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Diagnostic yield of the stepwise use of OCT and CMR in MINOCA: a meta-analysis

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Introduction

The incidence of myocardial infarction with non-obstructive coronary arteries (MINOCA) ranges between 5 to 10% of patients presenting with a myocardial infarction (MI). A recent meta-analysis showed that the 12-month all-cause mortality for MINOCA patients was better than those presenting with MI with obstructive coronary arteries, but worse than those without known history of MI (Pasupathy et al., 2021). The management of MINOCA is dependent on the accurate etiological diagnosis and the combined use of optical coherent tomography (OCT) at the time of coronary angiography and cardiovascular magnetic resonance (CMR) imaging has been shown to provide a diagnostic yield of between 85 to 100% in a recent systematic review (Machanahalli Balakrishna et al., 2022). The American and European position papers (Agewall et al., 2017; Tamis-Holland et al., 2019) do recommend considering the use of OCT at the time of coronary angiography and CMR as soon as clinically feasible. However, the diagnostic yield of each of these modalities has so far not been well-established and their adoption in clinical practice is variable. Several studies (Opolski et al., 2019; Gerbaud et al., 2020; Reynolds et al., 2021; Fluder-Wlodarczyk et al., 2022) have since reported paired findings of OCT and CMR in MINOCA patients. Therefore, we aimed to evaluate the diagnostic yield of using OCT first at the time of coronary angiography, followed by CMR in those patients without a culprit detected by OCT in a meta-analysis.

We searched the Embase and Medline databases from inception through to April 2023 for full-text articles using the following terms: “MINOCA”, “CMR”, “MRI”, and “OCT”. All studies performing paired OCT and CMR in MINOCA patients were identified and our search was cross-matched with findings from the recent systematic review (Machanahalli Balakrishna et al., 2022). A positive finding by OCT or CMR were per the study definitions. Although there were subtle variations in the definitions used for a positive finding by OCT or CMR, the common positive findings were as follows: OCT evidence of plaque rupture; plaque erosion; calcified nodule, in-situ thrombus; intramural hematoma or coronary dissection; CMR evidence of myocardial infarction, myocarditis, takostubo or other cardiomyopathies. A binary random-effects model was used to estimate the pooled diagnostic yield of OCT and CMR in MINOCA with 95% confidence interval (CI) using OpenMeta[Analyst] software to take into account any heterogeneity among the studies.

Out of 271 abstracts screened, four studies (Opolski et al., 2019; Gerbaud et al., 2020; Reynolds et al., 2021; Fluder-Wlodarczyk et al., 2022) met the inclusion criteria, involving a total of 197 patients with paired OCT and CMR data. The characteristics of the four studies are provided in Table 1.

In the whole cohort, combining OCT with CMR provided a positive finding in 169 out of 197 patients, giving an overall pooled diagnostic yield of 88% (77-100%), heterogeneity (I^2)=88%. OCT alone provided a positive finding in 100 out of 197 patients, with an overall pooled diagnostic yield of 56% (33-79%), I^2=90% (Figure 1). Among the patients without a culprit by OCT (N=97), CMR detected an abnormality in a further 69 patients, providing a further pooled diagnostic yield of 76% (59-94%), I^2=74% (Figure 1). A CMR-only approach provided a positive finding in 143 out of 197 patients, providing a pooled diagnostic yield of 76% (61-90%), I^2=82%, (MI: 56%; myocarditis: 9%; takostubo cardiomyopathy: 4%).

The main findings of our analysis are OCT at the time of diagnostic coronary angiography provided an etiological diagnosis in up to half of the patients with MINOCA; in those without a culprit lesion by OCT, subsequent CMR performed within a week provided a diagnosis in a further three quarters

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Table 1: Characteristics of the four studies

	Opolski 2019	Gerbaud 2020	Reynolds 2021	Fluder-Wlodarczyk 2022
N	38 (31 with paired CMR and OCT)	40	145 (116 with paired CMR and OCT)	10
Study design	Prospective, observational	Prospective, observational	Prospective, observational	Prospective, observational
Country	Poland Single-centre	France Two-centre	USA Multi-centre	Poland
Age/ years	62±13	50±11	60 (52-69)	53 (49-55)
Male, %	17 (45)	25 (63)	0 (0)	5 (50)
Diabetes Mellitus, %	5 (13)	2 (5)	23 (16)	1 (10)
Smoking, %	9 (24)	25 (63)	16 (11)	7 (10)
Hypertension, %	26 (68)	15 (38)	66 (46)	8 (80)
Dyslipidemia, %	15 (39)	12 (30)	51 (35)	2 (20)
NSTEMI, %	23 (61)	27 (67)	140 (96)	7 (70)
STEMI, %	15 (39)	13 (33)	5 (4)	3 (30)
Median time to OCT/ hours	11 (4-24)	42 (10, 87)	48 (24, 72)	NA
2-vessel OCT, %	26 (68)	11 (28)	47 (32%)	0
3-vessel OCT, %	8 (21)	5 (13)	86 (59%)	10 (100)
Median time to CMR/ days	4 (2-5)	3.5 (2-8)	6 (3.5-9)	NA

of MINOCA patients; lastly, without OCT, CMR alone could detect an abnormality in 76% of MINOCA patients in the total population.

CMR is not widely available and there is variable adoption of performing OCT in MINOCA patients. Our findings show that OCT has a high diagnostic yield and should be considered in centers with local expertise to acquire OCT data and analyze the findings. When the index of suspicion is high, routine OCT during the index coronary angiogram procedure could provide an etiological diagnosis in up to half of patients. Subsequently, only the other half of the patients without a culprit by OCT would require a CMR, when locally available. CMR would detect an abnormality in a further three-quarter of those patients. By this approach, 88% of MINOCA patients would have an etiological diagnosis. However, in centers where OCT is not available, CMR alone would detect an abnormality in 76% of the MINOCA patients.

Our study has the limitation of being a trial-level meta-analysis rather than patient-level analysis. The four studies included were heterogeneous in terms of definition of MINOCA (including or excluding myocarditis and takostubo cardiomyopathy) used; patients included (women only in Reynolds 2021); CMR protocol used; OCT definitions used for culprit lesion identification; and the timing of the investigations (Table 1). However, this reflects real-life clinical practice, where women are more likely to present with MINOCA, different hospitals having different protocols for edema imaging, different level of expertise for OCT image interpretation, and where the timing of angiography and CMR could also vary significantly. Lastly, in the context of proportional meta-analysis, I^2 can be high as was the case in our analysis and the I2 itself should be interpreted with caution.

In conclusion, in centers where OCT and CMR are available, an approach of OCT first in MINOCA patients could give a diagnosis in approximately 1 in 2 patients (Figure 1). In those without a culprit by OCT, CMR performed early could detect an abnormality in an additional three quarters of the patients (Figure 1), giving a high total diagnostic yield (88% in this analysis). However, when OCT is not available, CMR could provide a diagnosis in only three-quarter of cases. The stepwise approach of using OCT first, followed by CMR in cases without any obvious culprit on OCT could improve the etiological diagnostic yield for MINOCA, which could then impact on patient management and outcome.

Conflict of interest statement

No conflict of interest.

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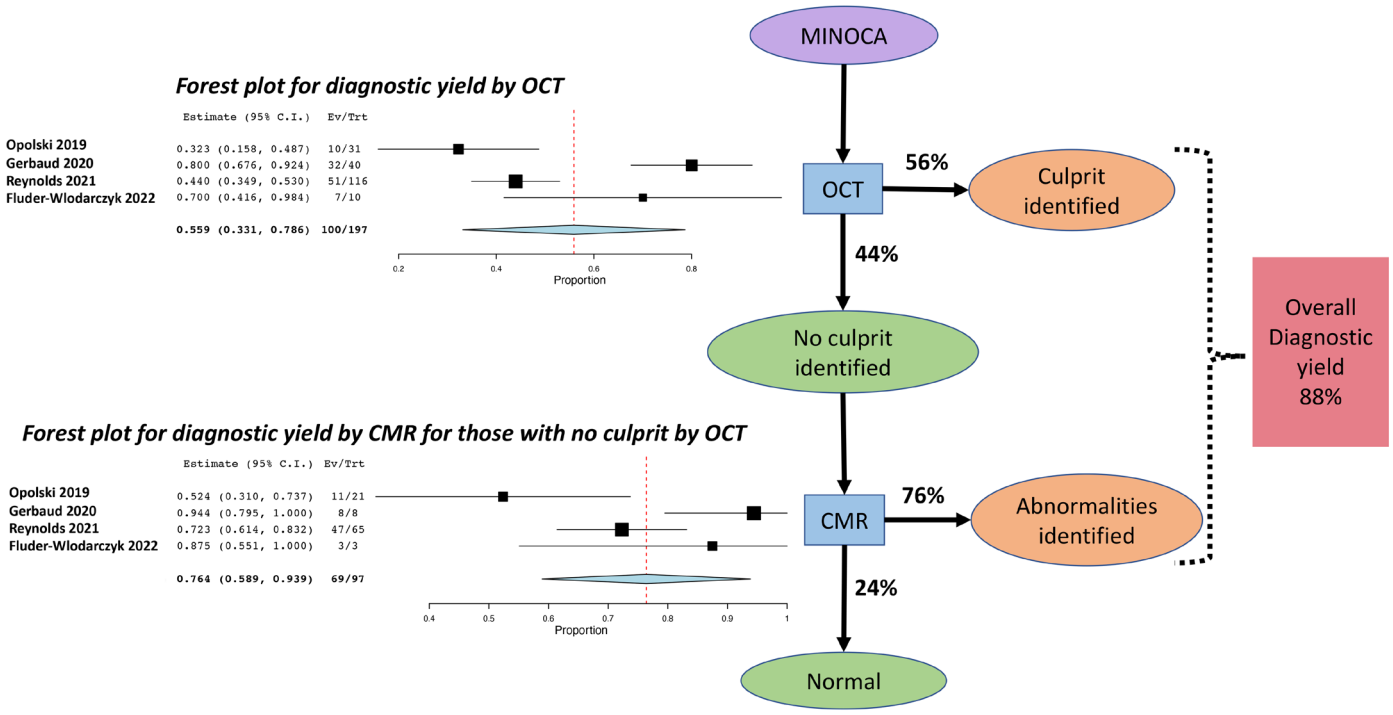

Figure 1. Diagnostic yield of the stepwise approach to using OCT and CMR in MINOCA patients

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