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Editorial

Current Insight on Percutaneous Coronary Intervention in Non-ST Elevation Acute Coronary Syndrome

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ABSTRACT

Percutaneous coronary intervention (PCI) is a cornerstone in the management of non-ST elevation acute coronary syndrome (NSTE-ACS), offering significant improvements in patient outcomes. Risk stratification is critical in guiding the urgency and timing of PCI, with invasive strategies recommended for high-risk patients identified by clinical, electrocardiographic, biomarker assessments, or validated scores. Multivessel coronary artery disease is frequently observed in patients with NSTE-ACS and is correlated with an increased likelihood of recurrent myocardial infarction and mortality. Preferably during the index procedure, complete revascularization should be considered in patients with stable hemodynamics. Functional invasive evaluation, including fractional flow reserve, may help assess the hemodynamic significance of coronary lesions and decide whether a non-culprit stenosed vessel prompts revascularization. Intravascular imaging techniques with optical coherence tomography and intravascular ultrasound are essential for evaluating lesion characteristics, optimizing stent deployment, and enhancing the precision of PCI. Overall, a personalized interventional approach in NSTE-ACS incorporating risk stratification, timely intervention, careful consideration of multivessel disease, and advanced diagnostic modalities is paramount in enhancing patient prognosis and minimizing recurrent ischemic events.

Non-ST elevation acute coronary syndrome (NSTE-ACS) encompasses a range of clinical conditions, including non-ST elevation myocardial infarction (NSTEMI) and unstable angina (UA). It comprises more than 70% of patients with acute coronary syndrome (ACS). Unlike ST-elevation myocardial infarction (STEMI), preceded mainly by total occlusion due to vessel plaque rupture, NSTE-ACS results from incomplete or transient vessel occlusion. Therefore, NSTE-ACS is deemed to be managed distinctly from STEMI.[1,2]

The American College of Cardiology/American Heart Association guidelines on coronary artery revascularization recommend an immediate invasive strategy within 2 hours for NSTE-ACS patients with cardiogenic shock, hemodynamic or electrical instability, and refractory angina (class of recommendation, COR 1). An early invasive strategy within 24 hours is advised for NSTE-ACS at high risk of clinical events (e.g., GRACE score >140) (COR 2a). In patients with intermediate or low risk of clinical events, implementing an invasive strategy prior to hospital discharge is a reasonable approach to enhance clinical outcomes (COR 2a).[2]

In line with American guidelines, the European Society of Cardiology guidelines recommend an immediate invasive strategy within 2 hours if one of the very high-risk criteria is satisfied (COR Ia): (1) cardiogenic shock or unstable hemodynamic; (2) acute heart failure secondary to ACS; (3) recurrent or ongoing chest pain despite pharmacological treatment; (4) malignant arrhythmia or survived cardiac arrest; (5) mechanical complications; and (6) recurrent dynamic electrocardiogram (ECG) changes suggesting ischemia. A routine invasive strategy during hospitalization is advised for patients who meet high-risk criteria (COR Ia), which include (1) confirmed NSTEMI, (2) a GRACE risk score exceeding 140, (3) transient ST-segment elevation, and (4) dynamic changes in ST-segment or T waves.[1]

Randomized trials and meta-analyses have demonstrated that, in patients with NSTE-ACS, the routine invasive strategy improves outcomes compared to the selective invasive approach. The invasive approach to managing NSTE-ACS has been associated with lower rates of refractory angina, myocardial infarction (MI), or death at 4 to 6 months of follow-up compared to selective invasive strategies. The benefit was driven primarily by reducing the risk of MI, especially in high-risk patients.[3–5] The VERDICT trial, which randomized patients to angiography within 12 hours or 48 to 72 hours from the time of diagnosis, and the TIMACS trial, which enrolled patients within 24 hours of symptom onset and randomized them to undergo angiography either within 24 hours or after 36 hours from the time of randomization, both assessed the benefits of early invasive management in NSTE-ACS patients. These trials demonstrated that early invasive approaches reduced the cardiovascular events in high-risk patients. [6,7]

The multivessel disease (MVD) is commonly found in NSTE-ACS presentation, comprising around half of patients presenting with MI. It mainly carries a higher risk of repeat MI and revascularization, and mortality. Preferably during the index procedure, complete revascularization should be considered in patients with stable hemodynamics (COR IIb).[1] The timing of this recommendation is based

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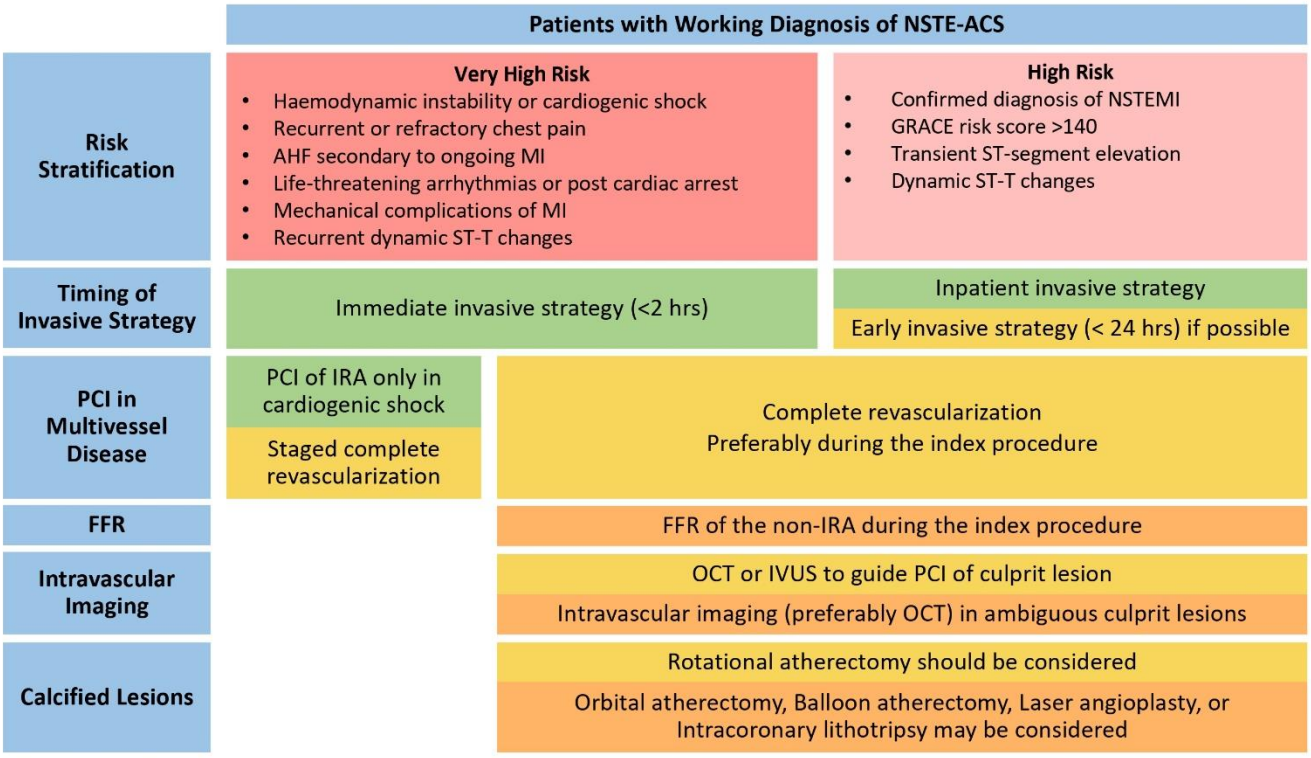

Figure 1. Summary of an invasive strategy in patients with working diagnosis of non-ST elevation acute coronary syndrome.

on the SMILE trial that implied immediate complete revascularization was related to a lesser risk of major adverse cardiac events (MACE) and repeat revascularization.[8] The SMILE trial was the only study observing the timing of revascularization involving NSTEMI with MVD patients until the recommendation was released. Recently, a prespecified substudy that comprised NSTE-ACS patients with MVD in the BIOVASC trial also favored immediate complete revascularization by reducing the MI and unplanned ischemia-driven revascularization compared to the staged complete revascularization.[9] However, the CULPRIT-SHOCK trial, which enrolled patients presenting with cardiogenic shock due to STEMI or NSTEMI before PCI, demonstrated that culprit-only PCI resulted in more favorable primary outcomes, including all-cause mortality and renal-replacement therapy, compared to multivessel PCI.[10] Routine multivessel PCI of non-culprit lesions should not be performed in NSTE-ACS patients with cardiogenic shock (COR 3).[1,2]

Functional invasive evaluation may help decide whether a non-culprit stenosed vessel prompts revascularization. Fractional flow reserve (FFR) measurement of non-infarct related artery (IRA) severity may be considered during the index procedure (COR IIb).[1] An analysis from the FAME trial showed that using FFR to guide PCI in multivessel disease resulted in similar reductions of MACE and its components in unstable angina and NSTEMI patients, compared with patients with stable angina.[11] The FAMOUS-NSTEMI trial showed that FFR-guided management led to decreased rates of coronary revascularization compared with angiography-guided management. However, management guided by FFR did not lead to a reduction in MACE at the 12-month follow-up.[12] Although current evidence on its benefit remains inconsistent, FFR has a role in estimating the flow in non-culprit lesions.

Intravascular imaging modalities, including optical coherence tomography (OCT) and intravascular ultrasound (IVUS), are now widely accepted for assessing lesion morphology in ACS patients to guide PCI (COR IIa). Ambiguity regarding the culprit lesion can occur in over 30% of patients suspected to have NSTE-ACS. In order to clarify ambiguous culprit lesions, intravascular imaging may be considered, preferably with OCT (COR IIb).[1] The DOCTORS trial recruited 240 patients with NSTE-ACS to compare OCT-guided PCI, which involved using OCT both before and after the procedure PCI, with angiography-guided PCI. This study showed that OCT guidance led to higher post-PCI FFR than angiographic alone. Moreover, OCT was safe, with no significant difference in periprocedural complications.[13] Compared to OCT, IVUS has a lower resolution for detecting microstructures such as the thrombi, erosions, fibrous cap, and necrotic core, making it less useful in ACS. However, IVUS can still be valuable in ACS when the clinical presentation is caused by factors other than plaque disruption. According to findings from the ULTIMATE trial, after a 3-year follow-up period, stent implantation guided by IVUS was linked to reduced rates of target vessel failure compared to those guided solely by angiography.[14]

Another role of intravascular imaging is to estimate the need for lesion preparation or modification. Calcium deposits thicker than 500 mm or calcium involving the vascular arc >270 degrees may require lesion modification before stent expansion. In order to enhance the success of the procedure, rotational atherectomy can be useful for plaque modification in fibrotic or heavily calcified lesions (COR 2a). Other modalities such as intracoronary lithotripsy, laser angioplasty, balloon atherotomy, and orbital atherectomy may also be considered as plaque modification efforts in fibrotic or heavily calcified lesions (COR 2b).[2]

Previously, elderly patients aged ≥80 years were excluded from many studies, and there was much hesitation in treating elderly patients due to frailty, comorbidities, and cognitive decline. As life expectancy increases, their proportion will increase in society. A randomized trial, the After Eighty Study, looked at long-term outcomes of conservative versus invasive approaches in NSTE-ACS patients aged ≥80 years. After a median follow-up duration of 5 years, invasive strategies demonstrated better results than conservative strategies on primary outcomes.[15] This highlights the need to consider invasive strategy options in this population.

Finally, NSTE-ACS is an entity of ACS that needs a meticulous approach due to its variable outcomes related to the risk of the patients. PCI plays a crucial role in managing NSTE-ACS to significantly improve patient outcomes. Effective risk stratification allows for identifying high-risk patients who benefit most from early

invasive strategies. In cases of MVD, physiology testing and intravascular imaging guide precise interventions, ensuring optimal treatment decisions. These tools collectively enhance the efficacy of the interventional approach, leading to better clinical outcomes and reduced adverse cardiovascular events in NSTE-ACS patients.

Conflict of Interest

There is no conflict of interest.

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