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Imaging Modalities for Diagnosing Spontaneous Coronary Artery Dissection: A Systematic Review

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Abstract

Spontaneous coronary artery dissection (SCAD) is an underdiagnosed, non-atherosclerotic cause of acute coronary syndrome (ACS), particularly affecting young to middle-aged women without traditional risk factors. Accurately diagnosing SCAD is essential, however, an effective imaging protocol remains uncertain. This systematic review aimed to evaluate the diagnostic performance, strengths, and limitations of invasive coronary angiography (ICA), optical coherence tomography (OCT), intravascular ultrasound (IVUS), and coronary computed tomography angiography (CCTA) in assessing SCAD. Following PRISMA 2020 guidelines, a comprehensive literature search of PubMed, Google Scholar and Scopus from inception to January 2025 identified eight studies, including retrospective cohorts, prospective observational studies, and case series (≥10 patients). The quality of included studies was assessed using the Cochrane Risk of Bias tool (RoB 1.0), as implemented in Review Manager (RevMan) version 5.4.1. Due to insufficient 2×2 diagnostic data for sensitivity and specificity, a meta-analysis was not feasible. Therefore, a qualitative synthesis was conducted. In this review, ICA was used as the initial diagnostic modality in all studies; however, it was often insufficient for a definitive diagnosis, particularly in SCAD Types 2, 3 and 4. OCT modality was used in seven studies, where it demonstrated superior spatial resolution for detecting intimal tears and double lumen morphologies, and proved effective in identifying intramural hematomas and changes in deeper layers of the vessel wall. IVUS was used in four studies, where it exhibited changes in deep arterial wall structures and intramural hematomas in the absence of intimal disruption. Additionally, IVUS is often used to complement ICA. CCTA was employed in four studies, mainly utilised in follow-up assessments due to its non-invasive nature, but was limited in acute settings. The findings suggest a multimodal imaging approach consistently enhances diagnostic accuracy across SCAD subtypes. Despite promising results, current evidence is limited by small sample sizes, study heterogeneity, and lack of standardised reporting. Future research should focus on prospective, multicenter studies with standardised imaging protocols to establish a robust diagnostic algorithm for SCAD.

Keywords: spontaneous coronary artery dissection, acute coronary syndrome, optical coherence tomography, intravascular ultrasound, invasive coronary angiography, coronary computed tomography angiography

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Методы визуализации при диагностике спонтанной диссекции коронарной артерии: систематический обзор

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Резюме

Спонтанная диссекция коронарных артерий (СДКА) является неатеросклеротической причиной острого коронарного синдрома (ОКС), которая часто не диагностируется, особенно у женщин молодого и среднего возраста без традиционных факторов риска. Точная диагностика СДКА имеет важное значение, однако до сих пор не существует единого эффективного протокола применения методов визуализации. Цель этого систематического обзора – оценка диагностических возможностей, преимуществ и ограничений инвазивной коронарографии, оптической когерентной томографии (ОКТ), внутрисосудистого ультразвукового исследования (ВСУЗИ) и компьютерной томографии коронарных артерий при оценке СДКА. В соответствии с рекомендациями PRISMA 2020, расширенный поиск литературы в PubMed, Google Scholar и Scopus с момента создания до января 2025 года выявил восемь исследований, включая ретроспективные когортные, проспективные обсервационные и серии случаев (≥10 пациентов). Качество включенных исследований оценивалось с использованием кокрановского инструмента оценки риска систематической ошибки (RoB 1.0), реализованного в Review Manager (RevMan), версия 5.4.1. Из-за недостатка диагностических данных 2×2 для определения чувствительности и специфичности проведение метаанализа не представлялось возможным. В связи с этим был проведен качественный синтез. В этом обзоре инвазивная коронарография использовалась в качестве исходного диагностического метода во всех исследованиях, однако во многих случаях ее было недостаточно для постановки окончательного диагноза, особенно при СДКА типов 2, 3 и 4. Метод ОКТ использовался в семи исследованиях, где он продемонстрировал высокую пространственную разрешающую способность,

позволяющую эффективно выявлять разрывы интимы и исследовать морфологию двойного просвета, и доказал свою эффективность при выявлении интрамуральных гематом и изменений в более глубоких слоях сосудистой стенки. ВСУЗИ применяли в четырех исследованиях, с его помощью были выявлены изменения в структурах глубоких артериальных стенок и интрамуральные гематомы при отсутствии повреждения интимы. Кроме того, ВСУЗИ часто используют в дополнение к инвазивной коронарографии. В четырех исследованиях выполняли компьютерную томографию коронарных артерий, в основном в ходе последующего наблюдения, что обусловлено ее неинвазивным характером, но ее применение при острых состояниях носило ограниченный характер. Полученные данные свидетельствуют о том, что мультимодальный подход к визуализации неизменно повышает точность диагностики всех подтипов СДКА. Несмотря на многообещающие результаты, имеющиеся данные ограничены небольшими размерами выборки и неоднородностью исследований. Необходимо проведение дальнейших проспективных многоцентровых исследований с использованием стандартизированных протоколов применения методов визуализации для создания надежного алгоритма диагностики СДКА.
Ключевые слова: спонтанная диссекция коронарной артерии, острый коронарный синдром, оптическая когерентная томография, внутрисосудистое ультразвуковое исследование, инвазивная коронарная ангиография, компьютерная томография коронарных артерий

■ INTRODUCTION

Spontaneous coronary artery dissection (SCAD) is defined as a sudden, non-traumatic and non-iatrogenic separation of the layers within the wall of an epicardial coronary artery. This condition is characterised by the development of an intramural hematoma and the formation of a false lumen. Unlike acute coronary syndrome (ACS) caused by atherosclerotic plaque rupture, trauma, or coronary intervention, SCAD is a non-atherosclerotic cause of ACS. The accumulation of blood within the arterial wall can propagate in both directions, either with the flow of blood (antegrade) or against it (retrograde), leading to compression of the true lumen. This may obstruct the coronary blood flow in various degrees and result in myocardial ischemia (MI). SCAD typically presents as an acute incident and is notably prevalent among young to middle-aged women who do not exhibit conventional cardiovascular risk factors [1–5]. Several predisposing factors have been identified, including female sex, extra-coronary vascular abnormalities such as fibromuscular dysplasia, coronary arterial tortuosity, connective disorders (Marfan syndrome, Ehlers-Danlos syndrome), the peripartum state, inflammatory diseases, polycystic kidney disease (PCKD), and episodes of extreme strenuous physical or emotional stress [6–8]. Although the exact cause of SCAD remains incompletely understood, emerging research suggests that genetics may play a significant role. Approximately 5% to 8% of patients carry mutations in genes linked to inherited connective tissue disorders, such as FBN1, COL3A1, and SMAD3. Variants in other genes, like PKD1 and LMX1B, associated with polycystic kidney disease and Nail-Patella syndrome, respectively, have also been identified. More recently, mutations in TSR1 and TLN1 have been reported in both familial and sporadic cases. In addition, common variants in the PHACTR1/EDN1 region have been linked to

SCAD, indicating a genetically diverse and complex aetiology [7]. Once considered rare, SCAD is now increasingly recognised due to heightened clinical awareness and advances in diagnostic imaging modalities. It is currently estimated to account for up to 35% of ACS cases in women under the age of 50 [2, 9, 10].

The clinical presentation of SCAD often resembles that of ACS, typically manifesting as classical anginal pain accompanied by characteristic electrocardiographic (ECG) changes and often elevated troponin levels. However, the underlying pathophysiology differs significantly, involving a spontaneous separation of the coronary arterial wall due to an intramural hematoma or intimal tear, which leads to coronary artery obstruction and myocardial infarction (MI) [3, 11]. Despite its clinical importance, SCAD is often underdiagnosed because of its variable clinical presentation, ranging from mild chest discomfort to sudden cardiac death [5]. Determining its true prevalence remains uncertain due to diagnostic challenges and the requirement for a high index of suspicion, particularly when traditional cardiac tests yield inconclusive results [12]. When SCAD is suspected, especially in the setting of ST-segment elevation myocardial infarction (STEMI), urgent coronary angiography is recommended. Angiographically, SCAD is classified into four types: SCAD type I, II, III and IV. Type I SCAD is identified by the presence of multiple radiolucent lumens separated by a radiolucent flap visible on contrast dye imaging. Type II SCAD presents as diffuse luminal narrowing or stenosis of the coronary artery accompanied by dissection. This type is further sub-classified into Type IIa, where normal coronary segments are visible both proximal and distal to the SCAD segment, and Type IIb, where the dissection extends to the most distal segment of the coronary artery. Type III SCAD is a rare type and mimics atherosclerosis, typically appearing as focal or tubular stenosis in the absence of any atherosclerotic changes in the coronary artery. Type IV SCAD most commonly involves a distal segment of a coronary artery and usually appears as a sudden total occlusion. It is important to differentiate this from thromboembolism incidents. Understanding these SCAD types enhances diagnostic accuracy by guiding the selection of the most suitable imaging modalities [13–17]. Invasive coronary angiography (ICA) remains the primary imaging modality due to its widespread accessibility and utility in early management. However, ICA has limitations in visualising subtle arterial wall abnormalities and may misinterpret findings as vasospasm or plaque rupture, thereby complicating diagnosis [18, 19]. Recent advancements in imaging, particularly optical coherence tomography (OCT), intravascular ultrasound (IVUS), and coronary computed tomography angiography (CCTA), have established these modalities as important diagnostic adjuncts to ICA. These modalities offer improved visualisation of coronary anatomy and are especially useful where ICA findings are inconclusive. Despite the availability of advanced imaging technologies, choosing the appropriate imaging method remains crucial for a better understanding of the condition. Enhancing awareness of the varied clinical manifestations of anginal pain is essential, especially in the context of SCAD. A comprehensive multimodal imaging approach that incorporates complementary imaging modalities plays a crucial role in accurately evaluating patients with suspected SCAD [20, 21]. However, the ideal imaging approach remains a topic of ongoing debate, and head-to-head comparisons in large cohorts are currently limited.

This systematic review aims to provide the existing evidence regarding the diagnostic strengths and limitations of various imaging modalities used in SCAD. By identifying trends, research gaps, and methodological limitations, we aim to guide clinicians towards

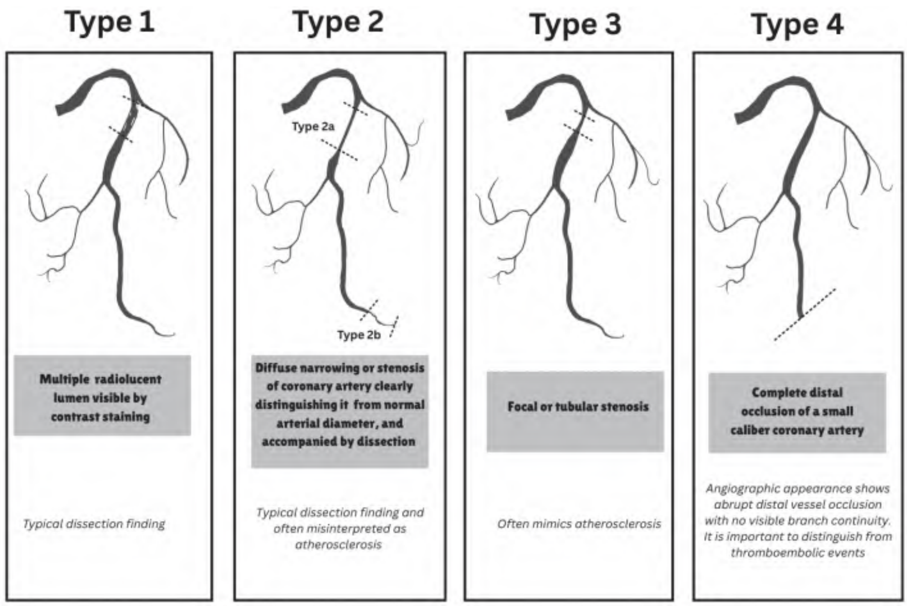


Fig. 1. Angiographic types of SCAD [13–17] (Image is created by Dr. Poorna Gayan Wattaladeniya (MD))

more evidence-based imaging strategies and highlight areas where future research is critically needed.

The primary objective of this systematic review is to evaluate and compare the diagnostic performance and clinical applicability of ICA, OCT, IVUS and CCTA in the detection of SCAD. In addition, this review aims to evaluate the strengths and limitations associated with each imaging modality and to identify gaps in the current literature. By highlighting methodological challenges and variations in diagnostic practices, the review seeks to advise future research efforts focused on standardising imaging protocols and improving diagnostic accuracy in SCAD.

■ METHODOLOGY

This systematic review was conducted following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) 2020 guidelines to ensure methodological transparency. A comprehensive literature search was performed in PubMed, Scopus, and Google Scholar from inception to January 2025 using predefined Boolean logic: ("Spontaneous Coronary Artery Dissection" OR "SCAD") AND ("Imaging" OR "Diagnostic Imaging") AND ("ICA" OR "IVUS" OR "OCT" OR "CCTA").

Inclusion Criteria

- Studies evaluating the diagnostic use of ICA, IVUS, OCT, and CCTA in SCAD diagnosis.
- Prospective and retrospective cohort studies, case-control studies, observational studies, randomised controlled trials (RCTs), and case series with more than 10 patients.
- Studies reporting patient-level data, imaging outcomes or comparative efficacy of Imaging Modalities.

Exclusion Criteria

- Case reports, editorials, systematic reviews, and expert opinions.
- Studies with fewer than ten confirmed SCAD cases.
- Non-English language publications.
- Studies lacking clear imaging (diagnosing) outcome data.

Study Selection and Data Extraction

Four independent reviewers screened all titles and abstracts for relevance. Potentially eligible full-text studies were then reviewed against the inclusion criteria. Discrepancies were resolved by a fifth reviewer as shown in the PRISMA FLOW CHART. Data extracted included author and publication year, study design and sample size, imaging modalities used, diagnostic outcomes and findings, and reported strengths, limitations, and follow-up strategies.

Note on Meta-Analysis

Initially, meta-analysis was planned, but the lack of standardised 2×2 diagnostic data for sensitivity and specificity precluded a quantitative synthesis. Therefore, findings are presented as a structured qualitative synthesis in this review.

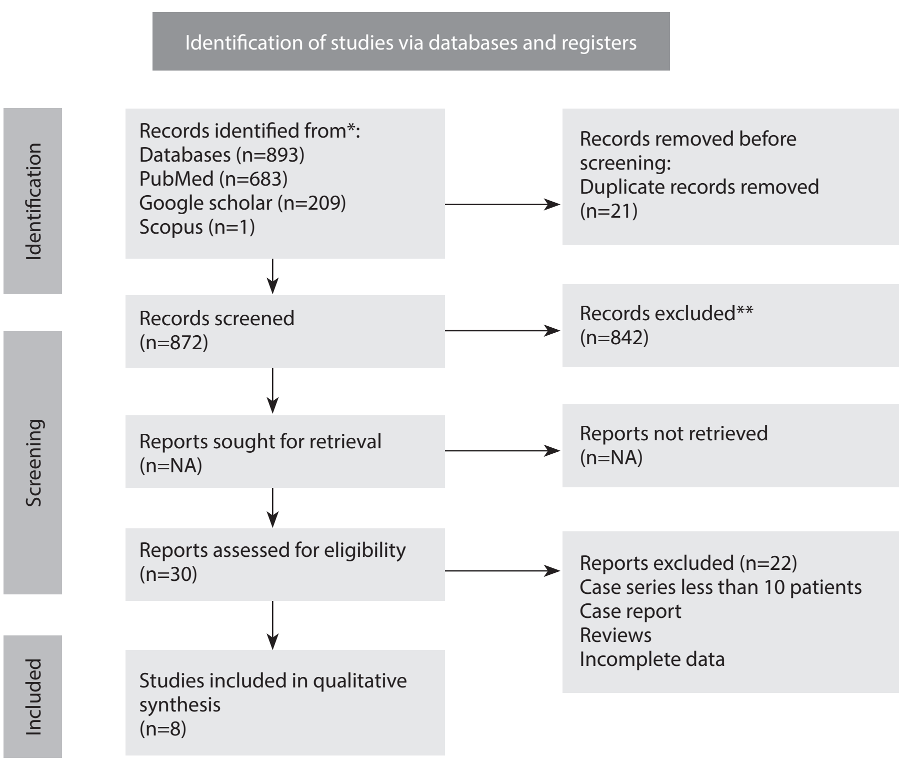


Fig. 2. Identification of studies via databases and register

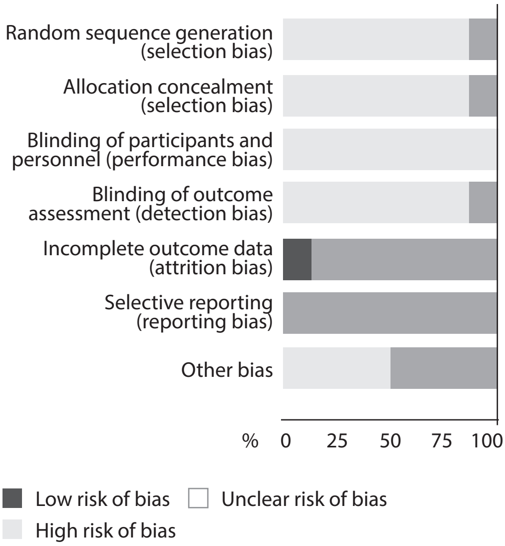


Fig. 3. Risk of bias graph: review authors' judgements about each risk of bias item presented as percentages across all included studies

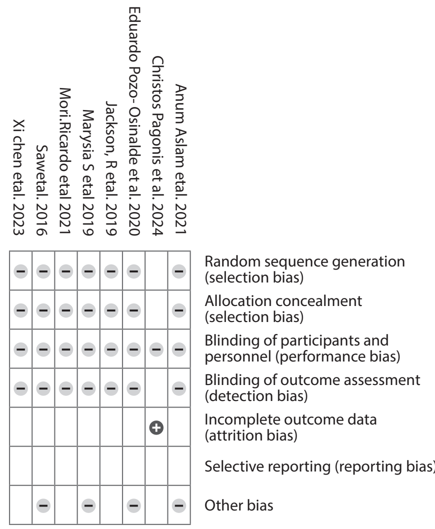


Fig. 4. Risk of bias summary: review authors' judgements about each risk of bias item for each included study

Risk of Bias Assessment

To evaluate the quality of the included studies, we used the Cochrane Risk of Bias tool (RoB 1.0), as implemented in Review Manager (RevMan) version 5.4.1. This tool assesses seven key areas where bias can be introduced: how participants were assigned to groups (random sequence generation and allocation concealment), whether blinding was applied to participants and outcome assessors, how outcomes were reported and analysed (including missing data), and any other potential sources of bias.

Each study was reviewed independently by four reviewers, and any disagreements were discussed and resolved by consensus. For every domain, studies were rated as having a low, high, or unclear risk of bias.

Overall, many of the included studies, particularly retrospective or case series, were assessed as having a moderate to high risk of bias, primarily due to small sample sizes, lack of randomisation, and limited blinding. These limitations were taken into account when interpreting the strength and generalizability of the findings.

Data synthesis

Due to significant heterogeneity in reporting studies and the absence of full 2×2 diagnostic accuracy data, a meta-analysis was not feasible. Instead, we conducted a comprehensive qualitative synthesis, summarising the diagnostic performance, imaging characteristics, and modality-specific roles across the included studies.

RESULTS

This systematic review encompassed eight studies, each meeting stringent inclusion criteria for imaging-based assessment of SCAD. The average sample size across these studies was 63 patients, although individual sample sizes varied substantially, reflecting heterogeneity in study design and recruitment scope.

Imaging Modalities in SCAD Diagnosis

Across all included studies, ICA was utilised, confirming its role as the initial diagnostic tool in suspected SCAD cases. However, standalone ICA was rarely sufficient in complex cases, necessitating additional imaging modalities.

- OCT was implemented in seven studies, emphasising its growing prominence as the preferred intravascular imaging tool for detecting intimal tears and false lumens.
- IVUS was used in four studies, typically where OCT was contraindicated or less informative due to anatomical or technical limitations.
- CCTA was used in four studies, mostly in the context of follow-up imaging rather than acute diagnosis.

Table 1 summarises the strengths, limitations, and key remarks for each modality.

All eight studies have used a multi-modality imaging approach for diagnosing SCAD. Each study also emphasised a preferred imaging modality, as outlined in Table 2.

Supplementary Tables

Table 1
Summary of Imaging Modalities for Diagnosis of SCAD

Modality	No. of Studies	Strengths	Limitations	Comments
ICA	8	Real-time imaging; immediate intervention	Poor at detecting intramural hematoma or subtle dissections	Common first-line diagnostic tool
OCT	7	High-resolution visualises intimal tears and false lumen	Needs contrast; may aggravate dissection	Most accurate in stable patients
IVUS	4	Detects deep wall structures and hematomas	Lower resolution than OCT; requires operator skill	Often used to complement ICA
CCTA	4	Non-invasive; useful in follow-up	Susceptible to motion artefacts; lower sensitivity in distal vessels	Promising for monitoring and stable cases

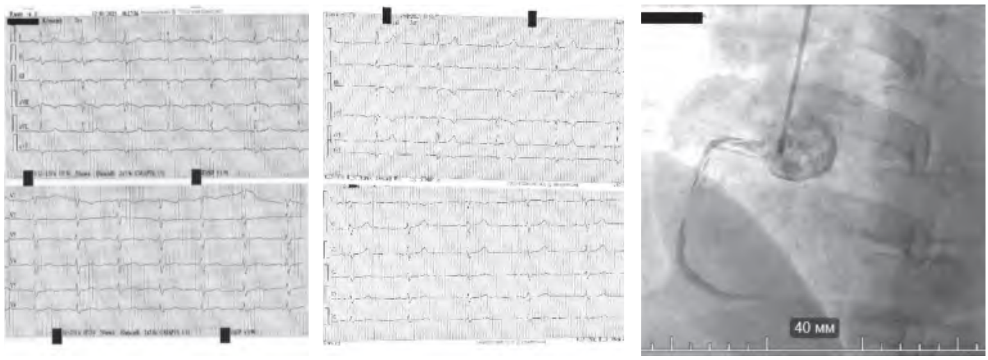
Table 2
Imaging Modalities Used and Preferred Method Per Study

STUDY ID	AUTHOR(S)	ICA	IVUS	OCT	CCTA	PREFERRED METHOD
1	Anum Aslam, MD et al., 2021 [22]	Y	Y	Y	Y	ICA
2	Marysia S. Tweet, et al., 2019 [2]	Y	Y	Y	Y	ICA
3	Saw J et al., 2016 [23]	Y	Y	Y	N	OCT
4	Eduardo Pozo-Osinalde et al., 2020 [24]	Y	N	Y	Y	CCTA
5	Mori, Ricardo et al., 2021 [25]	Y	N	Y	N/A	ICA
6	Xi Chen et al., 2023 [26]	Y	N/A	Y	N	OCT
7	Jackson R., et al., 2019 [27]	Y	N	Y	N	OCT
8	Christos Pagonis et al., 2024 [28]	Y	Y	N/A	Y	ICA

Notes: Y=Yes; N=No; N/A = Not Applicable.

■ DISCUSSION

This review emphasises the crucial role of imaging in the diagnosis of SCAD. ICA remains the first-line modality for evaluating suspected SCAD due to its real-time imaging capabilities and widespread availability. However, its diagnostic utility varies significantly across SCAD subtypes. In Type 1 SCAD, ICA typically reveals the classic features of dissection, including double or multiple radiolucent lumens and an identifiable intimal flap, often accompanied by contrast dye staining the false lumen. These angiographic features make Type 1 SCAD relatively straightforward to diagnose. In contrast, Type 2 SCAD presents as a long, diffuse, smooth narrowing of the coronary artery, often without a visible flap or double lumen. This can be misinterpreted as (vasospasm or atherosclerotic plaque) or artefact unless clinical suspicion is high. Type 3 SCAD is the most challenging to diagnose angiographically, as it appears as a short, focal tubular stenosis that closely resembles atherosclerotic plaque. Without adjunctive imaging such as OCT or IVUS, Type 2 and 3 SCAD may be misclassified, potentially leading to inappropriate treatment strategies [15, 18, 29]. Optical Coherence Tomography (OCT) emerged as the most consistently employed adjunctive imaging modality across studies included in this review. It provides unmatched spatial resolution, allowing for detailed visualisation of coronary arterial microarchitecture. This capability is particularly valuable in confirming SCAD when angiographic findings are ambiguous. OCT can identify intimal disruptions, small flaps, and double lumens. These benefits have been confirmed in studies by Alfonoso et al. and Maehara et al. [30, 31]. It also enables a detailed evaluation of the intima, media, and adventitia, enhancing diagnostic precision when angiographic findings are inconclusive. Specific OCT findings by SCAD subtypes include: Type 1 SCAD, OCT can portray the intimal tears, double lumen, and dissection planes by visualising the true and false lumen. In Type 2 SCAD, OCT is effective in identifying intramural hematomas that compress the true lumen, often without an identifiable intimal flap. In Type 3 SCAD, OCT helps to differentiate SCAD from atherosclerotic lesions through the identification of intramural hematomas in the absence of calcified or lipid-rich plaques. However, OCT's reliance on contrast injection can be problematic, especially in unstable cases of SCAD, as it may exacerbate existing dissections. Therefore, its use must be carefully considered in such a context [32–35]. IVUS offers an effective alternative approach, especially useful for visualising deeper arterial vessel wall structures and detecting intramural hematomas when intimal disruption is absent [36, 37]. Although it has lower spatial resolution than OCT, IVUS provides greater tissue penetration depth (4-8 mm vs OCT's 1-3mm), allowing assessment of the media and adventitial layers. Its clinical utility includes, ability to identify fibrous lesions and lipid pools, and monitoring dissection progression during procedures. In Type 1 SCAD, IVUS can visualise intimal flaps and blood flow through true and false lumens. In Type 2, it helps in differentiating SCAD from conditions such as atherosclerotic plaque and vasospasm by revealing intramural hematomas in the absence of significant atherosclerotic plaque burden. In Type 3 SCAD, IVUS is valuable for visualising subtle wall abnormalities or minor dissections that may not be detected on ICA, while also confirming the absence of atherosclerotic features [32–35]. It is particularly beneficial for patients at risk of contrast-induced complications or in anatomical regions that are difficult to assess using OCT [38, 39]. Despite the high diagnostic yield of OCT and IVUS, widespread application is challenged by high costs, limited availability in smaller centres, and the need for significant operator expertise. This highlights the necessity for broader training



A B

Fig. 5. Case example of SCAD in a 51-year-old woman: A – Twelve-lead ECG demonstrating evolving ischemic changes, including T wave inversions in lead III and V1, and smoothed T waves in leads aVF, V2, and V3, consistent with unstable angina. B – Coronary angiography revealing a spontaneous dissection of the right coronary artery (RCA), localized to the 1st and 2nd segments. The lesion is classified as Type 1 SCAD, characterized by a long segmental narrowing with double lumen and spiral dissection, and associated with thrombotic occlusion and reduced antegrade flow

Note: Images reproduced from: Snezhitskiy V.A., et al. Spontaneous Coronary Artery Dissection: A Case Report. *Cardiology in Belarus*. 2025;17(4):612–622. https://doi.org/10.34883/PI.2025.17.4.011

and improved access, particularly in resource-limited settings. While CCTA is limited in acute diagnosis due to motion artefacts and low resolution in distal vessels or identifying subtle arterial wall abnormalities, it provides significant value for non-invasive follow-up and monitoring of vessel healing [40, 41]. In Type 1 SCAD, CCTA possesses the potential to detect intimal flaps and double lumens, but its effectiveness is often hindered by small vessel size and cardiac motion. In Type 2 SCAD, CCTA helps in the identification of long segments of arterial narrowing but is less capable of detecting intramural hematomas or subtle arterial wall changes. In Type 3 SCAD, CCTA generally lacks the resolution needed to differentiate SCAD from atherosclerotic lesions [22, 42, 43].

Beyond the performance of imaging modalities, this review highlights the critical role of clinical suspicion in guiding an appropriate diagnostic workup. SCAD often presents with features that mimic acute coronary syndrome, but predominantly affects young to middle-aged women without traditional cardiovascular risk factors. A comprehensive understanding of patient-level risk factors associated with SCAD is crucial for early recognition and for tailoring individualised imaging strategies that facilitate timely diagnosis [7]. Figure 6 summarises the primary risk factors associated with SCAD, including genetic predispositions, connective tissue disorders, and hormonal influences in women.

Furthermore, the choice of imaging modality fundamentally depends on both the clinical presentation and the availability of institutional resources. The diagnostic approach should be tailored to the suspected SCAD subtype, patient stability, and any potential contraindications to specific imaging modalities. In clinical practice, the selection of imaging modality for diagnosing SCAD should be individualised. ICA remains the first-line diagnostic tool due to its real-time imaging capabilities and widespread availability, but it often fails to detect intramural hematomas or subtle dissections, particularly in Type 2 and Type 3 SCAD. For such cases, adjunctive imaging is needed. OCT offers high

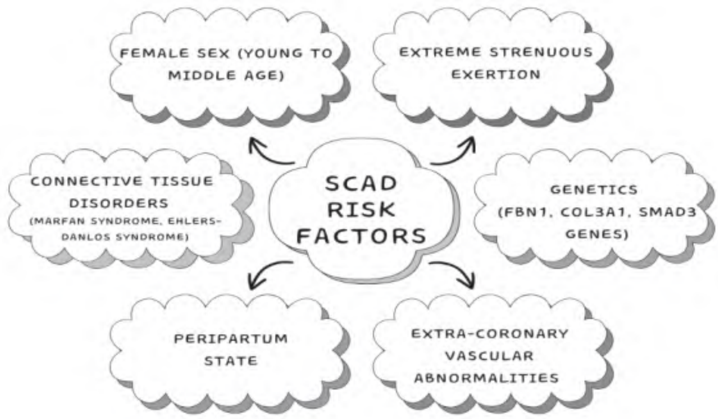


Fig. 6. Primary risk factors associated with SCAD, highlighting genetic predispositions, connective tissue disorders, and hormonal influences in women [1–8]

spatial resolution, making it the preferred modality for stable patients where intimal tears or double lumens need to be confirmed. However, it requires contrast injection, which may exacerbate dissections in unstable patients. In such cases, IVUS is a safer alternative. Although it has lower spatial resolution, IVUS provides greater tissue penetration, allowing visualisation of deeper arterial layers and intramural hematomas without the need for contrast. This makes it particularly useful in high-risk or hemodynamically unstable cases. CCTA, while not typically used in the acute setting due to motion artefacts and reduced resolution for distal segments, plays an important role in follow-up assessments. Its non-invasive nature makes it suitable for monitoring vessel healing and reducing the need for repeat invasive procedures. Therefore, a tailored, multimodal imaging approach based on patient stability, clinical urgency, and institutional capacity is essential to maximise diagnostic yield and minimise procedural risk and mortality in SCAD evaluation. Figure 7 illustrates a diagnostic workflow developed from the evidence reviewed in this study, outlining a practical, step-by-step approach that can help clinicians choose the most appropriate imaging method based on clinical presentation, angiographic findings, and resource availability.

This study provides a more integrated analysis of multimodal imaging strategies and their application across SCAD subtypes. Notably, recent guideline statements continue to emphasise ICA as first-line, but growing evidence supports the adjunctive use of OCT and IVUS in inconclusive cases.

Trends, limitations, and future directions

A clear trend toward multimodal imaging approaches is evident across studies, with ICA typically followed by OCT or IVUS to enhance diagnostic accuracy and better classify SCAD subtypes. However, several challenges persist. Notably, there is considerable heterogeneity in imaging protocols and diagnostic criteria, as well as a lack of standardised 2 x 2 diagnostic data for sensitivity and specificity, which precluded a pooled meta-analysis. Furthermore, many of the included studies had relatively small sample sizes,

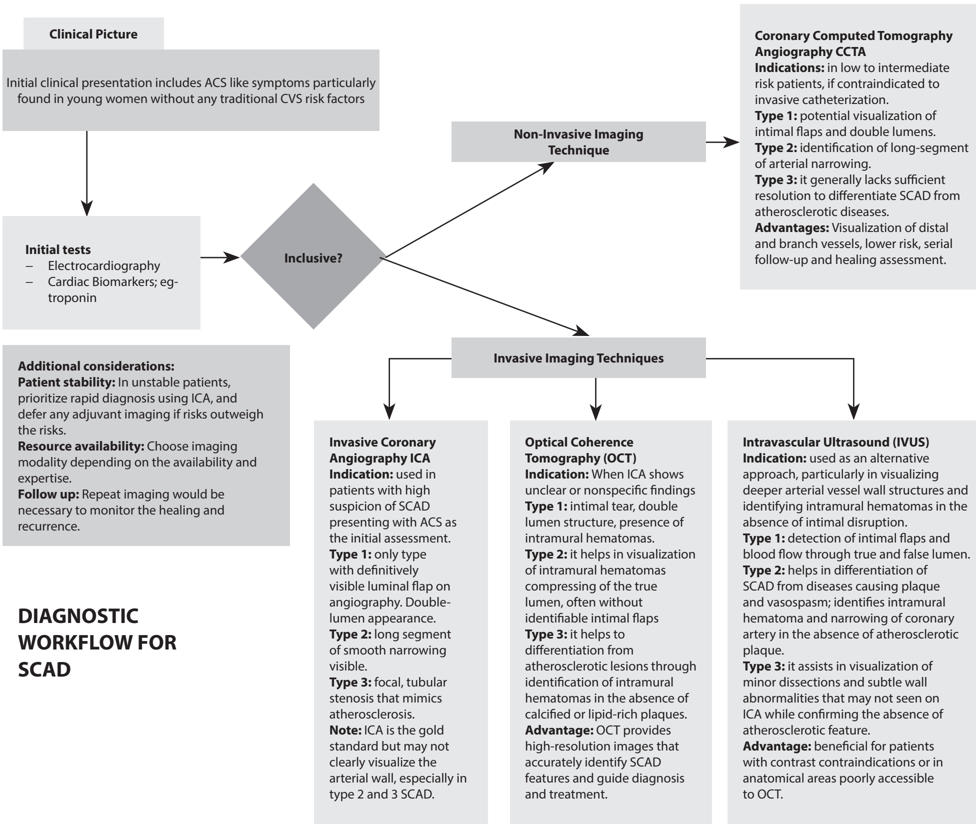


Fig. 7. Diagnostic workflow for SCAD based on clinical presentation, angiographic findings, and resource availability. This step-by-step approach helps clinicians select the most appropriate imaging modality tailored to SCAD subtype, patient stability, and diagnostic clarity [22, 32–34, 42, 43]

limiting the generalizability and strength of their conclusions. This variability in how imaging findings are defined and interpreted may contribute to inconsistent clinical outcomes and underdiagnosis.

To address these issues, future research should prioritise the development of standardised imaging criteria and reporting frameworks specific to SCAD. Additionally, larger-scale, prospective, multicentre studies are needed to provide a robust comparison of imaging modalities and to support the creation of evidence-based diagnostic algorithms. Emerging technologies, such as AI-driven diagnostic tools, may enhance the identification of subtle SCAD features, standardise image interpretation, and potentially reduce inter-observer variability. Integrating such technologies into diagnostic workflows may streamline SCAD detection in the future. Establishing such frameworks is essential for reducing diagnostic uncertainty, improving clinical management, and ultimately enhancing outcomes for patients with SCAD.

Timely and accurate diagnosis of SCAD has direct implications for patient outcomes. It is often misinterpreted as atherosclerosis ACS, which may lead to inappropriate interventions, such as stenting, which may worsen the dissection. Improved imaging strategies can help in avoiding such pitfalls and support safer, conservative management when appropriate.

Considering the atypical risk profile of SCAD patients, particularly young women without conventional cardiovascular risk factors, a targeted risk assessment framework may be beneficial. We suggest the development of screening protocols focused on individuals with predisposing conditions such as fibromuscular dysplasia, connective tissue disorders, or relevant hormonal or peripartum histories. Regular assessment in these high-risk groups could facilitate earlier identification and preventive intervention. Such screening could also inform the timing and choice of imaging, enabling more precise and timely diagnosis. Prospective studies are needed to evaluate the effectiveness of such screening in reducing SCAD incidence and improving clinical outcomes.

CONCLUSIONS

This systematic review highlights the evolving landscape of diagnostic imaging in SCAD. While ICA remains the first-line imaging modality due to its accessibility and therapeutic utility, it often falls short in detecting non-classical SCAD types, particularly Types II, III and IV. Adjunctive intravascular imaging techniques such as OCT and IVUS have demonstrated superior capabilities in visualising coronary arterial wall architecture. OCT provides high-resolution assessment of intimal tears and double lumen morphology, whereas IVUS offers valuable insights into deeper wall layers and intramural hematomas. Although limited in acute diagnosis, CCTA has proven useful for non-invasive follow-up and monitoring of vessel healing. Despite growing evidence supporting multimodal imaging strategies, our review revealed significant variability in study design, imaging protocols, and reporting standards. This heterogeneity, combined with limited sample sizes and moderate-to-high risk of bias, restricts the ability to draw definitive conclusions regarding diagnostic superiority. Future research should prioritise the development of standardised imaging criteria, head-to-head modality comparisons of modalities with complete diagnostic data for sensitivity and specificity, and prospective multicentre studies to better delineate the diagnostic role of each modality. These efforts are essential to refine clinical algorithms, optimise patient outcomes, and reduce diagnostic uncertainty in SCAD.

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