CHAPTER – 14

Frailty and Cardio-thoracic Surgery

Background:

Age over 70 years has been deemed to be a significant risk factor for mortality and morbidity in cardiac surgery in the past.[1] With the rising popularity of minimally invasive procedures for patients considered unsuitable for open surgery, the number of elderly people presenting for cardiac intervention is likely to climb in the coming years.[2,3] In recent years, biologic age, rather than chronological age, has emerged as a concept that may explain the variation in outcomes seen in senior patients after heart surgery and aid in the identification of susceptible elderly individuals who will benefit from novel intervention strategies.[4]

Although chronological age is integrally connected to frailty, it should not be used as the only indicator of surgical vulnerability or treatment futility. Frailty can also affect younger individuals. Frailty was found to be prevalent in those aged 18 to 34 years, 4% to 6% in those aged 35 to 49 years, 7% to 12% in those aged 50 to 64 years, and 8% to 20% in those aged 65 years, according to the Canadian Health Measures Study.[5] Because obese patients have greater metabolic reserve and can cope better with catabolic stimuli encountered in chronically advanced heart failure and acutely in cardiac surgery, we tend to link frailty with a low BMI.The "obesity paradox" is a term used to describe this situation.[6] Obese persons, however, can also be feeble, a condition known as "sarcopenic obesity".[7]

In-hospital mortality and significant morbidity are higher in frail patients, as are rates of institutional discharge and mid-term survival after cardiac surgery.There is now

adequate evidence to support the idea that frailty is a risk factor for poor cardiac outcomes. These patients must be pre-operatively assessed and the frailty score must be considered during treatment planning.

Risk scoring in cardiac patients:

The European System of Cardiac Operative Risk Evaluation (EuroSCORE) and the Society of Thoracic Surgeons (STS) score are routinely used to estimate cardiac surgical operative risk.[8, 9] Both of these scoring systems, on the other hand, ignore the patient's heightened physiologic susceptibility as a result of factors other than standard medical diagnosis and comorbidities. It has been proven that the EuroSCORE underestimates mortality at higher score levels of >13 and overestimates mortality at lower score levels of <6. [10]

Sündermann et al. proposed a Comprehensive Assessment of Frailty (CAF) score that took into account physical capacity, patient profile, Fried criteria, and laboratory results (Table 1).[11] The CAF score, as well as the EuroSCORE and STS scores, had a strong connection with observed 30-day mortality (area under receiver operating characteristic [ROC] curve 0.71).The CAF score, on the other hand, takes 10 to 20 minutes to complete, requires special equipment to measure grip strength, and may not be viable to include in a typical preoperative cardiac evaluation.[12] The CAF score was condensed into the simplified FORECAST (Frailty predicts mortality One year after Elective Cardiac Surgery test) score by the same authors, which incorporates the most highly predictive components of the CAF score and takes only 3 to 5 minutes to complete.

The FORECAST score outperformed the STS and EuroSCORE scores in predicting 1-year mortality risk (area under the ROC curve 0.76 vs. 0.67 and 0.67, respectively, for STS and EuroSCORE).[13] Afilalo et al. showed that

integrating frailty, disability, and risk scores offers a more complete method to predicting mortality or significant morbidity in older patients undergoing heart surgery.[14] When frailty and disability measurements were added to the model, it improved discrimination compared to using only the Parsonnet or STS scores (area under the ROC curve 0.73-0.76 v 0.68-0.72).[15]

Table 1
Comprehensive Assessment of Frailty Score

Fried Scale[26]	Unintentional weight loss
	Grip strength
	Endurance (ie, self-reported exhaustion using the Centre for Epidemiological Studies Depression Scale)
	Gait speed
	Physical activity (evaluation of 18 activities from the Minnesota Leisure Time Physical Activity Questionnaire)
Modified Physical Performance Test[27]	Standing static balance
	Chair rise
	Put on and remove a jacket
	Pick up a pen from the floor
	Turn 360 degrees
Clinical Frailty Scale[28]	Score from 1-7 determined by individual scoring the test (ranges from 1 [robust health]) to 7 [complete functional dependence on others])
Laboratory values	Serum albumin
	Forced expiratory volume in 1 s
	Serum creatinine
Body mass index score	< 18.5 in females and 19.5 in males

Table adapted from Frailty inCardiacSurgery Li YingKoh[16]

Mobility assessment using gait speed appeared to be the most sensitive single component of the frailty assessment in predicting post-discharge institutionalisation, disability, morbidity, and mortality, according to a systematic review by Kim et al examining frailty instruments for major and minimally invasive cardiac surgical procedures.[4] Multicomponent frailty indexes may improve these instruments' sensitivity in forecasting risk outcomes,

albeit at the cost of time and money. The Mini Mental State Examination, Katz Index of Independence in Activities of Daily Living, and Mini Nutritional Assessment, respectively, are used to test cognition, disability, and nutritional status.[17]

However, because these investigations are primarily single-center studies and the components assessed are quite heterogeneous, the biggest disadvantage of these frailty assessment tool studies is their lack of application to the broader cardiac surgery population. In their most recent edition of the adult cardiac surgery database, the Society of Thoracic Surgeons has incorporated 5-m gait speed as a diagnostic of frailty (Version 2.73). [18] The inclusion of a single, readily measured frailty metric is a step in the right direction, but it is not sufficient and does not represent the real impact of frailty on individual patient scores. Increased integration of frailty assessment into clinical databases and clinical risk scores for cardiac surgery patients will provide surgeons and their patients with critical risk information and aid in shared decision-making, as well as provide health economists with data to plan healthcare costs.

With the ageing cardiac surgery demographic, registries must contain frailty indicators to allow longitudinal monitoring of outcomes following intervention decisions in the frail older adult. Clinical trials must also collect frailty measures in order to spark comparative effectiveness research that compares the risks and benefits of therapies in frail versus non-frail patients. The goal is to ensure that patients not only survive but also thrive following cardiac surgery, with a good health-related quality of life and functional independence.A consensus on a precise and objective frailty scoring system has yet to be reached, and this is an area where more research is needed.

Frailty and cardiac surgery:

A prospective study by Lee et al. is one of the largest studies to assess frailty in cardiac surgery patients.[19] Frailty and clinical data were collected from 3,826 patients in one centre, including emergency and elective cardiac surgery cases. The Katz Index of Independence in Activities of Daily Living, an evaluation of independence in ambulation, and the presence or absence of dementia were all used to determine frailty. [20] Frailty was discovered in 4.1% of these patients, putting them at an elevated risk of in-hospital mortality, institutional discharge, and lower mid-term survival. These impacts of frailty were shown to be age-independent, according to the investigators.In a prospective cohort of 15,171 patients undergoing cardiac surgery (coronary artery bypass grafting [CABG] or valve surgery), Afilalo et al found similar results. In their investigation, a single measure of frailty, 5-m walking speed, independently predicted surgical mortality and the composite outcome of mortality or significant morbidity.[1]

The CAF score was applied to 400 patients aged 74 and older who were undergoing CABG or valve surgery, including transcatheter aortic valve implantation (TAVI).[13,21] The median CAF score of patients who died within a year was 16 (5-33) compared to 11 (3-33) for survivors. Patients who were not frail had a 4-percent 30-day mortality rate, compared to 8% and 26% for moderately and extremely frail patients, respectively. Despite significant variation in the frailty and post-operative outcomes criteria utilised in these studies, there is compelling evidence for a link between frailty and poor outcomes in heart surgery.[22]

Frailty appears to have negative consequences for advanced heart failure patients undergoing surgery to implant a left ventricular assist device. According to a recent systematic analysis, frail patients had a considerably longer time to extubation when their hospital stay was longer. Even though frailty did not predict short-term mortality, it did predict long-term mortality in this group of patients.[23]

Overall, a frail patient tends to have poor post-

operative outcome, however, the extent of post-operative complication depends upon the severity of the condition and the type of surgical procedure (Figure 1).

Figure 1: Three-strikes model of frailty and outcome of cardiac surgery[24]

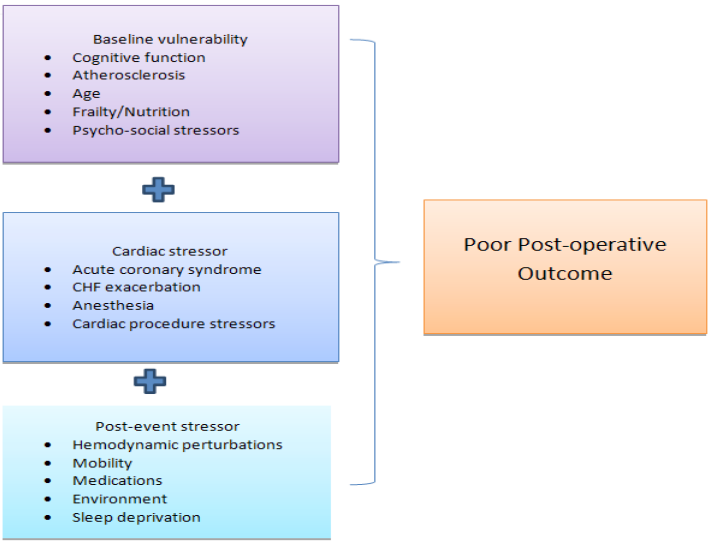

Image source: Arora RC, Djaiani G, Rudolph JL. Detection, prevention, and management of delirium in the critically ill cardiac patient and patients who undergo cardiac procedures. Can J Cardiol. 2017;33:80-7

'Defrailing' the patients prior to cardiac surgeries:

Aside from frailty tests, identifying at-risk frail persons, and weighing risk versus benefit in these patients, it's important to think about how frail patients might be better prepared for their surgery. Identification of frailty in elective patients may prompt the start of preoperative rehabilitation, or 'prehab' (Figure 2). A small pilot randomised controlled trial of prehab versus standard care, including exercise and education classes for 60 minutes/day, twice weekly for at least 4 weeks

versus standard care, was conducted for patients undergoing coronary artery bypass grafting and valvular surgery, building on the work of Arthur and colleagues.Although there were no changes in key clinical outcomes, participants in the prehab group had better walk distance and gait speed than those in the standard care group and were more likely to engage in cardiac rehabilitation.[25]

Figure 2: Infographic regarding frailty in the cardiac surgical setting[26]

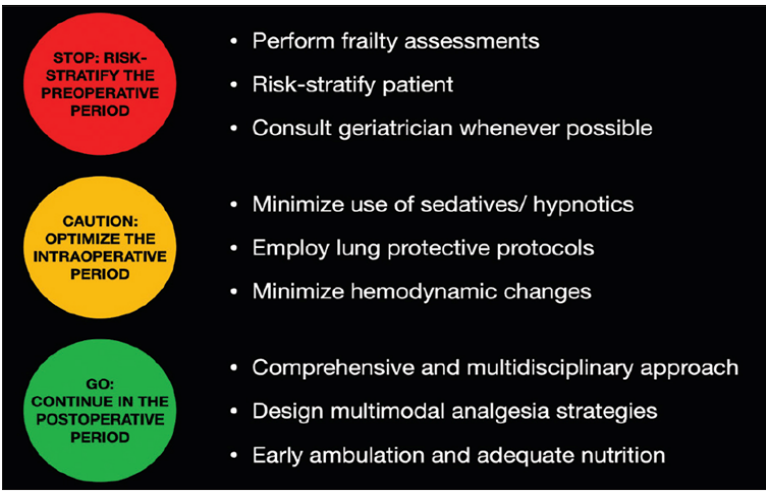

Image source: Shanker A, Upadhyay P, Rangasamy V, Muralidhar K, Subramaniam B. Impact of frailty in cardiac surgical patients—Assessment, burden, and recommendations. Ann Cardiac Anaesth. 2021; 24(2): 133.

Interdisciplinary team for frail patients:

Major practice guidelines in cardiology and cancer treatment, among other professions, have expressed interest in and support for the notion of Interdisciplinary Team–based care. A geriatrics consult for elective patients could assist identify vulnerable individuals, improve reversible frailty-related

preoperative patient features, and enable the team deliver better postoperative care for such patients. Physiotherapists, dietitians, and social workers may also be important components of the interdisciplinary team.[25]

Summary:

Frailty is linked to a number of negative outcomes, including increased hospital length of stay, use of medical resources, readmission rates, and mortality. In the management of frail cardiac surgery patients, prehabilitation may play a bigger role. Because the prevalence of frailty among cardiac surgery patients is expected to rise, multicenter trials to investigate management and therapy alternatives are needed. Until those trials are completed, high-volume surgical hospitals with competence in the management of frail patients may be the best option for frail heart surgery patients.

References:

1. Afilalo J, Eisenberg MJ, MorinJF ,etal. Gait speed as an incremental predictor of mortality and major morbidity in elderly patients undergoing cardiac surgery. J Am Coll Cardiol 2010; 56: 1668–76.

2. Benjamin EJ, Blaha MJ, Chiuve SE, etal. American Heart Association Statistics Committee and Stroke Statistics Subcommittee. Heart disease and stroke statistics—2017 update :A report from the American Heart Association. Circulation. 2017;135:146–603.

3. Afilalo J, KimS, O'Brien S, etal. Gait speed and operative mortality in older adults following cardiac surgery. JAMA Cardiol 2016; 1: 314–21.

4. Kim DH, KimCA, PlacideS, etal. Preoperative frailty assessment and outcomes at 6 months or later in older adults undergoing cardiac surgical procedures. Ann Intern Med. 2016;165:650–60.

5. O'Neill DE, Knudtson ML, Kieser TM, Graham MM. Considerations in cardiac revascularization for the elderly patient: age isn't everything. Can J Cardiol. 2016;32:1132-9.

6. Lavie CJ, Alpert MA, Arena R, Mehra MR, Milani RV, Ventura HO.

Impact of obesity and the obesity paradox on prevalence and prognosis in heart failure. JACC Heart Fail. 2013;1:93-102.

7. Zamboni M, Rossi AP, Corzato F, Bambace C, Mazzali G, Fantin F. Sarcopenia, cachexia and congestive heart failure in the elderly. Endocr Metab Immune Disord Drug Targets. 2013;13:58-67.

8. Lebreton G, Merle S, Inamo J,etal. Limitations in the inter-observer reliability of EuroSCORE: What should change in EuroSCOREII? Eur J Cardiothorac Surg 2011; 40: 1304–8.

9. Shahian DM, O'Brien SM, Filardo G,et al. The Society of Thoracic Surgeons 2008 cardiac surgery risk models: Part1—coronary artery bypass grafting surgery. Ann Thorac Surg. 2009; 88: 2–22.

10. Gogbashian A, Sedrakyan A, Treasure T. EuroSCORE: A systematic review of international performance. Eur J Cardiothorac Surg. 2004; 25: 695–700.

11. Fried LP, Tangen CM, Walston J, et al. Frailty in older adults: Evidence for a phenotype. J Gerontol A Biol Sci Med Sci. 2001;56:M146–56.

12. Rowe R, Iqbal J, Murali-Krishnan R, et al. Role of frailty assessment in patients undergoing cardiac interventions. Open Heart. 2014;1:e000033

13. Sündermann S, Dademasch A, Rastan A, et al. One-year follow-up of patients undergoing elective cardiac surgery assessed with the Comprehensive Assessment of Frailty test and its simplified form. Interact Cardiovasc Thorac Surg. 2011;13:119–23.

14. Afilalo J, Mottillo S, Eisenberg MJ, etal. Addition of frailty and disability to cardiac surgery risk scores identifies elderly patients at high riskof mortality or major morbidity. Circ Cardiovas Qual Outcomes. 2012;5: 222–8.

15. Parsonnet V, Dean D, Bernstein AD. A method of uniform stratification of risk for evaluating the results of surgery in acquired adult heart disease. Circulation. 1989;79:1.3–12.

16. Koh LY, Hwang NC. Frailty in cardiac surgery. J Cardiothorac Vasc Anesth. 2019; 33(2): 521-31.

17. Stortecky S, Schoenenberger AW, Moser A, et al. Evaluation of multi-dimensional geriatric assessment as a predictor of mortality and cardiovascular events after transcatheter aortic valve implantation. JACC Cardiovasc Interv. 2012;5:489–96.

18. Shahian DM, Jacobs JP, Badhwar V, Kurlansky PA, Furnary AP,

Cleveland Jr JC, Lobdell KW, Vassileva C, von Ballmoos MC, Thourani VH, Rankin JS. The Society of Thoracic Surgeons 2018 adult cardiac surgery risk models: part 1—background, design considerations, and model development. The Annals of thoracic surgery. 2018 May 1;105(5):1411-8.

19. Lee DH, Buth KJ, Martin BJ, et al. Frail patients are at increased risk for mortality and prolonged institutional care after cardiac surgery. Circulation. 2010;121:973–8.

20. Katz S. Assessing self-maintenance: Activities of daily living, mobility, and instrumental activities of daily living. J Am Geriatr Soc. 1983;31: 721–7.

21. Sündermann S, Dademasch A, Praetorius J, et al. Comprehensive assessment of frailty for elderly high-risk patients undergoing cardiac surgery. Eur JCardiothoracSurg2011;39:33–7.

22. Mejía OAV, SáM PBO, Deininger MO, et al. Off-pump versus on-pump coronary artery bypass grafting in frail patients: Study protocol for the FRAGILE multicentre randomized controlled trial. Braz J Cardiovasc Surg. 2017;32:428–34.

23. Tse G, Gong M, Wong SH, et al. Frailty and clinical outcomes in advanced heart failure patients undergoing left ventricular assist device implantation: A systematic review and meta-analysis. J Am Med Dir Assoc. 2018;19: 255–61.

24. Arora RC, Djaiani G, Rudolph JL. Detection, prevention, and management of delirium in the critically ill cardiac patient and patients who undergo cardiac procedures. Can J Cardiol. 2017;33:80-7

25. Yanagawa B, Graham MM, Afilalo J, Hassan A, Arora RC. Frailty as a risk predictor in cardiac surgery: beyond the eyeball test. J Thorac Cardiovasc Surg. 2018; 156(1): 172-6.

26. Shanker A, Upadhyay P, Rangasamy V, Muralidhar K, Subramaniam B. Impact of frailty in cardiac surgical patients—Assessment, burden, and recommendations. Ann Cardiac Anaesth. 2021; 24(2): 133.