

Review

Surgical Turndown: “What’s in a Name?” for Patients Deemed Ineligible for Surgical Revascularization

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ABSTRACT

Optimal revascularization in severe ischemic heart disease (SIHD) is addressed in all clinical guidelines. With an aging patient population, a growing challenge remains the management of patients with SIHD deemed ineligible for surgical revascularization, the so-called surgical turndown patient. The status of surgical ineligibility remains associated with worse clinical outcomes. As the general population grows older and comorbidities increase, this subset of SIHD will likely increase. Ascribing the label of surgical turndown has significant adverse prognostic implications, and thus, careful assessment is required as key issues related to frailty and completeness of revascularization need to be taken into consideration in the decision-making process. Clearly defining criteria for surgical turndowns are paramount, as well as a comprehensive assessment of revascularization suitability. As such, an integrated Heart Team represents the favoured path forward to ensure patient-centred cardiovascular care. The Heart Team approach can appropriately manage issues related to revascularization in patients with SIHD with multiple comorbidities. Therefore, the focus of this review will be on the importance of the diagnosis of surgical turndown, its impact on clinical outcomes, and factors to bear in mind when considering revascularization in this challenging patient subgroup.

RÉSUMÉ

Toutes les lignes directrices cliniques décrivent la technique de revascularisation optimale en cas de cardiopathie ischémique sévère. La prise en charge des patients atteints d'une cardiopathie ischémique sévère jugés inadmissibles à la revascularisation chirurgicale, les patients dits inopérables, continue de représenter un défi, un défi d'autant plus grand que cette population de patients vieillit. L'inopérabilité demeure associée à l'issue clinique la plus sombre. Il est fort probable que ce sous-ensemble de patients atteints d'une cardiopathie ischémique sévère continue de s'accroître à mesure que la population générale vieillit et que le nombre de comorbidités augmente. Assigner l'étiquette d'inopérabilité à un patient n'est pas sans conséquences pronostiques indésirables importantes, si bien qu'une évaluation approfondie s'impose. Les facteurs clés que sont la fragilité du patient et le caractère complet de la revascularisation doivent en effet entrer en ligne de compte dans le processus décisionnel. Il est impératif d'établir clairement les critères qui définissent l'inopérabilité et d'évaluer pleinement l'adéquation de la revascularisation. Une équipe de soins cardiaques intégrée représente donc l'approche privilégiée pour faire en sorte que les soins cardiovasculaires soient centrés sur le patient. Elle permet de gérer correctement les problèmes de revascularisation chez les patients atteints d'une cardiopathie ischémique sévère présentant plusieurs comorbidités. Le présent article portera donc sur l'importance du diagnostic d'inopérabilité, ses répercussions sur les résultats cliniques et les facteurs à prendre en considération lorsque la revascularisation est envisagée dans ce sous-groupe de patients difficiles à traiter.

Clinical guidelines have been elaborated on key aspects of evidence-based management and decision making for optimal revascularization in severe ischemic heart disease

(SIHD).^{1,2} Comparative effectiveness research has scrutinized issues related to an optimal revascularization strategy for complex settings of SIHD.³⁻⁵ Although country-to-country variations do exist in the ratio of percutaneous coronary intervention (PCI) over coronary artery bypass graft surgery (CABG), it is widely accepted that CABG remains the revascularization strategy of choice in the setting of left main (LMD) or multivessel disease (MVD) when clinically feasible.⁶

With an aging patient population, a growing challenge remains the management of patients with SIHD deemed ineligible for surgical revascularization, the so-called surgical

Received for publication March 28, 2019. Accepted May 5, 2019.

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See page 964 for disclosure information.

turndown patient. The focus of this review will be on the importance of the latter diagnosis, its impact on clinical outcomes, and factors to bear in mind when considering revascularization in this challenging patient subgroup.

Impact of Surgical Ineligibility on Clinical Outcomes

Registry data have reported on the unequivocal worse clinical outcome for the surgically ineligible patient. Head et al.⁷ reported on clinical outcomes of patients not randomized in the **Synergy** between Percutaneous Coronary Intervention with **Taxus** and Cardiac Surgery (SYNTAX) trial, which compared the efficacy of percutaneous and surgical revascularization for severe coronary artery disease (CAD). Despite the all-comers nature of this trial, the included patients had to be suitable for revascularization by either strategy, to be eligible for randomization. Patients for whom the study Heart Team concluded that neither CABG nor PCI was feasible were then included in the nested registries of the study. Among the 3075 patients in the SYNTAX trial, 35% were included in the CABG registry, with complex coronary anatomy for PCI being the main reason for inclusion in 70.9% of these patients. Conversely, 6.4% were included in the PCI registry as they were deemed unsuitable for surgery mostly due to their high surgical risk (70.7% of cases) as determined by the logistic EuroSCORE (European System for Cardiac Operative Risk Evaluation) and Parsonnet score. Older in age and with more severe comorbidities, the PCI registry patients also presented with greater lesion complexity (higher SYNTAX scores and more chronic total occlusions) than the randomized SYNTAX PCI group. Three-year major cardiovascular adverse events were 38.0% in the PCI registry, in stark contrast to 16.4% for the CABG registry patients. When stratified according to the SYNTAX score tertiles, a stepwise increase in poorer 3-year outcomes was found for the PCI registry patients as disease burden and complexity increased (tertiles: low, 29.5%; intermediate, 33.3%; severe, 46.3%; $P = 0.09$).

Administrative and quality assessment databases have also provided insight on outcomes. McNulty et al.⁸ compared surgically ineligible patients with LMD with their CABG-eligible counterparts in the National Cardiovascular Data Registry (NCDR) CathPCI dataset. Nonemergent unprotected LMD PCI was found to be performed mostly because CABG was not an alternative. Moreover, irrespective of the traditional risk score used for adjustment, surgical ineligibility remained an independent predictor of long-term outcomes and mortality for LMD: Society of Thoracic Surgeons (STS) (hazard ratio [HR], 5.4; 95% confidence interval [CI], 1.2-25), EuroSCORE (HR, 5.9; 95% CI, 1.3-27), or NCDR CathPCI mortality scores (HR, 6.2; 95% CI, 1.4-27). Waldo et al.⁹ also used the NCDR-CathPCI dataset and looked at all subjects undergoing nonemergent PCI for either LMD and MVD. Data were available for 6960 patients; investigators included 1013 patients in the final cohort undergoing PCI for either multivessel disease or unprotected LM disease and found that 22% were deemed unsuitable for CABG. After adjusting for known mortality risk factors, surgical ineligibility remained an independent predictor of both in-hospital (odds ratio [OR], 6.26; 95% CI, 2.16-18.15; $P < 0.001$) and long-term mortality (HR, 2.98; 95% CI, 1.88-4.72; $P < 0.001$).

Thus, surgical turndown is not only related to CAD and, from such data, “eye balling assessment” remained an important aspect in patient management.

Prior studies have also looked at datasets from nontertiary centres. Sukul et al.¹⁰ also investigated the impact of surgical ineligibility using data from a prospective, multicentre statewide registry of patients undergoing PCI in 33 nonfederal hospitals in Michigan. Their analysis focused on a cohort of 99,370 patients of whom 2% (1922) were turned down for surgery. Complex CAD was defined by the presence of LMD, 3-vessel CAD, or 2-vessel CAD with proximal left anterior descending (LAD) disease. Interestingly, after adjusting for hospital clustering, coronary anatomy, and complexity as well as preprocedural mortality risk, no difference in mortality was found between surgically eligible and noneligible patients, as 95.8% of surgically ineligible patients had noncomplex CAD. Conversely, patients with LMD (1% of surgically ineligible patients) fared far worse: mortality was strongly associated with surgical ineligibility (OR, 7.38; 95% CI, 2.32-23.49; $P < 0.001$). In-hospital outcomes were significantly higher among surgically ineligible patients with LMD undergoing PCI compared with others undergoing PCI: death (20.0% vs 5.3%; $P = 0.02$), cardiogenic shock (25% vs 5.1%; $P = 0.004$), and requirement for dialysis (10.5% vs 1.6%; $P = 0.04$). Thus, non-CAD-related comorbidities likely underlie these poorer outcomes.

Although most available data revolve on the outcomes of surgically ineligible patients undergoing PCI, little is known of those relegated to medical therapy (MT) only. In a single-centre cohort from a United Kingdom tertiary care centre, Danson et al.¹¹ compared the 1-year outcome when surgically ineligible patients were treated either by PCI or MT only. Although no discernible differences were found at 30 days, 1-year major adverse cardiac events were higher in MT patients compared with those treated by PCI (39.3% vs 26.7%, $P < 0.01$, respectively). In fact, incompleteness of revascularization (as assessed by the residual SYNTAX score [rSS]) was predictive of poorer outcomes and an independent predictor among MT surgically ineligible patients (OR, 6.45; 95% CI, 2.53-16.45), even after adjustment for key comorbidities (such as low ejection fraction or chronic lung, kidney, or vascular conditions).

When drawn from such registries or administrative datasets, such insights on outcomes of surgical turndowns are considered “real-world” data. However, contemporary datasets on this patient subgroup have key exclusions such as salvage or compassionate PCI (ie, selective and incomplete revascularization [IR]) as well as cardiogenic shock, PCI postcardiac arrest, or patients with prior history of CABG. Furthermore, caution should be used when interpreting data from available surgical ineligibility series, which remain with inherent limitations such selection biases (ascertainment bias, referral bias, and treatment selection bias). Patient and/or treating physician preferences for percutaneous revascularization were classified as surgical turndowns. Moreover, contemporary surgical series remain vulnerable in part to selection bias introduced by public reporting. The fundamental aim of public reporting is to improve delivery and quality of cardiovascular care. Nevertheless, whether for surgical or percutaneous interventions, broadened quality reporting has resulted in the unintended consequence of risk aversion behaviours by clinicians.¹²⁻¹⁴ Therefore, altered surgical practice patterns to

obtain suitable performance metrics might inevitably lead to an increase in cases judged to be inappropriate for surgical revascularization irrespective of whether or not the critically ill patient with SIHD truly has a prohibitive risk profile. Public reporting need not be a static sum of systems and processes. There is potential to introduce mitigating strategies to improve reported performance metrics, which will more closely mirror clinical reality (such as exclusion of patients considered high risk, reporting by condition or diagnosis rather than by procedures, or reporting at the hospital or programme level rather than at a physician level and collaborative, cross-disciplinary decision making) while allowing surgeons or interventionalists not to forgo treatment of higher risk patients.¹⁵

Bearing in mind the above limitations, according to the currently available literature, the label and status of surgical ineligibility in SIHD still bear prognostic implication and remain invariably an independent predictor of worse in-hospital and long-term clinical outcomes.

Taxonomy of Surgical Ineligibility

Prior studies and scientific societies have provided a taxonomy of contraindications for CABG.^{8,9} However, investigators reported on an important limitation of quality assessment datasets, that is, predefined criteria or conditions might lead to key diagnoses not being documented. McNulty et al.⁸ found that at least 1 non-NCDR-captured condition was found in 78% of surgically ineligible patients compared with only 22% in the surgically suitable LMD subgroup. Such non-NCDR conditions are impactful on the decision-making process and included, for example, severe aortic calcification, malignancy, cachexia, or dementia.

In addition to advanced age and poor surgical targets/conduits, data from the STS databases have confirmed the importance of commonly cited contraindications: the incremental negative impact of declining renal function (from mild chronic kidney disease to end-stage renal disease with dialysis) or increasing severity of lung disease (often in cases of chronic obstructive pulmonary disease) is noteworthy.^{16,17} With regard to the latter condition, pulmonary hypertension should not be neglected in considerations for surgical status in SIHD, but its contribution as a primary factor is likely not as impactful as in the setting of other cardiac surgical scenarios, such as cardiac transplantation. In addition, pulmonary hypertension likely represents a correlate of severity of chronic lung disease and/or ventricular dysfunction, which are well reported to represent deciding, prohibitive factors surgical ineligibility. All of the above predictors of poorer surgical outcomes (often cited either individually or in combination to justify surgical ineligibility) are well documented to be associated with either readmission or long-term survival.^{16,17}

Less conventional factors such as malignancy (whether active or in remission) or neuromuscular disease are not well captured in contemporary databases or surgical series. Small observational series or case reports discussing such contraindications can be found, but insufficient published data are available to ascertain firmly whether these might represent absolute or relative contraindications for revascularization. Thus, when confronted with unconventional risk factors, clinical judgement and operator experience remain of

paramount importance to incorporate them with more conventional factors in a rational decision-making process.

Cerebrovascular disease with or without a recent occurrence of cerebrovascular accident has been a well-established marker of poorer short- and long-term outcome after revascularization. However, with an aging population, cognitive decline and/or impairment (not just overt clinically significant dementia) is an increasing health burden and should also be taken into consideration. Although clinical cardiovascular outcomes are known to be poorer in such patients,¹⁸ contemporary data point to higher than anticipated prevalence rates and intervention could precipitate cognitive decline. Gu et al.¹⁹ report that almost 50% of patients presenting with non-ST elevation myocardial infarction (a typical presentation for surgical turndown patients) deemed eligible for revascularization have documented cognitive impairment. The prevalence rates remain unknown for surgical ineligible patients; one could hazard similar or higher rates among the latter. Thus, the spectrum of cognitive disorders needs to be incorporated into risk assessment tools to help guide not only clinicians but also patients and their families whether intervening remains acceptable or not.

In summary, efforts should be made to use a well-defined, exhaustive taxonomy for criteria justifying contraindications to surgical revascularization. Table 1 provides a taxonomy of factors leading to surgical turndown.

Surgical Ineligibility and Frailty

An important missing clinical feature poorly captured by current published registries or administrative datasets on surgical ineligibility is frailty. With the aging population, patients older than 75 years with multiple comorbidities including SIHD are an ever-increasing subset of patients.

Table 1. Taxonomy of surgical ineligibility

Conventional cardiac
Poor targets/conduits
Severe systolic dysfunction
Aortic calcification (porcelain aorta)
Extensive nonviable myocardium
Conventional noncardiac general
Advanced age
Frailty
Morbid obesity
Immunosuppression
Systemic infection
Conventional noncardiac specific
Severe lung disease
Chronic renal insufficiency
Malignancy
Severe peripheral arterial disease
Severe hepatic disease
Severe hematological disease
Severe cerebrovascular disease
Chest wall abnormality (hostile thorax)
Abdominal wall abnormality
Psychosis/encephalopathy
Cognitive dysfunction
Gastrointestinal bleeding
Pulmonary hypertension
Neuromuscular disease
Dementia and/or cognitive impairment

Frailty is associated with a complex pathobiological process leading to the frailty phenotype.²⁰ The state of depleted physiological reserve ultimately increases vulnerability to stressors (such as invasive procedures) and has been linked to poorer outcomes and increased mortality in cardiac patients. Both percutaneous interventional and surgical risk models are limited in their ability to adequately assess frailty and need to be optimized to integrate this key biological syndrome.²¹⁻²⁴ Frailty has been assessed using multiple scores applicable across surgical specialties and investigated in patients undergoing cardiac interventions.^{25,26} Moreover, Goldfarb et al.²⁷ showed that frailty is significantly related to a marked increase in hospital costs \$9 (adjusted additional cost, \$21,245; 95% CI, \$12,418-\$30,073; $P < 0.001$), after multivariable adjustment for age, sex, surgery type, and surgical risk score. Thus, the 2014 Canadian Cardiovascular Society Position Statement on multivessel revascularization discusses the use of routine screening of frailty to provide more informed decision making regarding surgical eligibility.¹

Interestingly, if frailty represents a key feature leading to surgical turnaround, one could wonder whether a “prehabilitation” programme could “defrail” the vulnerable patients with SIHD and reclassify these patients from ineligible to eligible candidates.²⁸ In a small pilot randomized trial, Sawatzky et al.²⁹ explored such a hypothesis in 15 patients awaiting elective CABG. A prehabilitation programme involved exercise and education classes for 60 minutes/d, twice weekly for at least 4 weeks; this was compared with standard care, which involved a single 3-hour assessment session before surgery. Three months after surgery, investigators documented a statistically significant improvement in both 6-minute walk test and gait speed among the “prehab” patients, whereas no change was shown in the standard care group.²⁹

As discussed in the seminal review by Afilalo et al.,²⁰ frailty is well documented to be associated with poorer clinical outcomes across all spectrum of cardiovascular disease, conferring a 2-fold increase in mortality irrespective of cardiovascular disease status or clinical presentation. Clinical evaluation of frailty is important but does remain limited by the fact that different scores are used at times in the same patient population, and published cutoffs have been derived in different populations (from elderly patients in the community or in long-term care facilities to patients in acute decompensated heart failure or those considered for cardiac surgery). The clinical entity of frailty is also presented as a dichotomous variable, derived from many clinical elements, and not all hold the same weight for prognostication. From a pragmatic perspective, cutoffs for 5-m gait speed (< 0.63 m/s or > 6 seconds to walk 5 m) or the Fried scale (≥ 3) could be used to screen potential surgical ineligible patients as these 2 scoring tools have been validated in either patients hospitalized with severe CAD³⁰ or those pre-evaluated for cardiac surgery.³¹

In summary, it is not appropriate to use frailty as the sole factor to decide on the eligibility for revascularization of patients with SIHD. Instead, frailty assessment should be used as part of an integrated approach (including other risk assessment tools) to determine whether a patient should or should not be deemed as a surgical turnaround.

Surgical Ineligibility and Completeness of Revascularization

Completeness of revascularization

Historically, surgical series have reported better clinical outcomes when every angiographically significant stenosis was revascularized with a distal anastomosis.³² Recent randomized data also argue for completeness of revascularization (CR). Ahn et al.³³ performed a patient-level pooled analysis of key trials on revascularization in the setting of severe CAD (MVD or LMD). Looking at the SYNTAX,⁷ Premier of Randomized Comparison of Bypass Surgery Versus Angioplasty Using Sirolimus-Eluting Stent in Patients with Left Main Coronary Artery Disease (PRECOMBAT-2),³⁴ and Randomized Comparison of Coronary Artery Bypass Surgery and Everolimus-Eluting Stent Implantation in the Treatment of Patients with Multivessel Coronary Artery Disease (BEST)³⁵ trials, the investigators documented CR for LMD or MVD to be 70.7% and 64.1%, respectively, in the surgical group, whereas the PCI group had rates of 67.2% and 50.5%, respectively. During the 5-year follow-up period, patients having IR with PCI had a higher risk of death from any cause (HR, 1.43; 95% CI, 1.03-2.00; $P = 0.036$) and the composite of death, myocardial infarction, and stroke (HR, 1.48; 95% CI, 1.14-1.92; $P = 0.003$), when compared with CABG patients having achieved CR. Nevertheless, there was no significant difference between patients undergoing CABG and PCI with CR regarding the risk of death from any cause and cardiac death. Similarly, Hannan et al.³⁶ investigated the impact of CR on patient outcomes in the New York State PCI registry, a multicentre registry of all nonfederal PCI hospitals with 41,639 New York residents having undergone PCI for MVD. Patients with IR in the setting of an ST elevation myocardial infarction fared better than those with IR presenting without ST elevation myocardial infarction. Moreover, not all IR are equal as mortality risk was found to be higher in certain subgroups of IR: those with proximal LAD artery vessel IR (20.8% vs 14.7%; HR, 1.11; 95% CI, 1.01-1.23), and those with more than 2-vessel IR or IR in lesions with at least 90% stenoses. In the current Canadian landscape, surgeons are often asked to assess patient eligibility in the setting of acute coronary syndromes. Two retrospective analyses of the Acute Catheterization and Urgent Intervention Triage Strategy (ACUITY) trial found a poorer clinical outcome in unstable angina/non-ST elevation myocardial infarction patients with IR, but more importantly, investigators also quantified levels of angiographic IR.^{37,38} The rSS quantifies the degree and complexity of residual stenosis after revascularization. Thus, in patients with acute coronary syndrome, an rSS of > 8 was associated with increased rates of ischemic events both at 30 days and at 1 year.

Reasonable IR

In the surgically ineligible patient, key factors such as frailty, comorbidities, presence of myocardial viability (or not), lesion complexity (tortuosity and calcification), and issues of vascular access need to be considered before embarking on a strategy of complete revascularization. It is likely that IR represents a marker of a patient's more severe atherosclerotic burden and overall clinical status. The 2014 Canadian position statement on multivessel revascularization suggests that multivessel PCI for symptom relief is an acceptable option in

select patients with IHD in whom survival benefit is uncertain.¹ Thus, palliative PCI with its inherent IR or selective PCI with an aim for reasonable IR remains a therapeutic option in the surgically ineligible patient.

When deciding between reasonable IR or aggressive CR, it is important to keep in mind that definitions of IR may vary not only according to angiographic thresholds but also between studies.³⁷ Moreover, most studies report IR using angiographic assessment of coronary stenoses, which is hampered by shortcomings related to its inability to appropriately ascertain the physiological significance of stenoses. Fractional flow reserve (FFR) has emerged as an invasive index, which can appropriately assess the physiological importance of an angiographic coronary lesion.³⁹ Thus, FFR has impacted the decision-making process by its ability to reclassify patients with SIHD. The Fractional Flow Reserve-Registre Français de la FFR (FFR-R3F) trial included 1075 patients in whom FFR was performed during diagnostic angiogram to ascertain its impact on the decision-making process for revascularization.⁴⁰ Reclassification of clinical management (ie, the difference between the final applied therapeutic strategy compared with the *a priori* determined strategy) occurred in 43% of patients. The use of FFR allowed clinicians to alter individual management in a significant portion of study patients. Thus, FFR may offer a cost-effective tool to allow for “angiographic reasonable IR” in surgical turndown cases with MVD.

In surgical turndown patients, when contemplating reasonable incomplete percutaneous revascularization, assessment of myocardial viability can and should play a pivotal role. Prior data favouring the assessment of viable myocardium in the setting of SIHD, notably those with reduced left ventricular ejection fraction, are limited by their retrospective nature and the bias of including only patients eligible for revascularization.⁴¹ The STICH trial, and more precisely its viability substudy, argues against the need for viability testing as the sole deciding factor to decide to revascularize patients with CAD with left ventricular dysfunction.⁴² However, this trial has also enlightened clinicians on how to identify patients with ischemic cardiomyopathy in whom revascularization will likely be beneficial (over optimal medical therapy) by stratifying patients based on 3 key prognostic factors (presence of 3-vessel CAD, ejection below 27%, and end-systolic volume index >79 mL/m²).⁴³ Conversely, both clinical guidelines and experts in the field have divergent perspectives on the usefulness of viability testing with or without ischemia documentation in the presence of SIHD, systolic dysfunction, and revascularizable coronary anatomy.⁴⁴ Nevertheless, if an SIHD patient with extensive CAD is deemed surgically ineligible, discerning hibernating or stunned myocardium from nonviable myocardium would lead to a more rational approach to percutaneous revascularization in this higher risk subgroup of patients. This would in effect limit potential PCI-related adverse effects such as contrast nephropathy and radiation exposure. Thus, complementing myocardial viability studies with FFR evaluation in surgical turndowns can lead to a safer, and potentially cost-effective, strategy of reasonable IR.

A Common Path Forward for Surgically Ineligible Patients

In daily clinical practice, the process of determining suitability (or not) for surgical revascularization is complex and

based on clinical judgement and a host of demographic factors. A key finding from the literature was that documentation of the process to ascertain surgical ineligibility was imperfect. In the NCDR database, when patients were deemed to be surgical turndowns, formal documented surgical assessment stating ineligibility was found in only 17% of patients. Otherwise, documentation sources to establish surgical candidacy were the catheterization report (21%), cardiology consult note (37%), and discharge summary (24%).⁹ This points to a process in which physicians taking care of very ill and potentially unstable patients such as patients with SIHD work in silos. Moreover, this archaic model is perpetuated by commonly used clinical risk scores (such as EuroSCORE or STS score or angiographic score such as the SYNTAX score and its variants), which provide but one side of the coin when faced with the complex, high-risk comorbid SIHD patient.

With greater value and emphasis put on patient-centred cardiovascular care, decisions regarding cardiac interventions should adopt an interdisciplinary approach.⁴⁵ This entails taking a Heart Team approach to the assessment of surgical eligibility for CAD.⁴⁶ Although at the centre of the Heart Team is an integrated process, prerequisite to dialogue is for clinicians to speak the same language. Few available tools can capture all the subtleties of clinical judgement or help bridge such a gap between noninvasive and interventional cardiologist and cardiac surgeons. However, the global risk score does offer a treatment algorithm cross-tabulating surgical risk and angiographic burden of CAD.⁴⁷ Serruys et al.⁴⁷ demonstrated that the EuroSCORE was more discriminant and allowed us to reclassify patients for revascularization appropriateness by adding incremental risk stratification from the SYNTAX score. Such an approach could serve as a template to establish new scores moving forward and integrating relevant risk factors in an overall Heart Team assessment of the patient with SIHD. As an example, we provide Figure 1, in which frailty is incorporated into an algorithmic assessment of revascularization candidacy according to procedural risk and CAD complexity.

A systematic approach will provide consistency, both prevent inappropriate and, conversely, contain unintended risk aversion from public reporting, and limit underutilization of revascularization when clinically relevant.^{48,49} Looking at the

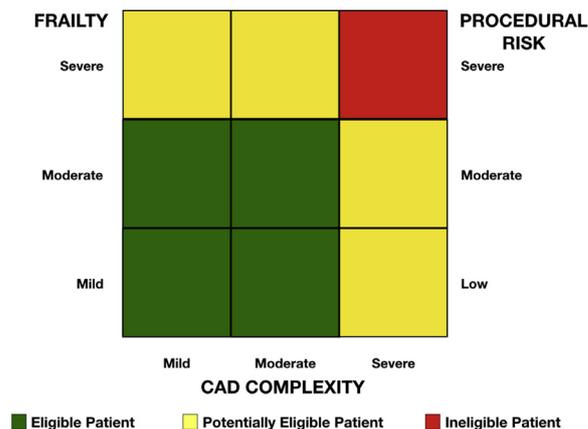


Figure 1. Interdisciplinary assessment of revascularization eligibility. CAD, coronary artery disease.

National Heart, Lung, and Blood Institute Dynamic Registry, Bortnick et al.⁵⁰ reported that despite greater CAD severity over time, revascularization was not likely offered to patients with SIHD especially if comorbidities increased. Patients with greater than 5 key comorbidities had a 40% to 60% mortality rate at 5 years.⁵⁰

This harkens back to the old adage that those who may benefit the most from revascularization might not be offered such an option (whether surgical or percutaneous). Revascularization techniques and thus strategies have evolved. With the advent of novel surgical techniques such as minimally invasive surgery (ie, MIDCAB robotic surgery), the patient with SIHD previously labelled too high risk could now be offered the benefit and advantages of a hybrid revascularization strategy.^{51,52} The ongoing Hybrid Coronary Revascularization trial ([ClinicalTrials.gov: NCT03089398](https://clinicaltrials.gov/ct2/show/study/NCT03089398)) funded by the National Heart, Lung, and Blood Institute will be investigating this strategy in MVD. In this prospective multicentre randomized trial with parallel assignment study design of 2354 patients, investigators will be comparing the effectiveness and safety of standard PCI for all diseased vessels relative to grafting of the LAD coronary artery using the left internal mammary artery combined to PCI for non-LAD lesions.

Nevertheless, absolute operative ineligibility does occur, but it does not preclude the use of percutaneous revascularization in the elderly, non-frail patient with SIHD. However, this does not automatically imply that PCI will be any safer. Contemporary PCI for the surgically ineligible has evolved, and now the concomitant use of mechanical cardiac assist devices has afforded the ability to proceed with safer interventions while bearing in mind that important periprocedural risks (eg, vascular injury) remain nonnegligible.⁵³ As pointed out by Kirtane et al.,⁵⁴ when revascularization is indicated in the higher risk patient, an integrated approach (factoring in comorbidities, surgical eligibility, complexity of CAD, and potential for haemodynamic compromise) can guide the Heart Team in choosing a revascularization strategy that will mitigate risk and favour procedural and clinical successes. Current data on the emerging concept of “protected PCI” remain controversial, but optimal percutaneous revascularization in the patient with complex CAD can be successfully performed when an integrated approach factors in proper case selection and operator to the learning curve of left ventricular support devices.⁵⁵

Finally, in the broader shared decision-making process adopted by any Heart Team, patient-centred care should be prioritized when proposing a revascularization strategy. In the highly morbid or gravely ill and potentially unstable surgical turnaround subgroup, patient preferences and values need to be taken into consideration as such patients might ultimately opt for different pathways of care (eg, regarding resuscitative measures and other end-of-life issues) either before or during interventions when complications might arise.^{56,57}

Conclusions

With the currently available data from registries and administrative datasets, surgical ineligibility remains associated with poorer clinical outcomes. As the general population grows older and comorbidities increase and clinical practice

patterns evolve, the prevalence and clinical demands of this subset of SIHD will likely increase.

Clearly defining criteria for surgical turn downs are required, as well as a comprehensive assessment of revascularization suitability. Ascribing the label of surgical turnaround has significant adverse prognostic implications.

The interdisciplinary Heart Team—based approach can appropriately manage the complexities related to revascularization in patients with SIHD with multiple comorbidities. Thus, an integrated Heart Team decision-making process represents the favoured path forward to ensure optimal care.

Disclosures

The authors have no conflicts of interest to disclose.

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