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Assessment of the High-Risk Patient in Interventional Radiology – Part 2

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Functional Capacity

Preoperative functional capacity is an important and useful tool in building a picture of the patient's co-morbid state and their potential risk of mortality and morbidity post-operatively. Assessment of this can be done in both a subjective and objective manner ranging from a set of informal questions to a well recognised index system such as the Duke Activity Status Index (DASI) to comprehensive testing through cardiopulmonary exercise testing[1].

Traditionally functional capacity has been assessed in a fairly informal way by the physician or anaesthetist asking about their ability to climb stairs or the distance they can walk on level ground. This can be used to estimate metabolic equivalents.

One metabolic equivalent (MET) is defined as the amount of oxygen consumed while sitting at rest and is equal to 3.5 ml O2 per kg body weight x min[2]

General consensus believes that a METS >4 shows reasonable functional capacity and thus less than 4 poor functional capacity. Though quick and easy, this method is subjective and crude. A recent prospective multi-centre study, showed that when anaesthetists' were asked to assess functional capacity into either poor (less than 4 metabolic equivalents), moderate (4–10 metabolic equivalents) or good (more than 10 metabolic equivalents), a poor correlation was found with subjective CPET and concluded that estimating metabolic equivalents should not be used to assess functional capacity. Instead either DASI or CPET should be used[1].

This subjective approach has essentially been formalised into the '6 Minute Walk Test', which measures the maximum distance walked in 6 minutes. Similarly the 'Incremental Shuttle Walk' (ISWT) has also been developed as an active measurement tool for functional capacity. The ISWT involves the patient walking a set distance between 2 cones or a 'shuttle' (in total 10m distance) at an incremental pace till they can no longer complete the distance. The total number of shuttles are recorded. This benefits of both these tests is that they are simple and easy to set up and conduct and measure both baseline and rehabilitated functional capacity. Both have been used in pulmonary rehabilitation programs[3].

The Duke Activity Status Index is a 12 item scale developed to assess functional capacity. The self administered questionnaire uses a weighted value on each question to give a score ranging from 0 to 58.2[4]. The higher the score the better the functional capacity. Nested cohort analysis from the METS study showed a self reported DASI score of 34 or more to be associated with a reduced risk of death and myocardial injury at 30 days and a reduced risk of death or new disability at 1 year[5].

The overall aim of assessing functional capacity is to assess the bodies ability to deliver oxygen to muscle when the demand is increased. Cardiopulmonary exercise testing is a sophisticated way to measure multiple parameters and combine these measurements to give functional capacity. Key measurements such as VO2peak and anaerobic threshold, as well as ECG changes, cardiac, and ventilatory function can be used to help prognosticate high-risk patients. A low anaerobic threshold (AT < 11 ml O2 kg^{-1} min^{-1}) in particular has been shown to be associated with poor post-operative outcomes. The drawback to CPET is the labour intensive nature of setting up, running and reporting these tests. A CPET machine, together with trained staff are required to run the cardiopulmonary exercise test[6].

Simple tools such as the DASI score, the incremental shuttle walk or the 6 minute walk test have shown good correlation with maximum oxygen consumption on CPET. Negative predictive values are less accurately predicted and a disproportionately higher volume of patients are classified as poor or low functional capacity[5].

Biomarkers

As a risk stratification tool, biomarkers are limited to assessing cardiac dysfunction. There are few, well evidenced biomarkers that can assist in risk stratification either before or after surgery. The most commonly used biomarker is pro-BNP a natriuretic peptides released by cardiac myocytes on ischaemic conditions or stretching of the ventricular wall. Pre-operatively, current practise sees pro-BNP measurement used as a decision making tool for further cardiac investigation such as echocardiogram. Helping to decipher between

symptoms such as shortness of breathe being cardiac or respiratory in origin. Pro-BNP has also been used extensively in vascular surgery and been found to have strong correlation with post-operative cardiac complications[7]. Some interest has been also been shown in developing C-reactive protein (CRP) and troponins (Tns) as pre-operative biomarkers. However, evidence has not shown a strong and consistent association with post-operative complications. CRP is associated with pathophysiology that is inflammatory in nature and has not proven to be superior to pro-BNP[8].

Summary

The scope and complexity of interventional radiology continues to grow and expand, which means that the cohort of patients coming through will be more of a challenge both radiologically and medically. Its is crucial, therefore, to start incorporating clinical risk prediction into assessment of the interventional radiology patient. This article has touched on some of the common instruments for risk stratification that are clinically used but there are numerous assessment tools developed and validated for assessing risk. Most of the studies, however, have been designed in single centres and only a few validated in multiple centres, improving their generalisability. When considering the most appropriate tool to use, accuracy is balanced against ease of use. The P-Possum score has consistently shown accuracy but has 18 questions on both pre-operative and intra-operative parameters and thus difficult to implement in the pre-operative setting. Currently, there is no such tool developed for patients undergoing interventional radiology procedures under general anaesthetic.

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