardiovasc Thorac Ann. 2018;26(3):236-8. <http://doi.org/10.1177/0218492317729618>. PMID:28870088.
64. Nili M, Deviri E, Jortner R, Strasberg B, Levy MJ. Surgical removal of a mobile, pedunculated left ventricular thrombus: report of 4 cases. *Ann Thorac Surg.* 1988;46(4):396-400. [http://doi.org/10.1016/S0003-4975\(10\)64651-6](http://doi.org/10.1016/S0003-4975(10)64651-6). PMID:3178348.
 65. Jeon GJ, Song BG, Park YH, Kang GH, Chun WJ, Oh JH. Acute stroke and limb ischemia secondary to catastrophic massive intracardiac thrombus in a 40-year-old patient with dilated cardiomyopathy. *Cardiol Res.* 2012;3(1):37-40. <http://doi.org/10.4021/cr142w>. PMID:28357023.
 66. Chamsi-Pasha MA, Anwar AM, Nosir YF, Chamsi-Pasha H. Hanging by a thread" left ventricular thrombus in an asymptomatic soldier. *Saudi Med J.* 2009;30(3):436-8. PMID:19271079.
 67. Bakhtiari RE, Khaledifar A, Kabiri M, Danesh Z. Mobile pedunculated left ventricular masses in a man with recurrent emboli. *Heart Views.* 2012;13(4):146-8. <http://doi.org/10.4103/1995-705X.105734>. PMID:23439797.
 68. Marchini JFM, Rodrigues AJ, Schmidt A. A ventricular thrombus mimicking a tumour. *BMJ Case Rep.* 2009;2009:bcr06.2009.1944. <http://doi.org/10.1136/bcr.06.2009.1944>. PMID:21886661.
 69. Singal AK, Deepti S, Sharma G, Kothari SS. Herculean mistake: mephentermine associated cardiomyopathy. *Phys Sportsmed.* 2021;49(1):116-22. <http://doi.org/10.1080/00913847.2020.1763146>. PMID:32404042.
 70. Kharwar RB, Chandra S, Dwivedi SK, Saran RK. A pedunculated left ventricular thrombus in a women with peripartum cardiomyopathy: evaluation by three dimensional echocardiography. *J Cardiovasc Ultrasound.* 2014;22(3):139-43. <http://doi.org/10.4250/jcu.2014.22.3.139>. PMID:25309691.
 71. Weinsaft JW, Kim J, Medicherla CB, et al. A novel imaging algorithm for post myocardial infarction left ventricular Thrombus–regional LV function on echocardiography as a gatekeeper for Thrombus evaluation by delayed enhancement cardiac magnetic resonance. *JACC Cardiovasc Imaging.* 2016;9(5):505. <http://doi.org/10.1016/j.jcmg.2015.06.017>. PMID:26476503.
 72. Corrado PA, Macdonald JA, François CJ, Aggarwal NR, Weinsaft JW, Wieben O. Reduced regional flow in the left ventricle after anterior acute myocardial infarction: a case control study using 4D flow MRI. *BMC Med Imaging.* 2019;19(1):1-10. <http://doi.org/10.1186/s12880-019-0404-7>. PMID:31888531.
 73. O'gara PT, Kushner FG, Ascheim DD, et al. 2013 ACCF/AHA guideline for the management of ST-elevation myocardial infarction: executive summary: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. *Circulation.* 2013;127(4):529-55. <http://doi.org/10.1161/CIR.0b013e3182742c84>. PMID:23247303.
 74. Zhang Z, Si D, Zhang Q, et al. Prophylactic rivaroxaban therapy for left ventricular thrombus after anterior ST-segment elevation myocardial infarction. *Cardiovascular Interventions.* 2022;15(8):861-72. <http://doi.org/10.1016/j.jcin.2022.01.285>. PMID:35367170.
 75. Shantsila E, Koziel M, Lip GY. Anticoagulation versus placebo for heart failure in sinus rhythm. *Cochrane Database Syst Rev.* 2021;5(5):CD003336. <http://doi.org/10.1002/14651858.CD003336.pub4>. PMID:34002371.
 76. Cokkinos DV, Haralabopoulos GC, Kostis JB, Toutouzas PK, HELAS investigators. Efficacy of antithrombotic therapy in chronic heart failure: the HELAS study. *Eur J Heart Fail.* 2006;8(4):428-32. <http://doi.org/10.1016/j.ejheart.2006.02.012>. PMID:16737850.
 77. Weinsaft JW, Kim HW, Shah DJ, et al. Detection of left ventricular thrombus by delayed-enhancement cardiovascular magnetic resonance: prevalence and markers in patients with systolic dysfunction. *J Am Coll Cardiol.* 2008;52(2):148-57. <http://doi.org/10.1016/j.jacc.2008.03.041>. PMID:18598895.
 78. Mehana EM, Shawky AM, Abdelrahman HS. Insights on the left ventricular thrombus in patients with ischemic dilated cardiomyopathy. *Egypt J Radiol Nucl Med.* 2021;52:246. <https://doi.org/10.1186/s43055-021-00628-5>.
 79. Weinsaft JW, Kim J, Medicherla CB, et al. A novel imaging algorithm for post myocardial infarction left ventricular Thrombus–regional LV function on echocardiography as a gatekeeper for Thrombus evaluation by delayed enhancement cardiac magnetic resonance. *JACC Cardiovasc Imaging.* 2016;9(5):505. <http://doi.org/10.1016/j.jcmg.2015.06.017>. PMID:26476503.
 80. Howick J, Chalmers I, Lind J, et al. Oxford Centre for Evidence-Based Medicine 2011 Levels of Evidence [Internet]. 2011 [cited 2023 Oct 15]. Available from: <http://www.cebm.net/index.aspx?o=5653>

■ **APPENDIX. DATA ON BASELINE CHARACTERISTICS, PRESENTATION, ECG, POSSIBLE CAUSE, MANAGEMENT, AND OUTCOME. (ECG, ELECTROCARDIOGRAM; TIA, TRANSIENT ISCHEMIC ATTACK; MI, MYOCARDIAL INFARCTION; STEMI, ST-SEGMENT ELEVATION MYOCARDIAL INFARCTION; MCA, MIDDLE CEREBRAL ARTERY; NR, NOT REPORTED; HF, HEART FAILURE; LVAD, LEFT VENTRICLE ASSIST DEVICE; AKI, ACUTE KIDNEY INJURY; BIVAD, BIVENTRICULAR ASSIST DEVICE; IHD, ISCHEMIC HEART DISEASE; PCI, PERCUTANEOUS INTERVENTION; LAD, LEFT ANTERIOR DESCENDING ARTERY; FUO, FEVER OF UNKNOWN ORIGIN; LCX, LEFT CIRCUMFLEX ARTERY; LV, LEFT VENTRICLE; CABG, CORONARY ARTERY BYPASS GRAFT; NYHA, NEW YORK HEART ASSOCIATION; NSTEMI, NON-ST-SEGMENT ELEVATION MYOCARDIAL INFARCTION; COVID-19, CORONAVIRUS DISEASE 2019; IV, INTRAVENOUS; RTPA, RECOMBINANT TISSUE PLASMINOGEN ACTIVATOR; AF, ATRIAL FIBRILLATION; DVT, DEEP VEIN THROMBOSIS; RVOT, RIGHT VENTRICLE OUTFLOW TRACT; DCL, DISTURBED CONSCIOUSNESS LEVEL; RBBB, RIGHT BUNDLE BRANCH BLOCK.**

Table 1. Data on baseline characteristics, presentation, ECG, possible cause, management, and outcome. (ECG, electrocardiogram; TIA, transient ischemic attack; MI, myocardial infarction; STEMI, ST-segment elevation myocardial infarction; MCA, middle cerebral artery; NR, not reported; HF, heart failure; LVAD, left ventricle assist device; AKI, acute kidney injury; BiVAD, biventricular assist device; IHD, ischemic heart disease; PCI, percutaneous intervention; LAD, left anterior descending artery; FUO, fever of unknown origin; LCX, left circumflex artery; LV, left ventricle; CABG, coronary artery bypass graft; NYHA, New York heart association; NSTEMI, non-ST-segment elevation myocardial infarction; CoVID-19, coronavirus disease 2019; IV, intravenous; RTPA, recombinant tissue plasminogen activator; AF, atrial fibrillation; DVT, deep vein thrombosis; RVOT, right ventricle outflow tract; DCL, disturbed consciousness level; RBBB, right bundle branch block.

Author/ year	Age (year)	Gender	Risk factors	Presentation	ECG	Extracardiac emboli site	Cause	Management	Outcome/ complications	Evidence level
Kumar et al., 2016 ⁹	44	Male	Smoking	TIA (upper limb weakness)	old anterolateral MI (t wave inversion and downward ST sloping v1-4)	brain	Old anterolateral STEMI	surgical removal	Recovery and discharge.	4
Grewal et al., 2020 ¹⁰	23	Female	ulcerative colitis (diagnosed 2-3 weeks before presentation)	Stroke (sudden weakness on the right side with aphasia; left MCA infarction) followed by episodes of TIA despite anticoagulation therapy	Normal	brain, MCA	Ulcerative colitis	Surgical removal	Recovery and discharge.	4
Garg et al., 2021 ¹¹	60	Male	Hypertension, schizophrenia	fever, dyspnea, desaturation (83% room air), altered consciousness	Sinus rhythm, left ventricular hypertrophy, prolonged QTc	mural thrombus and pulmonary embolism	CoVID-19 pneumonia	Heparin	NR	4
Cousin et al., 2014 ¹²	63	Male	HF	cardiogenic shock and hypotension	NR	None	Non-ischemic dilated cardiomyopathy	Surgical thrombectomy and LVAD	Recovery and discharge (with a plan for heart transplantation)	4
	50	Male	Biventricular HF and coagulopathy	dyspnea, bilateral lower limb edema, pneumonia, septic shock, and AKI	NR	None	HF/ coagulopathy (occluded right popliteal vein)	Surgical thrombectomy and BiVAD. Heart transplantation after 6 months.	Recovery and discharge	4

Table 1. Continued...

Author/ year	Age (year)	Gender	Risk factors	Presentation	ECG	Extracardiac emboli site	Cause	Management	Outcome/ complications	Evidence level
	64	Male	IHD, HF, chronic lymphocytic leukemia, and acute promyelocytic leukemia	NR	NR		IHD and HF	Surgical removal	Thrombus recurrence after 6 months of recovery.	4
Kana-zawa et al., 2016 ¹³	75	Female	NR	NR (referral)	Q waves v1-v4	None	Apical aneurysm due to asymptomatic MI	Surgical removal	NR	4
Allende et al., 2011 ¹⁴	74	Female	essential thrombocythemia and previous unstable angina (PCI to the LAD)	Atypical chest pain and left hemiparesis (on the 2nd day of admission)	Normal then negative T wave	Brain and heart (distal LAD)	Combined essential thrombocythemia with IHD.	Surgical removal and saphenous vein graft to the distal LAD.	Improvement (of neurological symptoms) and discharge	4
Lutz et al., 2007 ¹⁵	34	Male	hyperlipidemia, gastroesophageal reflux disease, pyelonephritis, hydronephrosis, Crohn's disease, ischemic colitis, and depression	Referral, FUO	NR	None	Ulcerative colitis	Surgical removal	Recovery and discharge (4 days)	4
Nili et al., 1988 ¹⁶	59	Male	Eight-month history of stable angina	Chest pain, acute anteroseptal MI followed by HF	NR	None	Acute MI and HF	Surgical removal and graft of the LAD	Recovery and discharge (14 days)	4
	56	Male	Polycythemia vera	left upper quadrant abdominal pain and fever for two weeks after anterior MI (treated by heparin infusion).	NR	Spleen	Acute MI and HF	Surgical removal of thrombus and double coronary bypass (LAD and LCX)	Recovery and discharge (22 days)	4
	46	Male	MI 1 year before presentation	Left common femoral artery occlusion	NR	Common femoral artery	MI (1 year before presentation)	Surgical removal of LV thrombi (thrombectomy)	Recovery and discharge (10 days)	4
	66	Male	eleven-year history of angina; MI 2 years; CABG candidate	Angina	NR	None	MI (2 years)	Surgical removal then CABG	Recovery and discharge (12 days)	4
Kharwar et al., 2014 ¹⁷	30	Female	Pregnancy (hypercoagulable state) with poor LV function	peripartum cardiomyopathy Orthopnea and dyspnea on exertion (3 weeks after delivery)	Sinus tachycardia	None	Peripartum cardiomyopathy (poor LV function and hypercoagulable state)	Oral anticoagulation (warfarin)	Complete dissolution (30 days) and improvement of systolic function to 43%	4
Ito et al., 2022 ¹⁸	52	Female	IHD	Discovered during an MRI study	NR	None	MI (15 years)	Surgical removal	recovery and discharge (10 days)	4

Table 1. Continued...

Author/ year	Age (year)	Gender	Risk factors	Presentation	ECG	Extracardiac emboli site	Cause	Management	Outcome/ complications	Evidence level
Singal et al., 2021 ¹⁹	32	Male	Two-year history of anabolic androgenic steroid abuse and three-month history of mephentermine abuse.	Acute decompensated heart failure (plus left upper limb monoparesis and embolic TIA on the second day)	Sinus tachycardia and left ventricle enlargement	Brain (left parietal lobe and right cerebellum)	Toxic cardiomyopathy (secondary to mephentermine and/or anabolic androgenic steroid abuse)	Anticoagulant (warfarin)	Complete dissolution (with an improvement of NYHA classification and LV function after two weeks)	
Tanaka et al., 2014 ²⁰	37	Female	Pregnancy (hypercoagulable state) with poor LV function	Exertional dyspnea and fatigue	NR	None	Peripartum cardiomyopathy (poor LV function and hypercoagulable state)	Surgical removal	Recovery and discharge (day 10)	4
Jeganaathan et al., 2011 ²¹	62	Male	Hypertension, renal impairment, and colon cancer treated surgically (4 years)	Right acute limb/leg ischemia with compartment syndrome	NR	Right popliteal artery	Idiopathic	Surgical removal	Recovery and discharge	4
Janula et al., 2021 ²²	47	Male	Diabetes mellitus, obesity, and dyslipidemia	NSTEMI in the context of CoVID-19 infection, fever, and expressive aphasia developed during hospital stay (day 4)	RBBB	Right occipital and left temporal regions (with micro-hemorrhagic transformation, contraindication for anticoagulation)	procoagulant state of CoVID-19 and acute MI	Surgical removal	Recovery	4
Marchini et al., 2009 ²³	33	Female	Hypertension, smoking, and repeated miscarriage	Dyspnea and lower limb edema for 3 years (NYHA II)	Q waves I, aVL; ST depression II and III; T wave inversion I, aVL, V5, and V6; and LV hypertrophy	None	HF	Surgical removal	Recovery (discharge 9 days)	4
Mukai et al., 1991 ²⁴	68	Male	Diabetes	Congestive heart failure (thrombus developed during the hospital stay, on the 15 th day)	Sinus tachycardia, mild LV hypertrophy	None	Dilated cardiomyopathy	Surgical removal	Recovery	4
Park et al., 1986 ²⁵	33	Male	IHD (inferior STEMI 6 years before presentation), emboli to the right femoral artery and left internal iliac artery (failed bypass and right above-knee amputation)	Mesenteric artery thromboembolism (abdominal pain)		mesenteric artery	MI (6 years)	Surgical removal	Recovery without recurrence (complicated with an embolus to the left femoral artery on the 20 th day, which was treated with left above-knee amputation).	4

Table 1. Continued...

Author/ year	Age (year)	Gender	Risk factors	Presentation	ECG	Extracardiac emboli site	Cause	Management	Outcome/ complications	Evidence level
Bakhtiari et al., 2012 ²⁶	51	Male	Diabetes mellitus, hypertension, hyperlipidemia, IHD (MI 3 years prior)	Two-week history of right-sided weakness, left-sided paresthesia, and visual disturbance bilaterally.		Brain (biocapital, basal ganglia, and internal capsule)	MI (3 years)	Surgical removal	Recovery	4
Chen et al., 1981 ²⁷	74	Male	IHD, ventricular ectopy, congestive cardiomyopathy, and diabetes mellitus	Dysarthria, weakness, and ataxia		Brain	Idiopathic congestive cardiomyopathy	IV heparin	Death	4
Rester et al., 2001 ²⁸	23	Female	Pregnancy-induced hypertension and peripartum cardiomyopathy	Fatigue, shortness of breath, and bilateral flank pain.	Sinus tachycardia with non-specific ST-T segment abnormality	Spleen, right kidney	Peripartum cardiomyopathy (poor LV function and hypercoagulable state)	RTPA (after failure of heparin infusion and enlargement of the thrombus size)	Recovery (complete lysis of the thrombus after 8-10 hours)	4
Azari et al., 2021 ²⁹	45	Male	Diabetes mellitus, hypertension, smoking, and alcohol intake	Negligible MI (severe epigastric pain, fever, sweating, and tachycardia)	Q waves in V1-2 and biphasic T wave V2-4	mesenteric artery	Acute MI and HF	Surgical removal	Recovery	4
Chen et al., 2008 ³⁰	84	Male	IHD (anterior MI 8 years ago), and AF	Acute left lower limb ischemia	NR	Left lower limb	MI (8 years)	Surgical removal	NR	4
Kumar et al., 2022 ³¹	57	Male	None	Bilateral acute lower limb ischemia with absent dorsalis pedis and posterior tibial artery pulses bilaterally	Normal	mid and distal anterior tibial and dorsalis pedis bilaterally	Idiopathic	Aspirin [®] (150 mg), clopidogrel (75 mg), and LMWH for 48 hours/ till leg numbness disappeared. Then antiplatelet plus dabigatran 110 mg for two weeks (till the thrombus disappeared). Resumed on aspirin [®] plus dabigatran 150 mg twice daily for 6 months.	Recovery of leg condition and lysis of the LV thrombus	4
Eren et al., 2013 ³²	45	Female	NR	Cerebrovascular accident (loss of consciousness for 15 minutes followed by ataxia)	Normal (sinus rhythm)	Brain (bilateral infarcts)	Idiopathic	Surgical removal	NR	4
Daley et al., 1987 ³³	40	Male	Agnogenic myeloid metaplasia	Maculopapular rash, fever, and pleuro-pericardial pain	Normal	None	Idiopathic myocarditis and spontaneous platelet aggregation.	Surgical removal	Recovery and discharge (4 weeks)	
John et al., 1991 ³⁴	63	Female	Peptic ulcer	MI	Inverted T wave I, aVL, and V2-6	None	Acute MI	Surgical removal	Recovery and discharge.	4
	56	Male	NR	Unstable angina (4 weeks)	Q waves anteriorly	None	Acute MI	Surgical removal	Recovery and discharge.	4

Table 1. Continued...

Author/ year	Age (year)	Gender	Risk factors	Presentation	ECG	Extracardiac emboli site	Cause	Management	Outcome/ complications	Evidence level
Lewin et al., 1980 ³⁵	51	Male	IHD (inferior MI 6 years and anterolateral MI 4.5 years backward)	Bilateral acute limb ischemia	Old inferior and anterior MI (persistent ST elevation)	bilateral to the Iliac arteries	Aneurysm of the anterior wall	Surgical removal of the thrombus with aneurysmectomy	Recovery and discharge (14 days)	4
Shetty et al., 2011 ³⁶	49	Female	Anxiety, hypertension, and surgical history of hysterectomy.	One month history of exertional dyspnea	NR	None	prothrombin G20210 mutation	Surgical removal followed by anticoagulation (enoxaparin and warfarin then warfarin).	Recovery and discharge. Complicated by atrial mass after 6 weeks, dissolved medically after two months of medical treatment	4
Vaganos et al., 1989 ³⁷	43	Female	history of bilateral DVT and pulmonary emboli.	Eight-hour history of pain, pallor, pulselessness, and paralysis of the left leg.	Normal	Left common femoral artery	Possible hypercoagulable state	Surgical removal	Recovery	4
Lew et al., 1983 ³⁸	63	Male	history of DVT and pulmonary embolism (the patient was already on IV heparin)	Acute right limb ischemia		Right femoral artery	Possible hypercoagulable state	Surgical removal	Recovery	4
Chamsi-Pasha et al., 2009 ³⁹	32	Male	None	Routine echocardiography (asymptomatic)	Normal	None	Idiopathic cardiomyopathy	Warfarin overlapped with enoxaparin maintaining INR 2-3, then warfarin for 6 months	Complete dissolution after 6 weeks	4
Early et al., 2001 ⁴⁰	64	Female	NR	Acute anterior MI, received thrombolytic therapy + no LV thrombus on presentation	Anterior STEMI	None	Acute MI	Surgical removal	Recovery	4
Wohlfarter et al., 1991 ⁴¹	28	Male	Appendectomy (4 weeks)	Occlusion of the left superior femoral A at the adductor canal (dragging pain at the cuff)		Left superior femoral artery		Heparin failed, systemic thrombolysis with streptokinase 750000 IU replaced by ancred 70 IU/day IV for increased movement, then heparin 3000 IU IV	Recovery (thrombus size decreased to 0.7 after 5 days, then it disappeared after two weeks)	4
Palazzuoli et al., 1994 ⁴²	70	Male	bilateral lower limb arteriopathy.	Episodes of disorientation	Recent inferior MI	None	Acute MI	Calcium heparin 12500 IU/ 8 hours	Complete dissolution after 20 days.	4
Jeon et al., 2012 ⁴³	40	Male	None	Stroke and acute limb ischemia (dyspnea, right facial and limb weakness as well as both lower limb pain, pulselessness and coldness).	Sinus rhythm with diffuse non-specific ST segment changes.	Brain, right femoral and right popliteal, and left popliteal arteries	Idiopathic dilated cardiomyopathy	Surgical removal	Recovery and discharge (7 days)	4

Table 1. Continued...

Author/ year	Age (year)	Gender	Risk factors	Presentation	ECG	Extracardiac emboli site	Cause	Management	Outcome/ complications	Evidence level
Chirillo et al., 1996 ⁴⁴	47	Male	Recurrent pulmonary embolism, DVT (bilateral femoral and saphenous), smoking, and left lung cancer	Bilateral pulmonary embolism, left pulmonary infarction masking tumor, and thrombosis in the IVC (Sudden dyspnea, tachycardia, and hypoxemia)	RBBB	Lung, lower limb, IVC	Hypercoagulable state resistant to anticoagulation (paraneoplastic hypercoagulable state)	Heparin and RTPA after 5 days	Death (electromechanical dissociation due to RVOT obstruction)	4
DeWitt et al., 1988 ⁴⁵	80	Female	None	Stroke (right upper limb weakness and speech abnormality)	Nonspecific ST and T wave changes	Brain	Idiopathic	Heparin then warfarin.	Recovery and dissolution of thrombus (12 days)	4
Hwang et al., 1985 ⁴⁶	43	Male	None	Anterior MI (2 weeks)	NR	Superior mesenteric artery	Acute MI	Surgical removal	Recovery and discharge.	4
Çil et al., 2013 ⁴⁷	28	Male	IHD (anterior MI 2 years)	Deteriorating dyspnea (decompensated heart failure NYHA class IV)	Anterior ST-segment elevation	None	Essential thrombocytopenia, previous IHD with resultant aneurysm, and HF	Tirofiban after failed heparin infusion (1000 IU/hour for 48 hours)	Complete dissolution after 48 hours (decreased size after 24 hours to 1.8*0.7)/ recovery and discharge (on the 6th day)	4
Seitz et al., 2012 ⁴⁸	48	Male	Cystic fibrosis	DCL, hemoptysis, dyspnea, and respiratory arrest	NR	None	Takotsubocardiomyopathy	Surgical removal	Recovery and discharge (on day 5 after the operation)	4
Manasrah et al., 2022 ⁴⁹	54	Female	Type II DM and smoking	Two-hour history of right leg pain.	RBBB	The aortoiliac bifurcation, bilateral common iliac arteries, and proximal left internal iliac artery	Idiopathic	Surgical removal	Recovery and discharge	4
Jeganathan and Ralph-Edwards, 2011 ⁵⁰	62	Male	Hypertension, colorectal carcinoma, and renal impairment.	Acute right leg ischemia	NR	Right popliteal artery	Idiopathic	Surgical removal (after heparin failed)	Recovery and discharge	4
Erkal et al., 2017 ⁵¹	63	Male	Right femoral embolectomy 2 weeks before presentation	Left femoral artery occlusion	Normal sinus rhythm	Left femoral artery	Idiopathic	Medical treatment	Recovery	4
Maruri-Sánchez et al., 2019 ⁵²	38	Male	Smoking, dyslipidemia, hypertension, and left lower limb DVT 2 years ago	Stroke	NR	right MCA	Idiopathic	Surgical removal	Recovery and discharge	4
Muller et al., 1996 ⁵³	41	Female	Hypertension	Stroke	Left anterior hemiblock, and non-specific ST-T wave changes	Left MCA	Idiopathic	Surgical removal	Recovery (the patient had post-operative wound infection)	4

Table 1. Continued...

Author/ year	Age (year)	Gender	Risk factors	Presentation	ECG	Extracardiac emboli site	Cause	Management	Outcome/ complications	Evidence level
Lin et al., 2004 ⁵⁴	23	Male	None	MI (acute proximal LAD lesion), TIA, transient loss of vision 5 min the day before presentation.	Q waves V1 to V5 and low voltage limb leads	Brain (TIA)	Acute MI and premature coronary artery disease	Heparin then surgical removal	Recovery and discharge	4
Kuroki and Murakami, 2012 ⁵⁵	58	Female	None	MI (acute LAD occlusion), chest pain for two days	Anterior ST elevation	None	Acute MI	Surgical removal	Recovery	4
Rao et al., 1990 ⁵⁶	71	Female	NR	Constitutional symptoms mostly Dressler's syndrome following silent MI, masked by RBBB.	Sinus rhythm with RBBB then AF	None	Acute silent MI	Surgical removal	Recovery	4
Zaikokuji et al., 2018 ⁵⁷	68	Female	Bipolar disorders	Gastric ulcer (upper abdominal discomfort)	ST-segment depression and T wave inversion V3-V6	None	Takotsubo cardiomyopathy	Surgical removal	Recovery (discharged on day 15 postoperative)	4
Ho et al., 2008 ⁵⁸	29	Male	Cocaine use	Embolic stroke	NR	Brain	MI (substance abuse)	Surgical removal	Recovery	4

Table 2. Thrombus characteristics. LV, left ventricle; EF, ejection fraction; NR, not reported; LVOT, left ventricle outflow tract.

Author/ year	LV thrombus Site	Thrombus dimensions by echocardiography (Cm)/ (pathology specimen)	Other significant echocardiographic findings
Kumar et al., 2016 ⁹	Apical and anterior mitral leaflet	3.8* 1.9/ pathology (4*2*1)	EF 50%; hypokinetic apex and apical segment.
Grewal et al., 2021 ¹⁰	Apical	1.9*1	Normal systolic function, no segmental wall motion abnormality
Garg et al., 2021 ¹¹	Apical, apical anterior, lateral, and inferior walls.	Largest was 3*3	Moderately reduced LV function
Cousin et al., 2014 ¹²	Apical	3.3*2.5	EF 5- 10% and dilated LV with global hypokinesia
	Apex, septum, and anterior wall	4.2* 3.5	EF 15- 20%, global hypokinesia, apical akinesia, and dilated right ventricle.
	Apical	2.5* 1.7	Moderate global hypokinesia, severe hypokinesia inferiorly, and inferoseptally.
Kanazawa et al., 2016 ¹³	Apical	NR	EF 40%, akinesia from the anteroseptal wall to the apex.
Allende et al., 2011 ¹⁴	Mid-anterior wall	2.5*1.4	On the first day, normal systolic function and mild left atrial enlargement. On the second day, EF was 52% with hypokinesia of the apical segments.
Lutz et al., 2007 ¹⁵	Apical	1.3*1.7 (1*0.9*1.7 after excision)	Normal LV systolic function
Nili et al., 1988 ¹⁶	interventricular septum	4*3	EF 26%, dilated LV, akinetic septum, and dyskinetic anterior wall.
	Apical	2*2	EF 28%,
	NR	NR (two pedunculated thrombi)	NR
	NR	1.5*2	NR
Kharwar et al., 2014 ¹⁷	Interventricular septum	2.5*2	EF 32%, global hypokinesia, and dilated four chambers.
Ito et al., 2022 ¹⁸	Ventricular free wall.	NR	Ef 25% and anterior wall akinesia
Singal et al., 2021 ¹⁹	Apical	3.4*1.6	Biventricular systolic dysfunction (EF of 20%), global hypokinesia, and severe central MR

Table 2. Continued...

Author/ year	LV thrombus Site	Thrombus dimensions by echocardiography (Cm)/ (pathology specimen)	Other significant echocardiographic findings
Tanaka et al., 2014 ²⁰	Apical	3*3	EF 10%
Jeganathan et al., 2011 ²¹	Apical	3*1	Normal
Janula et al., 2021 ²²	Apical	NR	EF 35% with akinetic septum, antero-septal, and anterior walls.
Marchini et al., 2009 ²³	Interventricular septum	4.6* 1.2	EF 41%, an akinetic distal portion of the septum, anterior wall, and the whole apex.
Mukai et al., 1991 ²⁴	lateral wall (near the apex)	1*1 (1.2*1*0.7)	EF 44%, global hypokinesia, akinetic apex, and dilated LV
Park et al., 1986 ²⁵	Apical	7*3 (7*4.5*2.7)	Slightly enlarged LV cavity, akinetic apex, and distal septum
Bakhtari et al., 2012 ²⁶	Posterior wall and anterolateral wall (mid-segment)	Posterior wall: 2.5*1.8 (2.5*2 after excision). Anterolateral wall 2.8*2.2 (3*4 after excision)	Mild LV dilatation with LVEF 35-40%, akinetic basal inferior, and hypokinetic lateral wall (basal and mid segments)
Chen et al., 1981 ²⁷	Apical	NR	dilated LV with global hypokinesia.
Rester et al., 2001 ²⁸	Apical	2.1*2.5	LVEF decreased from 40% (anteroseptal and inferior wall hypokinesia, LA enlargement, mild MR, and mild TR) to 25%.
Azari et al., 2021 ²⁹	Apical	1.7*1.9	LVEF 40%
Chen et al., 2008 ³⁰	Apical	NR	NR
Kumar et al., 2022 ³¹	Apical	3.4*1.1	Normal LVEF
Eren et al., 2013 ³²	Apical	1.8*0.8	Normal (LVEF 67%)
Daley et al., 1987 ³³	Posterior wall	2	Normal
John et al., 1991 ³⁴	Apical	1*2.5	Normal
	Apical	1*1.5	Anteroapical akinesia
Lewin et al., 1980 ³⁵	Anterolateral	NR	Anterior wall aneurysm.
Shetty et al., 2011 ³⁶	posterolateral papillary muscle	NR	Normal
Vaganos et al., 1989 ³⁷	Apical	3.6*2.9*1.1 (after excision)	Normal
Lew et al., 1983 ³⁸	Apical	1.5	LV dilatation and septal hypokinesia.
Chamsi-Pasha et al., 2009 ³⁹	Apical (apical septal)	1.5*2.7	LVEF 35%, global hypokinesia, and mild mitral regurgitation.
Early et al., 2001 ⁴⁰	Apical	2*2	LVEF 25% and akinetic apex
Wohlfarter et al., 1991 ⁴¹	Septum	3.5*2	NR
Palazzuoli et al., 1994 ⁴²	Apical	1.5 at the longest diameter	NR
Jeon et al., 2012 ⁴³	Apical	4.3*4.2	Global systolic dysfunction with LVEF 19% and dilated LV (6.5 cm).
Chirillo et al., 1996 ⁴⁴	Apical	10 at the longest dimension.	NR
DeWitt et al., 1988 ⁴⁵	Apical	2*2.5	Normal
Hwang et al., 1985 ⁴⁶	Apical	4 to 5	LVEF 26% and anterior apical aneurysm.
Çil et al., 2013 ⁴⁷	Apical (apical septal)	4*1.1	Left ventricle dysfunction (LVEF 26%) and apical aneurysm
Seitz et al., 2012 ⁴⁸	Apical (apical inferior)	2.8*1.6 (3*1.5)	Left ventricle dysfunction with apical to mid-anterior hypokinesia.
Manasrah et al., 2022 ⁴⁹	Apical	Apical thrombus measuring 1.8*1.2 (2.3*2.1 by TEE at the anterolateral wall) and 1*0.5 (Apex)	Normal LV function with no segmental wall motion
Jeganathan and Ralph-Edwards, 2011 ⁵⁰	Apical	3*1	Normal
Erkal et al., 2017 ⁵¹	Septum	1.3*1.1	LVEF 65%
Maruri-Sánchez et al., 2019 ⁵²	Septum	1.6*1.7	Normal (LVEF 60% with no regional wall motion)
Muller et al., 1996 ⁵³	Apical	4*2	Normal LV function
Lin et al., 2004 ⁵⁴	Between the septum and inferior wall close to the LVOT	1. 3*2 (3*2*2) 2. 1*1 (1*1*0.5)	Normal
Kuroki and Murakami, 2012 ⁵⁵	Apical	1. 1.5*1.4*1.3 2. 0.3*0.2*0.1	Apical and antero-septal wall motion and mild mitral regurgitation
Rao et al., 1990 ⁵⁶	Apical	NR	On day 2: mid and apical anterior akinesia

Table 2. Continued...

Author/ year	LV thrombus Site	Thrombus dimensions by echocardiography (Cm)/ (pathology specimen)	Other significant echocardiographic findings
Zaikokuji et al., 2018 ⁵⁷	Apical	NR	Highly mobile, pedunculated mass arising from the left ventricular apex and protruding into the mitral orifice
Ho et al., 2008 ⁵⁸	Apical	1.9*1.8 (decreased to 1.8*1.1 on the 5 th day but became more mobile)	LVEF 42.1%; akinetic apical and mid segments
	Apical	2.5*1.5	LVEF 45%; apical anterior dyskinesia; apical septal, inferior, and lateral hypokinesia.

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 Overall responsibility: AAA, EES

*All authors have read and approved of the final version of the article submitted to J Vasc Bras.