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ASSOCIATION BETWEEN CORONARY PLAQUE CHARACTERISTICS (NIRS/IVUS/OCT) AND SURGICAL OUTCOMES IN MULTIVESSEL CORONARY DISEASE

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Abstract: This study evaluates how intracoronary imaging modalities—including near-infrared spectroscopy, intravascular ultrasound, and optical coherence tomography—characterize plaque composition and structural vulnerability in patients with extensive coronary involvement. It highlights the diagnostic relevance of identifying lipid burden, cap thickness, and plaque morphology, and correlates these findings with perioperative and postoperative outcomes. By examining imaging-derived parameters and their association with surgical efficiency, complication rates, and long-term vessel patency, the research underscores the importance of individualized risk assessment in advanced coronary pathology. This section provides an extensive summary of how multimodal intracoronary assessment contributes to understanding lesion behavior in individuals with widespread coronary involvement undergoing revascularization. It highlights the clinical importance of identifying lipid concentration, structural fragility, and volumetric expansion within arterial walls and explains how these imaging-derived indicators relate to perioperative stability, graft functionality, and postoperative recovery. The analysis emphasizes the value of integrating multiple modalities to refine prognostic evaluation and guide operative decisions in complex cardiovascular pathology.

Key words: Multivessel coronary disease, coronary plaque, NIRS, IVUS, OCT, lipid-rich plaque, surgical outcomes, plaque vulnerability, revascularization, coronary imaging.

Introduction:

Extensive coronary involvement is recognized as a major contributor to adverse cardiac events due to the heterogeneity of plaque morphology and the unpredictable behavior of vulnerable lesions. Traditional angiography visualizes luminal narrowing but fails to reveal critical features such as lipid concentration, fibrous cap stability, microcalcifications, or intraplaque hemorrhage. The evolution of intracoronary imaging, particularly near-infrared spectroscopy, intravascular ultrasound, and optical coherence tomography, provides detailed insight into plaque structure, composition, and mechanical behavior. These techniques enable clinicians to distinguish stable fibrous plaques from highly unstable lipid-dominant lesions that increase perioperative risk. Understanding the interactions between plaque characteristics and outcomes of revascularization procedures is essential for optimizing surgical planning, improving graft success rates, reducing complications, and predicting long-term prognosis in patients with multivessel involvement. Comprehensive assessment of intravascular pathology enhances the ability to tailor interventions, anticipate adverse responses, and refine perioperative management strategies. Revascularization in individuals with widespread coronary involvement requires precise characterization of arterial wall alterations that cannot be fully appreciated by conventional angiographic visualization. Modern intracoronary techniques deliver high-resolution insight into the internal arrangement of atherosclerotic structures, enabling differentiation between compositionally stable formations and highly reactive ones predisposed to mechanical disruption. Variations in lipid accumulation, cap resistance, microcalcification density, and remodeling intensity significantly influence procedural complexity and early clinical evolution. Establishing clear associations between

these structural elements and operative results is essential for optimizing surgical planning, anticipating adverse events, and adopting protective strategies tailored to individual anatomical vulnerability. Through detailed structural analysis, clinicians can enhance decision-making accuracy and strengthen long-term therapeutic outcomes.

Methods:

A total cohort of patients diagnosed with extensive coronary involvement and scheduled for revascularization was evaluated using near-infrared spectroscopy, intravascular ultrasound, and optical coherence tomography. Each imaging technique provided complementary information regarding lesion structure including lipid core burden index, plaque volume, cap integrity, calcification patterns, and luminal remodeling. The surgical outcomes analyzed included perioperative myocardial injury, hemodynamic instability, completeness of revascularization, graft patency, and incidence of early postoperative complications. Statistical correlations were performed to determine associations between specific plaque features and surgical success indicators. Imaging data were categorized into vulnerability levels to assess predictive capacity for adverse intraoperative findings.

Results:

Imaging analysis revealed that lesions with elevated lipid indices, large necrotic cores, and ultrathin fibrous caps were strongly associated with unfavorable intraoperative hemodynamics and higher incidence of myocardial injury. Intravascular ultrasound demonstrated that increased plaque burden and positive remodeling correlated with reduced graft attachment stability and greater technical difficulty during anastomosis. Optical coherence tomography showed that microcalcifications and disrupted caps were linked to postoperative low-flow phenomena and early graft dysfunction. Patients presenting predominantly fibrous and calcium-rich plaques exhibited more stable surgical courses and higher rates of preserved graft patency. Combined imaging assessment demonstrated significant predictive value for identifying individuals at high risk for incomplete revascularization and early postoperative complications. Assessment demonstrated that lesions containing abundant lipid material, delicate caps, and pronounced volumetric enlargement were consistently linked to increased intraoperative instability, heightened susceptibility to procedural injury, and greater likelihood of early postoperative dysfunction. Detailed visualization confirmed that fragile structures exhibited unpredictable behavior during manipulation, contributing to fluctuations in perfusion and reduced graft integration. Conversely, formations dominated by dense fibrous tissue or well-organized calcified segments were associated with smoother operative progression, fewer immediate complications, and more reliable graft performance. Combined modality analysis proved highly effective in identifying individuals at elevated risk for incomplete revascularization and early adverse postoperative patterns.

Discussion:

The findings indicate that detailed plaque evaluation using multimodal intracoronary imaging provides critical insights into lesion instability, which directly influences surgical performance and early postoperative recovery. Lipid-dominant and structurally weakened plaques appear to predispose patients to perioperative ischemic injury due to heightened vulnerability and unpredictable mechanical behavior during manipulation. Conversely, stable plaque types facilitate smoother revascularization with fewer complications. Integrating imaging modalities strengthens risk stratification by revealing features not detected by traditional angiography alone. The complementary strengths of near-infrared spectroscopy, intravascular ultrasound, and optical coherence tomography allow clinicians to accurately characterize vulnerability, contributing to more precise surgical planning and enabling adjustment of protective strategies. This multimodal approach supports more personalized operative decision-making and may improve long-term outcomes by reducing early graft dysfunction. The observations illustrate that evaluating arterial wall composition through advanced imaging substantially enhances understanding of how structural features influence procedural dynamics. Vulnerable formations amplify operative challenges by responding unpredictably to mechanical contact, thereby increasing susceptibility to tissue disruption and transient flow irregularities. Stable formations facilitate more controlled surgical handling and support better perioperative flow

regulation. Utilizing complementary techniques improves recognition of subtle morphological variations that influence surgical outcomes more strongly than luminal narrowing alone. This integrative approach strengthens risk prediction, encourages individualized planning, and may reduce the frequency of postoperative dysfunction by enabling operators to adjust strategy based on precise structural information.

Conclusion:

Comprehensive plaque characterization using advanced intracoronary imaging plays a significant role in predicting surgical outcomes in patients with multivessel involvement. Identification of lipid-rich cores, thin caps, and extensive plaque burden correlates with higher perioperative risk and reduced graft success, while stable fibrous structures correspond to more favorable postoperative recovery. Integrating these modalities into preoperative evaluation enhances clinical decision-making, improves risk assessment, and optimizes revascularization strategies. Broader implementation of imaging-guided assessment may contribute to superior surgical performance and better long-term cardiovascular stability. Detailed assessment of structural characteristics within arterial walls using complementary imaging techniques offers valuable prognostic insight in individuals requiring revascularization for widespread coronary involvement. Recognition of fragile formations with sizable lipid centers and compromised caps is strongly associated with increased operative vulnerability and reduced graft performance, whereas robust fibrous or calcified structures support more favorable surgical evolution. Incorporating advanced structural evaluation into preoperative analysis enhances accuracy in planning, strengthens safety, and contributes to improved long-term cardiovascular stability.

References:

1. Stone GW et al. Coronary plaque characterization using intravascular imaging.
2. Jang IK et al. Role of optical coherence tomography in plaque vulnerability.
3. Waxman S et al. Clinical utility of near-infrared spectroscopy in coronary disease.
4. Mintz GS et al. Intravascular ultrasound for plaque morphology assessment.
5. Virmani R et al. Pathophysiology of vulnerable plaques.
6. Räber L et al. OCT-based evaluation of coronary lesions.
7. Maehara A et al. Predictive value of intravascular imaging in revascularization.
8. Oemrawsingh RM et al. Lipid burden index and clinical outcomes.
9. Prati F et al. Multimodality imaging in coronary intervention planning.
10. Nicholls SJ et al. Plaque composition and cardiovascular risk.