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Impact of Intracoronary Optical Coherence Tomography in Routine Clinical Practice: A Contemporary Cohort Study

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ABSTRACT

Background/purpose: Guidelines recommend intracoronary optical coherence tomography (OCT) to assess stent failure and guide percutaneous coronary intervention (PCI) but OCT may be useful for other indications in routine clinical practice.
Methods/materials: We conducted an international registry of OCT cases at two large tertiary care centers to assess clinical indications and the potential impact on decision making of OCT in clinical routine. Clinical indications, OCT findings, and their impact on interventional or medical treatment strategy were retrospectively assessed.
Results: OCT was performed in 810 coronary angiography cases (1928 OCT-pullbacks). OCT was used for diagnostic purposes in 67% ($N = 542$) and OCT-guided percutaneous coronary intervention in 50% ($N = 404$, 136 cases with prior diagnostic indication). Most frequent indications for diagnostic OCT were culprit lesion identification in suspected ACS (29%) and stent failure assessment (28%). OCT findings in the diagnostic setting influenced patient management in 74%. OCT-guided PCIs concerned ACS patients in 45%. Among the 55% with chronic coronary syndrome, long lesions >28 mm (19%), left main PCI (16%), and bifurcation PCI with side-branch-stenting (5%) were the leading indications for PCI-guidance. Post-procedural OCT findings led to corrective measures in 52% (26% malapposition, 14% underexpansion, 6% edge dissection, 3% intrastent mass, 3% geographic plaque miss).
Conclusions: OCT was most frequently performed to identify culprit lesions in suspected ACS, for stent failure assessment, and PCI-guidance. OCT may impact subsequent treatment strategies in two out of three patients.

1. Introduction

Since more than one decade, intracoronary optical coherence tomography (OCT) is available as complementary diagnostic tool in addition to coronary angiography. The high-resolution visualization of the coronary artery vessel wall, intraluminal structures and stent struts are key characteristics that distinguish the technique from coronary angiography. Despite rapid technological progress including co-registration with angiography and semi-automated measurements, OCT use in routine clinical practice remains limited and varies substantially among operators, centers and geographical region.

A survey among interventional cardiologists found stent-optimization to be the most frequent indication for intracoronary imaging, followed by procedural/strategy guidance [1]. The ESC/EACTS-guidelines on myocardial revascularization recommend OCT use for guidance of percutaneous coronary interventions (PCI) (Class IIa, level of evidence B) and stent failure assessment (IIa, C). No recommendation is provided for other diagnostic indications [2]. Limited outcome data from randomized controlled trials, lack of reimbursement and uncertainties in how to apply OCT and implement findings in decision-making may be reasons for limited adoption of OCT in clinical practice [3]. We therefore studied the indications for OCT at two European tertiary care centers and assessed the immediate impact on patient management.

2. Material and methods

2.1. Study population and data source

All consecutive patients undergoing OCT-assisted coronary angiography between 01/2016 and 07/2019 at Bern University Hospital, Switzerland, and Centre Hospitalier Universitaire Gabriel-Montpied,

Abbreviations: ACS, acute coronary syndrome; OCT, optical coherence tomography; PCI, percutaneous coronary intervention; IVUS, intravascular ultrasound.

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Clermont-Ferrand, France, were enrolled in this registry. Cases with research indications for OCT were excluded (350 cases). At Bern, baseline, procedural and discharge characteristics were retrieved from the prospective Cardiobase Bern PCI registry (NCT02241291). At Clermont-Ferrand these data were collected from the CRAC France PCI registry (NCT02778724) and completed by retrospective patient chart reviews. OCT imaging was performed with the frequency-domain OCT system ILUMIEN OPTIS (Abbott, Santa Clara, CA, USA) and a 2.7 French C7 Dragonfly imaging catheter (Dragon Fly Duo, Abbott, Santa Clara, CA, USA), or the Terumo OCT imaging system Lunawave (Terumo®, Tokyo, Japan) and a Fastview® coronary imaging catheter (Terumo®, Tokyo, Japan). Contrast medium (Xenetix 300, Guerbet) was used to clear the coronary artery from blood during the OCT-pullback (usually 5.5 ml/s for the left coronary artery, 4.0 ml/s for the right coronary artery).

All OCT pullbacks, coronary angiographies, and intervention reports were reviewed and assessed according to the definitions below by a committee not involved in the OCT-acquisition. Patient consent was retrieved according to local regulations. The study was approved by the local ethics committee on human research (KEK 137/14) and was conducted in accordance with the Declaration of Helsinki.

3. Definitions

3.1. Indications

Two consensus documents by the European Association of Percutaneous Cardiovascular Interventions recommend adjunctive use of intracoronary imaging in clinical routine for both, diagnostic indications and PCI-guidance or stent optimization [4,5]. We further specified and extended the list of diagnostic indications and categorized them as follows:

1) Stent failure assessment.
2) Culprit lesion identification in suspected ACS.
3) Assessment of lesion severity in patients with stable coronary artery disease.
4) Angiographically inconclusive findings in patients with stable coronary artery disease prior to any PCI.
5) Ambiguous finding during or after PCI.
6) OCT during elective follow-up angiography.

The complete list of diagnostic indications, their subcategories, and their precise definitions is available in the *supplementary material*.

OCT-guided PCI required a minimum of one post-stent pullback (with or without pre-stent pullback). Indications for OCT-guided PCI were adapted from the consensus document on PCI-guidance and optimization [4] and included in hierarchical order: PCI in ACS, left main PCI, bifurcation-PCI with side-branch-stenting, long lesion (>28 mm), complex anatomy (e.g. severe calcification or ectatic/aneurysmatic lesion), and other.

3.2. OCT findings and diagnoses

OCT-pullbacks were assessed qualitatively. A detailed list of OCT findings and diagnoses stratified by indication is available in the *supplementary material*.

Post-stent OCTs were reviewed to assess the presence of malapposition, underexpansion, irregular intrastent mass, edge dissection and/or geographic plaque miss [4]. Findings were deemed clinically significant, when they triggered additional intervention, change in medical therapy, or the follow-up strategy.

3.3. Definition of "impact on patient management"

Impact of OCT findings on patient management was assumed by the independent adjudication committee based on the review of angiography, OCT findings and procedural comments of the responsible operators and the catheterization laboratory report. This may have included treatment selection (PCI versus conservative management) or procedural aspects (lesion preparation, balloon only versus stent). Impact on medical therapy was assumed, when OCT findings led to the administration of more intense intraprocedural antithrombotic regimens or prolonged or more intense antiplatelet therapy. Follow-up regimen was considered impacted if OCT findings triggered the recommendation for a control angiography or the search for other specific etiologies (e.g. magnetic resonance imaging in MINOCA without unstable plaque). In each case, the specific decisions assumingly impacted by OCT were noted. Due to the manifoldness of decisions impacted, they were grouped for analysis and presentation: conservative instead of interventional treatment, impact on the intervention (or interventional strategy), impact on medication, impact on follow-up.

Inter- and intra-observer variability were assessed as reported in the *supplementary material*.

3.4. Statistical analysis

For the purpose of this work, only descriptive statistics were performed. Baseline clinical, procedural and discharge characteristics are presented as counts and percentages for categorical variables or as mean ± standard deviation for continuous variables. Statistical analyses were performed using STATA version 15.1.

4. Results

4.1. Study population and baseline characteristics

Between January 2016 and July 2019, OCT was used for clinical indications in 810 cases at two tertiary centers. OCT was increasingly used over time from 7.3 OCTs per month and site in 2016 to 15 OCTs per month and site in 2019. Baseline clinical and procedural characteristics are shown in Table 1 (discharge medication in *Supplementary Table 2*). The majority of patients undergoing OCT had suspected ACS and the remainder suspected chronic coronary syndromes. PCI was performed in 80% of cases.

On average, 2.4 ± 1.4 pullbacks were performed per case. Imaged vessels were LAD in 59%, left main in 24%, RCA in 18% and LCX in 14%. In 67% of cases ($N = 542$), a diagnostic OCT was done. OCT-guided PCI was recorded in 50% of cases ($N = 404$, 136 cases with prior diagnostic indication), Fig. 1.

4.2. Diagnostic OCT

In 542 cases, OCT was used for diagnostic indications. Identification of culprit lesions in patients with suspected ACS (29%) and assessment of stent failure (28%) were the most frequent indications, followed by OCT use during elective follow-up angiography (19%), lesion severity assessment (10%), and examination of inconclusive findings during or after PCI (8%) or in stable patients (6%). The specific indication are listed in Table 2 and OCT diagnoses according to indication groups are provided in the *Supplementary Table 3*. Fig. 2 summarizes OCT findings of patients undergoing OCT for culprit lesion identification. In this indication group, OCT was most frequently performed to characterise the underlying pathophysiology in "atypical" ACS patients (young age or low cardiovascular risk profile) and showed a high rate of plaque erosion (48%) followed by plaque rupture (31%), and spontaneous coronary artery dissection Type 3 or 4 (10%). Plaque rupture (38%) was the most frequent finding among patients undergoing OCT in the hazy lesion category. The percentage of cases in which a suspected ACS culprit lesion could be excluded varied substantially according to the indication for OCT (Fig. 2).

Reasons for stent failure assessments were suspected stent thrombosis (80 cases) and in-stent restenosis (70 cases). OCT-derived mechanisms of

Table 1
Baseline and procedural characteristics.

	Overall N = 810
Baseline characteristics	
Age (years)	60.9 ± 14.6
Female	201 (24.8%)
Diabetes mellitus	158 (19.5%)
Arterial hypertension	412 (50.9%)
Dyslipidemia	434 (53.6%)
Current smoker	232 (38.6%)
Family history of coronary artery disease	208 (25.7%)
Body mass index (kg/m^2)	27.1 ± 4.9
Baseline eGFR (ml/min/1.74 m^2)	91.9 ± 37.2
Renal failure (eGFR <60 ml/min)	106 (13.1%)
Prior myocardial infarction	314 (38.8%)
Prior coronary artery bypass grafting	30 (3.7%)
Prior PCI	313 (38.6%)
Indication for angiography and procedural characteristics	
Chronic coronary syndrome	371 (45.8%)
NSTE-ACS	219 (27.0%)
STEMI	220 (27.2%)
LV-EF (%)	54 ± 13
PCI performed	644 (79.5%)
Number of vessels treated[a]	1.21 ± 0.44
Number of lesions treated[a]	1.32 ± 0.61
Total length of stents (mm)[b]	36.5 ± 20.8
Mean stent diameter (mm)[b]	3.21 ± 0.49
Predilation[a]	318 (39.3%)
Postdilation[b]	477 (58.9%)
Bifurcation treatment[a]	203 (25.1%)
Amount of contrast used (ml)	212 ± 88.9
Procedural OCT-characteristics	
Number of pullbacks per patient	2.38 ± 1.37
OCT console used	
Abbott	656 (81%)
Terumo	154 (19%)
Number of regions of interest per patient	1.60 ± 0.75
Vessel of interest	
Left main	198 (24%)
LAD	482 (59%)
LCX	112 (14%)
RCA	146 (18%)
Bypass graft	2 (0.2%)

Categorical variables are expressed as frequencies (N) and percentages (%), continuous data as mean ± standard deviation.
Abbreviations: eGFR = estimated glomerular filtration rate; LAD = left anterior descending; LCX = left circumflex artery; LV-EF = left ventricular ejection fraction; NSTE-ACS = non-ST-elevation acute coronary syndrome; PCI = percutaneous coronary intervention; RCA = right coronary artery; STEMI=ST-elevation myocardial infarction.
[a] In patients undergoing PCI.
[b] In patients with stent implantation.

stent thrombosis were malapposition (50%), neoatherosclerosis (16%), uncovered struts (10%), other structural causes (e.g. edge-related disease, underexpansion, side-branch thrombosis or stent fracture in 16%), and in 6% no structural reasons. Neoatherosclerosis (34%), neointimal hyperplasia (23%) and stent underexpansion (14%) were identified as the leading OCT findings for in-stent restenosis. OCT excluded the presence of significant in-stent restenosis in 16% of cases (*Supplementary Table 3*).

Diagnostic OCT had an impact on subsequent patient management in 74% of cases (Fig. 3). The proportion was highest in the setting of stent failure assessment (82%) and lowest when OCT was used as an adjunctive tool during elective follow-up angiography (60%), *Supplementary Table 4*.

4.3. OCT-guided PCI

OCT was used for PCI-guidance in 404 cases, with pre-and post-stent OCT in 64% and only post-stent OCT in 36%. Indication for OCT-guidance was ACS in 45% of the cases, followed by long lesions (19%), left main PCI (16%) and bifurcation PCI with side-branch-stenting (5%), Table 3.

In 52% of OCT-guided cases, post-stent OCT revealed presumably significant findings triggering additional intervention for stent optimization or change in medical therapy (Fig. 3). Key OCT finding were malapposition (26%), followed by underexpansion (14%), edge dissection (6%), irregular intrastent mass (3%), and geographic plaque miss (3%), Table 3. Additional stent implantation occurred in 9.4% of cases. Fig. 4 summarizes the key findings and the respective interventions.

4.4. Impact of OCT on decision-making

Among all patients, a specific action triggered by OCT findings obtained during diagnostic OCT or post-PCI OCT was found in 66% of cases (Fig. 3).

5. Discussion

This cohort study derived from two large European tertiary care centers shows that OCT use in daily routine is broader than acknowledged in current guidelines and impacts subsequent clinical management in 66% of patients. While previous studies investigated the frequency of OCT use in clinical routine, which ranged from 1.3% to 7.5% [6,7], we additionally assessed the diagnostic and therapeutic indications for OCT and its potential impact on the subsequent patients' management.

5.1. OCT as diagnostic tool

In 67% of cases, OCT was used for diagnostic purposes and influenced patient management in 74%. Current ESC/EACTS-guidelines give class IIa recommendation for diagnostic intracoronary imaging with OCT for stent failure assessment [2], which accounted for the minority of diagnostic OCTs in this study (28%). The majority of indications (72%) observed was not supported by current guidelines despite their clinical usefulness.

OCT allows to detect ACS plaque events (i.e. plaque ruptures, erosions as well as other unusual morphologies that can cause ACS) [8]. Accordingly, the leading indications for diagnostic OCTs were inconclusive angiographic findings regarding the culprit lesion in ACS patients. The uncertainty was either related to the localization of the culprit lesion or the underlying pathophysiology (Fig. 2). OCT assisted in confirming or excluding the presence of a culprit lesion to tailor the treatment or complement the diagnostic workup following coronary angiography. As a result, a conservative management strategy was chosen in 30% of patients on basis of the OCT (Fig. 3).

Among cases with suspected ACS, OCT was most frequently performed in patients with low pre-test probability for atherosclerotic ACS, i.e. those at young age or low cardiovascular risk profile. In this subgroup, OCT revealed non-plaque-rupture etiologies in more than two thirds of cases with the main finding being plaque erosion. The relatively high frequency of plaque erosion is in line with results from an OCT registry suggesting younger age and absence of diabetes mellitus as being associated with plaque erosion [9]. Further reasons for OCT use in suspected ACS were the assessment of hazy lesions, where an ACS plaque event could be confirmed in almost 80% of patients, and the further evaluation of angiographically non-severe stenosis (<90% diameter stenosis and absence of haziness). In the latter cases, proof of an acute coronary event by detection of thrombus or vessel wall disintegrity was possible in one out of four patients. This is similar to an OCT study that found culprit lesions in 25% (8/31) of OCT-imaged non-obstructive lesions in patients with suspected ACS [10].

In patients with distal embolic occlusion, a culprit lesion could be identified in the upstream region in 41% and in the remainder, a thromboembolic source outside the coronary system was specifically investigated after coronary angiography. Regional wall motion abnormalities pointing to a specific infarct vessel were confirmed in 20% and in the remainder, referral to magnetic resonance imaging may be the next diagnostic step [11]. Overall, OCT adds substantial certainty to the final diagnosis and facilitates the selection of additional non-invasive tests.

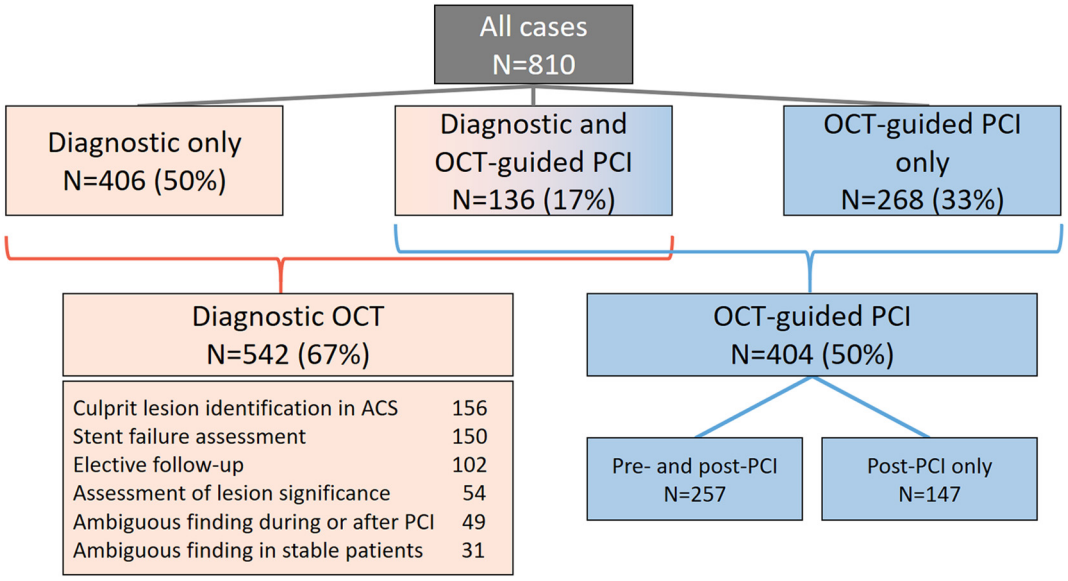


Fig. 1. Study flow chart: Flow chart shows the distribution of cases in whom OCT was done for diagnostic indications, for PCI-guidance, or for both. Most diagnostic OCTs were performed for culprit lesion identification in suspected ACS or stent failure assessment. Abbreviations: ACS = acute coronary syndrome; OCT = optical coherence tomography; PCI = percutaneous coronary intervention.

Stent failure assessment using OCT represents a guideline-endorsed indication and the findings obtained in this setting are in line with previous research that identified malapposition and neoatherosclerosis as principal causes for stent thrombosis [12,13], and neoatherosclerosis, neointimal hyperplasia and underexpansion as the leading etiologies of in-stent restenosis [14]. While dilation with a non-compliant balloon may be sufficient for the correction of malapposition or underexpansion, neoatherosclerosis or neointimal hyperplasia may warrant more extensive lesion preparation and frequently require additional stent implantation [15]. When no structural cause for stent thrombosis is found, long-term dual antiplatelet therapy may be considered. Interestingly in 1/6 of OCTs for the assessment of in-stent restenosis, significant stenosis could be excluded and no PCI was required considering the minimal lumen area obtained by OCT.

Table 2
Diagnostic OCTs.

Diagnostic OCT in 542/810 cases (67%)	
Indications	Indication subgroups, N (% of indication group)
Stent failure assessment *N = 150 (28% of diagnostic OCTs)*	Stent thrombosis, **80** (53%) In-stent restenosis, **70** (47%)
Culprit lesion identification in suspected ACS *N = 156 (29% of diagnostic OCTs)*	ACS in the young or few risk factors, **60** (39%) Hazy lesion, **39** (25%) Stenosis <90% without hazyness, **29** (19%) Distal embolic occlusion, **17** (11%) Left ventricular hypokinesia, **10** (6%)
Lesion significance *N = 54 (10% of diagnostic OCTs)*	Left main, **27** (50%) Non-left main, **27** (50%)
Ambiguous finding in stable patients *N = 31 (6% of diagnostic OCTs)*	Hazy lesion, **28** (90%) Other, **3** (10%)
Ambiguous finding during or after PCI *N = 49 (9% of diagnostic OCTs)*	New/residual stenosis post-PCI, **19** (39%) Hazyness post-PCI, **16** (33%) Persistent contrast staining post-PCI, **5** (10%) True lumen verification, **5** (10%) Slow flow post-PCI, **4** (8%)
Elective follow-up *N = 102 (19% of diagnostic OCTs)*	Surveillance after complex PCI, **43** (42%) - Left main PCI, **17** - CTO-PCI, **12** - Other (e.g. aneurysmatic lesion, bifurcation), **14** FUP after conservatively treated ACS, **27** (26%) - Plaque erosion, **17** - Spontaneous coronary artery dissection, **6** - Other, **4** Follow-up after BVS implantation, **19** (19%) After heart transplantation, **5** (5%) Follow-up after stent thrombosis, **4** (4%) Other, **4** (4%)

Abbreviations: ACS = acute coronary syndrome; BVS = bioresorbable vascular scaffold; OCT = optical coherence tomography; PCI = percutaneous coronary intervention.
The number of cases per indication subgroup is provided in bold for better visibility.

5.2. OCT for PCI guidance

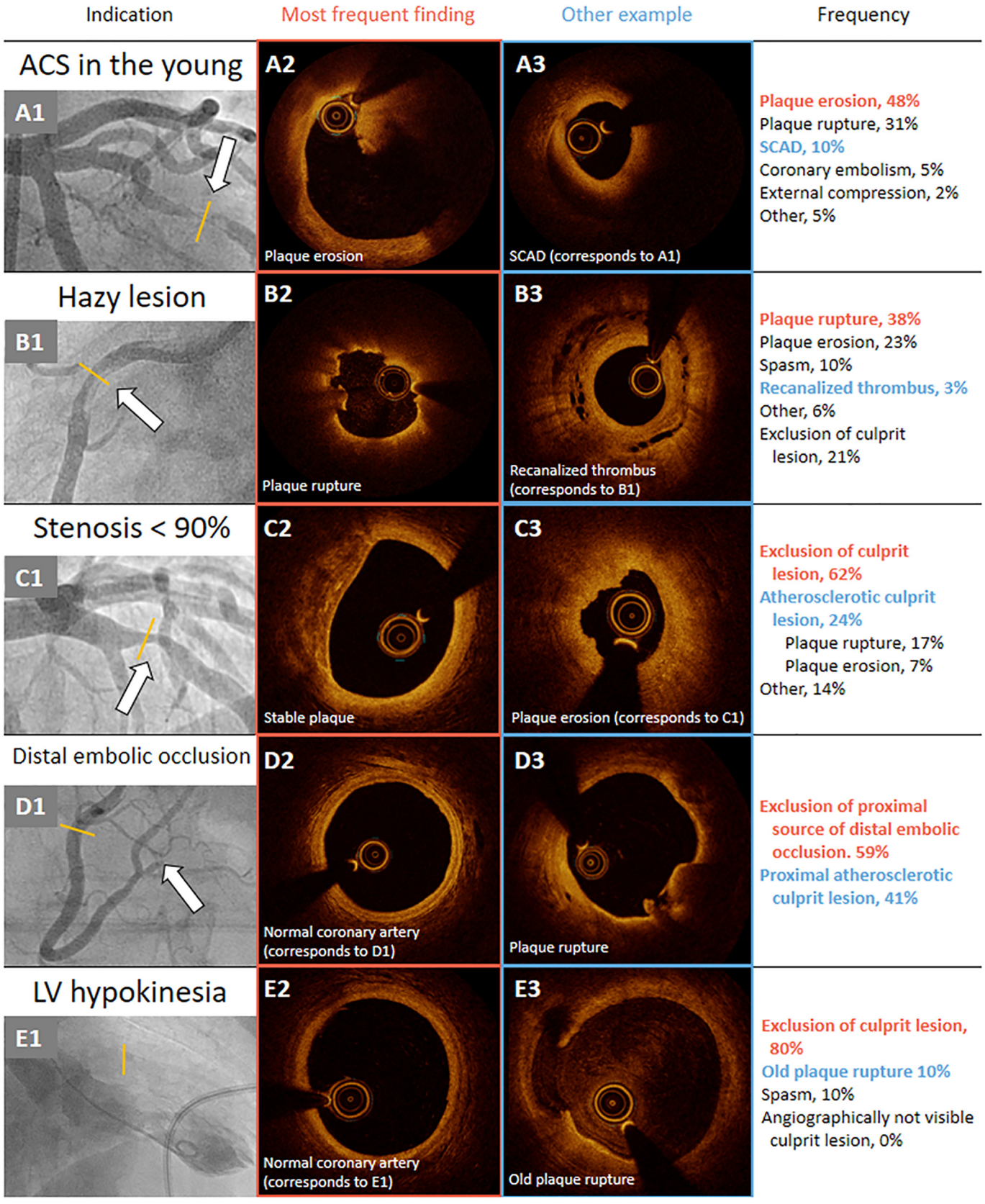
OCT was used in approximately 7% of patients undergoing PCI at the two institutions. Almost half of the patients treated with OCT-guided PCI presented with ACS, and the majority of the remaining patients underwent treatment of complex lesions (long lesions >28 mm, left main PCI, and non-left main bifurcation PCI with two-stent-technique). These indications are supported by available evidence and much comparable with the eligibility criteria for the largest ongoing RCT in this field, the ILUMIEN 4 study [16]. In the ADAPT-registry, IVUS-guided PCI was particularly effective in ACS-patients [17], and OCT-guided PCI was superior in surrogate outcomes as compared to angiography-guided PCI in randomized trials with ACS-patients [18,19].

In 52% of post-stent OCTs, the findings led to additional PCI-optimization. This is considerably higher than in other observational studies. In ILUMIEN I, OCT changed PCI strategy in 27% [20], and the authors of CLI-OPCI reported post-stent optimization in 35% of cases [21]. The selected use of OCT in this cohort may be different from ILUMIEN I, where OCT was used in every enrolled patient. Furthermore, in ILUMIEN I, OCT was only acquired, when a 'best of care' angiographic result was obtained, whereas in this study, representing routine clinical practice, timing of the first post-stent OCT pullback was left at the operator's discretion. Finally, both studies only considered PCI-optimization (additional balloon dilation or stent implantation), whereas in this study, impact of OCT on antithrombotic medication and follow-up regimen was also considered.

First insights from the LightLab Initiative reported that OCT impacted procedural decision-making in 88% of PCI cases. This was mainly attributed to changes on the interventional plan due to the pre-PCI-OCT findings (83%), whereas post-PCI-OCT resulted in stent optimization in 31% [22].

Malapposition was the most frequent finding after stent implantation, similar to ILUMIEN I [20] and CLI-OPCI [21]. The impact of

Culprit lesion identification in suspected ACS



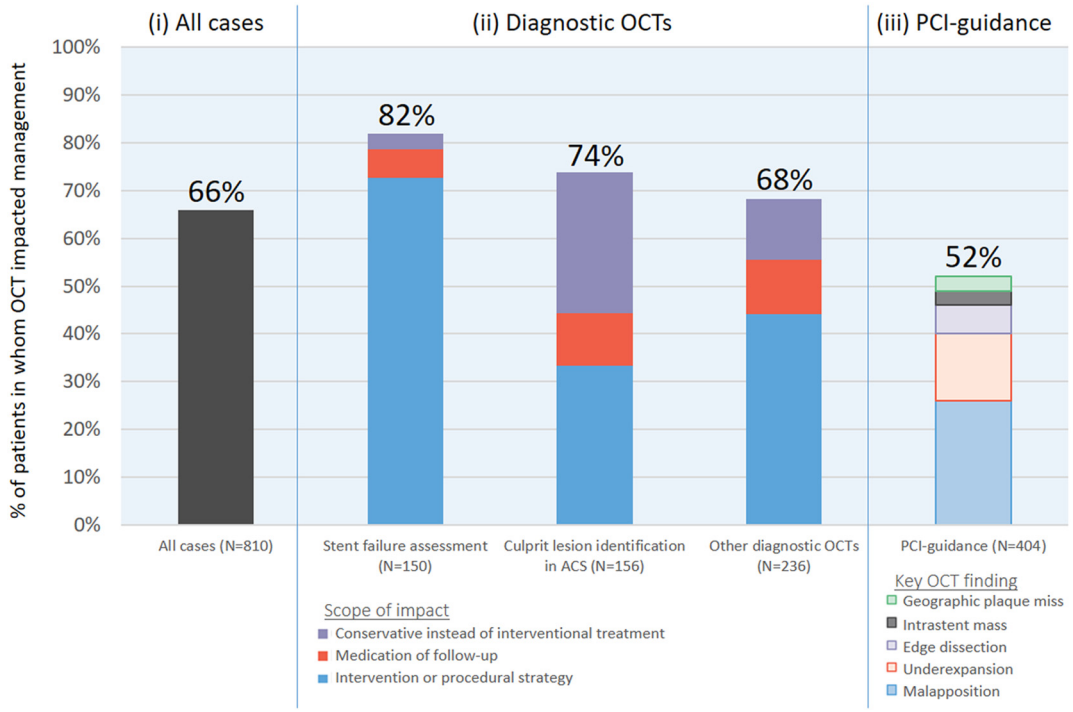


Fig. 3. Impact of OCT on patient management in routine clinical practice: Proportion of cases in which OCT impacted patient management (i) across all patients by either diagnostic or post-stent OCT (left/black bar), (ii) within each diagnostic setting (stent failure assessment, culprit lesion identification, and other) differentiating between the scope of impact (3 bars in the middle), and (iii) in patients for whom PCI-guidance was used (right bar) summarizing the specific key significant post-stent OCT-findings. Abbreviations: ACS = acute coronary syndrome; OCT = optical coherence tomography; PCI = percutaneous coronary intervention.

uncorrected large malapposition remains a matter of ongoing debate. Malapposition was consistently identified as the most prevalent stent abnormality in thrombosed stents with some evidence suggesting that large persistent malapposition zones are responsible for future thrombotic events [4,13]. Conversely, observational studies with limited sample size did not associate post-procedural malapposition with subsequent thrombotic events [23,24]. In contrast to previous and ongoing randomized studies, which focus on stent expansion, edge and reference segment optimization, appropriate stent strut apposition is an additional criterion for optimal stent deployment in the ongoing OCTOBER-trial [NCT03171311].

5.3. Limitations

Indications and potential impact on further treatment were assessed at the University Corelab by experienced cardiologists based on the serial OCT-pullbacks, operators' comments on the OCT and catheterization report. For that purpose, prespecified standardized definitions for indications and impact on treatment were applied (*supplementary material*). The inter- and intraobserver variability was assessed and found to be good. We cannot exclude that the retrospective nature of this assessment was incomplete in some cases. This study reflects current practice at two centers well experienced in the use and interpretation of OCT. OCT use at these sites may be more liberal than at other sites with less OCT-familiar operators and impact on patient management may be different. Nevertheless, this study illustrates the wide range additional value that OCT may provide beyond angiographic assessment. Although we report on the impact of OCT findings on the patient management, it remains unknown whether a more systematic use of OCT will improve cardiovascular outcomes.

Finally, the decision whether or not to use OCT may be depending on local re-imbursement regulations. Operators may hesitate using OCT for indications not re-imbursed, so potential other indications would not be represented in this study.

6. Conclusions

In this contemporary study, OCT was most frequently performed for identification of culprit lesions in patients with suspected ACS, stent failure assessment, and PCI-guidance. Use of OCT in routine clinical practice is broader than acknowledged in current guidelines and may impact subsequent treatment strategy in two out of three patients.

Fig. 2. OCT for culprit lesion identification in suspected ACS: Diagnostic OCT was most frequently used for culprit lesion identification. This figure lists the indication subgroups (first column), illustrates the most frequent finding (second column) and another example (third column) found in OCT, and summarizes the OCT diagnoses found for the corresponding indication subgroup (fourth column, red-colored entity corresponds to red-colored box in second column, blue-colored entity corresponds to blue-colored box in third column). A1) ACS in the young (or in patients with low cardiovascular risk profile): Coronary angiography image of a young ACS patient. A2) OCT-frame of a plaque erosion. A3) OCT-frame of a spontaneous coronary artery dissection (corresponds to angiography in A1). B1) Hazy lesion: Coronary angiography image of an ACS patient with a hazy lesion. B2) OCT-frame showing a plaque rupture. B3) OCT-frame of the lesion in B1, showing organized, recanalized thrombus in a late presenting ACS. C1) Less than 90% stenosis: Culprit lesion identification in patients presenting with minimal troponine elevation may be challenging if they only present with non-severe stenosis. OCT helps differentiating between bystander stenosis (C2, stable fibro-calcific plaque) and culprit lesion (C3, plaque erosion, corresponds to angiography in C1). D1) Distal embolic occlusion: OCT allows detection/exclusion of a proximal coronary source. D2 shows a healthy coronary artery (corresponds to D1) triggering the search for non-coronary embolic source. In D3, OCT revealed rupture of a non-stenosing plaque in the proximal RCA as the source for distal embolic occlusion. E1) LV-hypokinesia: LV angiography showing apical ballooning. Although most frequently screening-OCT allowed exclusion of a coronary cause for LV hypokinesia in the absence of a significant stenosis (non-atherosclerotic coronary artery in E2, corresponding to E1), it also allows finding coronary disease (OCT in E3 shows an old plaque rupture, to prove the LV- hypokinesia to be of older date). The prespecified diagnosis category "angiographically not visible culprit lesion" was not met in any of our LV hypokinesia cases. Abbreviations: ACS = acute coronary syndrome; LV = left ventricle; OCT = optical coherence tomography; RCA = right coronary artery; SCAD = spontaneous coronary artery dissection.

Table 3
OCT-guided PCI.

	Overall N = 810
OCT-guided PCI	404 (50%)
Indications, N (% of patients with OCT-guided PCI)	
ACS	183 (45%)
Non-ACS	221 (55%)
Long lesion (>28 mm)	*76 (19%)*
Left main PCI	*63 (16%)*
Bifurcation (with side-branch-stenting), excluding left main	*19 (5%)*
Complex anatomy (calcification, ectasia)	*17 (4%)*
Other	*46 (11%)*
Significant post-stent OCT findings	
Any significant finding from post-stent OCT	211 (52%)
Key significant finding triggering PCI-optimization	
Malapposition	*104 (26%)*
Underexpansion	*58 (14%)*
Edge dissection	*26 (6%)*
Irregular intrastent mass	*12 (3%)*
Geographic plaque miss	*11 (3%)*

Abbreviations: ACS = acute coronary syndrome; OCT = optical coherence tomography; PCI = percutaneous coronary intervention.
Subcategories are provided in italic for better readibility

Sources of funding

None.

CRediT authorship contribution statement

JH and LR drafted the manuscript. All authors were involved either in the conception and design or analysis and interpretation of data, or both. All authors have read and critically revised the manuscript. All authors have read and approved submission of the manuscript.

Declaration of competing interest

JH received a travel-grant from Bayer. GCMS reported receiving honoraria from Abbott outside the submitted work. SB reports a research grant to the institution from Medis Medical Imaging Systems. SS has received research grants to the institution from Edwards Lifesciences, Medtronic, Abbott Vascular and Boston Scientific, serves as consultant for BTG and Teleflex and has received speaker fees from BTG and Boston Scientific. PM serves as consultant for St Jude Medical / Abbott and Terumo. SW reports research and educational grants to the institution from Abbott, Amgen, Bayer, BMS, Boston Scientific, Biotronik, Cardinal Health, CSL Behring, Daiichi Sankyo, Edwards Lifesciences, Guerbet AG, Johnson&Johnson, Medtronic, Sanofi-Aventis, and Terumo. SW serves as unpaid member of the steering/executive group of trials funded by Abbott, Abiomed, Amgen, BMS, Boston Scientific, Biotronik, Cardiovalve, Edwards Lifesciences, MedAlliance, Medtronic, Polares, Sinomed, V-Wave, and Xeltis, but has not received personal payments by any pharmaceutical company or device manufacturer. SW is member of the steering/executive committee group of several investigated-initiated trials that receive funding by industry without impact on his personal remuneration. GS serves as consultant for St Jude Medical / Abbott and Terumo. LR received research grants to the institution by Abbott, Biotronik, BostonScientific, Medis, Infraredx, Sanofi, Regeneron and consultation/speaker fees by Abbott, Amgen, AstraZeneca, Canon, Sanofi, Vifor. All other author have nothing to disclose.

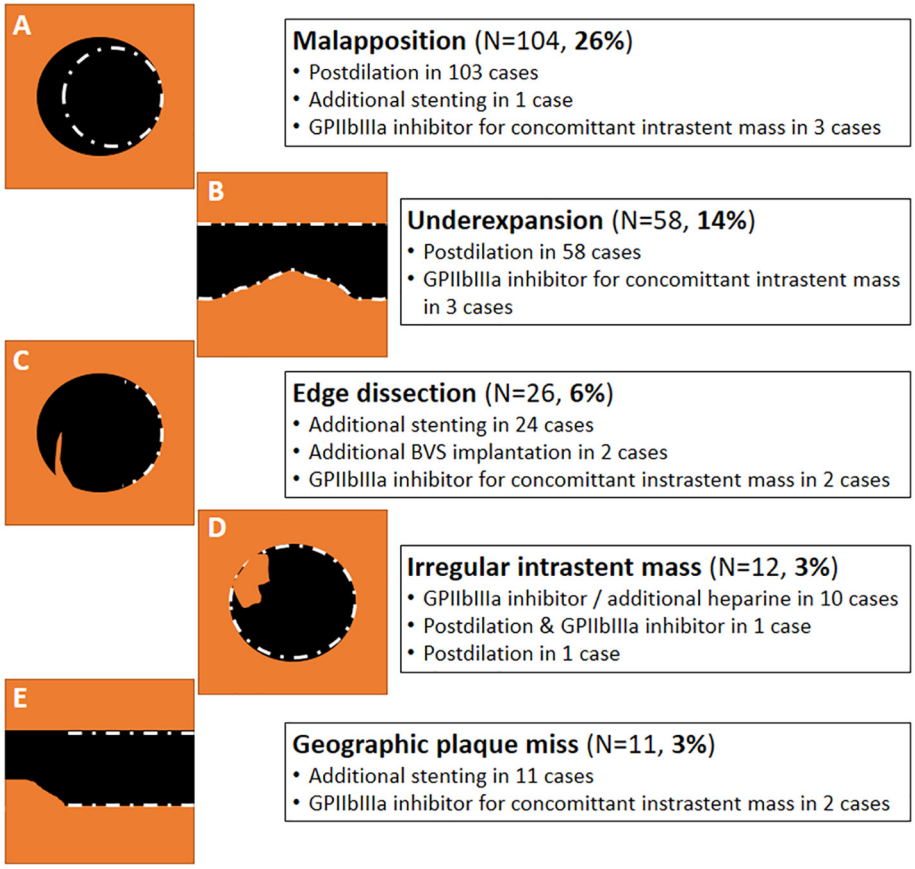


Fig. 4. Post-stent OCT findings and corresponding PCI-optimization: Post-stent OCT showed significant findings triggering corrective measures in 52% of cases. This figure summarizes the key significant findings, with a representative illustration on the left and the corresponding corrective actions taken on the right. Cartoons show malapposition (A), underexpansion (B), irregular intrastent mass (C), edge dissection (D) and geographic plaque miss (E). Abbreviations: BVS = bioresorbable vascular scaffold.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.carrev.2021.07.024.

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