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Assessment of the High-Risk Patient in Interventional Radiology – Part 1

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Introduction

The cohort of patients that come to interventional radiology are on a spectrum of fit and well patients having minor procedures to high risk patients that are almost considered too high risk to have major surgery. Though interventional radiology (IR) offers a minimally invasive way to treating major conditions, it is not without risk.

This article is the first in a series discussing what this risk looks like for adult patients undergoing IR procedures, particularly under general anaesthesia and some of the ways too quantify and stratify this risk. Key points in history and examination, together with appropriate investigations and specialist input, remains the cornerstone of this process. Supported by dedicated scoring systems, enables a complete and objective perioperative assessment and strong platform for discussion and shared decision making.

Understanding Risk

Risk refers to the probability of an adverse outcome following a surgical operation or procedure. Currently there is no test that can accurately predict risk but there are some ways to help estimate it. If you consider the patient's comorbidities, the impact of the surgical insult and results of the appropriate biomarkers and scoring systems you can start to build a picture of potential complications during and after the procedure.

Surgical Related Factors

What does risk and the high risk patient look like in interventional radiology? A large proportion of work done in IR is on patients considered too high risk for major surgery. This is referring to the risk related to the surgical insult. Normally, major surgery would mean a large cytokine release and subsequent inflammatory cascade causing clinical features similar

to a 'Systemic Inflammatory Response Syndrome' (SIRS). This can manifest into single organ or multi-organ dysfunction[1].

The benefit of interventional radiology is that it offers a minimally invasive alternative to some surgical procedures which may reduce the physiological stress on the patient during the procedure and thus limit the severity of systemic inflammatory response stimulated. Though this does not take away all risk, it should significantly reduce it.

Patient Related Factors

Comorbidity

A lot of research has been conducted looking at the impact of various comorbidities on surgical outcomes. In particular advancing age[2], diabetes mellitus[3], renal impairment and cardiac failure[4,5] to name but a few. In recent years, a number of different methods of predicting perioperative risk have been developed which attempt to take into consideration the contributions of all the different risk factors which patients might have; these include risk stratification tools, measures or estimates of functional capacity, and biomarkers. Each of these will now be discussed in turn.

Table 1. Outcome by comorbidities[6]. Data from a UK prospective audit of 13 513 patients having inpatient surgery, March 1–7, 2010 (several patients had more than one comorbidity)

Comorbidity	30-day mortality (%)	Number of patients with comorbidity
Respiratory disease	3.7	1810
Ischaemic heart disease	3.8	1457
Cancer	3.8	1417
Arrhythmia	5.7	1029
Diabetes (non-insulin)	2.9	1005
Cerebrovascular accident	4.4	591
Diabetes (insulin)	4.1	386
Congestive cardiac failure	8.2	243
Documented cirrhosis	8.9	123

Cardiac Morbidity

Multiple studies and research has gone into looking at the risks associated with cardiac disease and cardiac morbidity. In vascular surgery, cardiac complication rates have been shown to be as high as 13.5%[7]. This has led to a comprehensive set of guidelines from the

American College of Cardiology / American Heart Association (ACC/AHA) on cardiovascular preoperative assessment. ACC/AHA guidelines recommend a stepwise approach to pre-operative investigation of cardiac disease, based on the presence of clinical risk factors, the patient's functional capacity and the severity of the proposed surgical intervention. Using the Duke Activity Status Index to determine if a patient is at high risk of cardiac morbidity then any choice of simple non invasive investigation can help to determine what that risk looks like. The most important consideration after investigating patients' cardiac health is what, if anything, can be done to optimise these patients prior to surgery. Unstable angina, significant heart failure or poorly controlled atrial fibrillation can be managed with pharmacological intervention, any percutaneous intervention has shown mixed benefit. Any optimisation programme is likely to take 3 to 6 months and therefore needs to be weighed up against the urgency of surgery[8].

Patients often require urgent treatment in interventional radiology and therefore delay is unlikely. However, by assessing patients cardiac morbidity it allows a frank discussion about risk and appropriate intra-operative and post-operative provisions.

The most common cardiovascular insult patients suffer with is hypertension. This is especially so in patients coming for vascular and renal procedures. The link between hypertension and peri-operative harm is well documented but the pressure at which this translates to risk is less well defined. Poorly controlled hypertension increases the likelihood of target organ damage, which in itself can increase peri-risk of morbidity and mortality. For patients with stage 1 or 2 hypertension and no suggestion of target organ damage, there is little evidence that controlling blood pressure pre-operatively will mitigate risk but for stage 3 or 4 hypertensives the guidelines suggest keeping pre-operative blood pressure below 180/110mmHg[9].

Table 2. Categorisation of the stages of hypertension[29]

Category	Systolic Blood Pressure; mmHg	Diastolic Blood Pressure; mmHg
Stage 1	140-159	90-99
Stage 2	160-179	100-109
Stage 3	180-209	110-119
Stage 4	>210	>120

Endocrine Morbidity

Nearly 4 million people are diagnosed diabetic in the UK and make up nearly 18% of the surgical population in hospitals[10]. All evidence points to an increase in morbidity and mortality of poorly controlled diabetics with perioperative mortality increased by as much as 50%. This increased mortality is multifactorial, from their poly pharmacy of medications, the associated diabetic complications and increased risk of infection[11].

'The Working Party supports the consensus advice published in the 2011 NHS Diabetes guideline that the HbA1c should be < 69 mmol.mol1 (8.5%) for elective cases'[11].

A panel of experts believed that an HbA1c of 8.5% should be used as a cut off for diabetic control and surgery. Of course this must be considered in respect to the urgency of surgery. But utilising any available time to optimise blood glucose control is beneficial and though diabetic management is outside the scope of anaesthetist and interventional radiology, liaising with the diabetic team is vital. Available resources such as the 'Diabetes passport' is also a comprehensive overview of baseline[12].

Renal Morbidity

Chronic kidney disease is classified as an estimated glomerular filtration rate of <60 ml min^{-1} 1.73 m^{-2} for 3 months or more[13]. Studies have repeatedly shown that pre-existing renal dysfunction is associated with an increased risk of morbidity and mortality, especially post operative cardiac morbidity. Both Lee's index and the euro score have identified pre-operative raised creatine as an independent risk factor for post-operative complications.Equally the occurrence of acute kidney injury post-operatively correlates with reduced long term survival[14].

In interventional radiology, we may treat these patients for vascular access, fistuloplasty and thrombectomy. Vascular patients needing angioplasty often have a degree of renal impairment. Chronic kidney disease by nature has little reversibility to it and therefore little opportunity to optimise patients with their kidney function. For patients in interventional radiology the added insult of contrast can potentially cause further deterioration of kidney function. This all needs to be considered when planning patients care in IR[15].

Table 3. Classification of CKD. Adapted from: Joint Specialty Committee on Renal Medicine of the Royal College of Physicians and the Renal Association, and the Royal College of General Practitioners. Copyright © 2006 Royal College of Physicians. Adapted with permission

Stage 1: Normal GFR; GFR ≥90 ml min−1 1.73 m−2 with other evidence of chronic kidney damage*
Stage 2: Mild impairment; GFR 60–89 ml min−1 1.73 m−2 with other evidence chronic kidney damage*
Stage 3: Moderate impairment; GFR 30–59 ml min−1 1.73 m−2
Stage 4: Severe impairment; GFR 15–29 ml min−1 1.73 m−2
Stage 5: Established renal failure: GFR <15 ml min−1 1.73 m−2 or on dialysis

*The 'other evidence of chronic kidney damage' may include: persistent microalbuminuria; persistent proteinuria; persistent haematuria, after exclusion of other causes, e.g. urological disease; structural abnormalities of the kidneys demonstrated on ultrasound scanning or other radiological tests, e.g. polycystic kidney disease, reflux nephropathy; biopsy-proven chronic glomerulonephritis

Frailty, Delirium and Cognitive Impairment

Post operative delirium is an acute confusional state that often has a degree of reversibility and can be fluctuating in nature. Post operative cognitive dysfunction (POCD), on the other hand, can develop later and is less well understood, with evidence that in some cases can become permanent.[16]

Risk of developing delirium includes advancing age, significant comorbidities and dementia whilst the mechanism by which POCD develops is less clear. This may be influenced by a number of factors such as inflammation, microvascular disease and increasing age. The baseline prior to surgery can be mild or significant cognitive dysfunction, though unless the patient is diagnosed with dementia may not be measured[17].

Is delirium a significant risk factor for POCD? A recent study in Anesthesiology suggests that post operative delirium and longer term POCD do not correlate and may in fact be different disorders altogether.[18]

Frailty refers to a "distinctive health state related to the ageing process in which multiple body systems gradually lose their in-built reserves". In the over 65 year olds, there is an incidence of about 10% which rises to between 25 to 50% in the over 85 year olds. The

clinical impact of frailty have less favourable outcome in almost all studies compared to the non-frail group, with studies showing longer hospital stays, higher readmission rates, and decreased survival rates.[19]

Risk Stratification Tools

Together with history and examination, appropriate investigations and utilisation of assessment tools can provide a complete picture of perioperative risk and guide discussion of this with patients.

ASA: One of the most commonly used risk stratification tools is the American Society of Anaesthesiologists' Physical Status Score (ASA-PSS). First reported in 1948, it is a simple categorical numbered scale (I-V) validated for categorisation of population risk. This has not, however, been validated in predicting individual risk and suffers from wide inter-observer variability.[20,21]

POSSUM: Physiological and Operative Severity Score for the enUmeration of Mortality and Morbidity or POSSUM Score was developed by Copeland et al in 1991 and has since been used by almost all surgical groups as a risk-prediction tool for morbidity and mortality[22]. It goes beyond the simplified grading of ASA by using physical and operative variables to provide patient specific risk. There are some subjective parameters such as jugular venous pressure, which can lead to variability and some parameters that are only available during or after the surgery. The Portsmouth modification, P-POSSUM, uses the same dataset but analyses it using linear instead of logistic regression and has been shown to be equivalent if not superior in predicting mortality. Further surgery specific variants such as Cr-POSSUM have also been validated.[23,24]

SORT score: SORT score is a pre-operative risk prediction tool for death within 30 days of surgery. It has been developed and validated for use in adult inpatient non-neurological, non-cardiac surgery (aged 16 or over)[25]. The benefit of this online tool is that with only six variables it is simple, easy and quick to complete and can be used pre-operatively. Recent modifications include the addition of operators suspicion of risk as well.

STOP-Bang: Snoring, tiredness, observed apnoea, high blood pressure, body mass index, age, neck circumference and male gender (STOP-Bang) questionnaire was developed as an easy and simple tool for screening for obstructive sleep apnoea. It consists of eight dichotomous (yes/no) items related to the clinical features of obstructive sleep apnoea, with a score range of 0 to 8. As the STOP-Bang score increases from 0 to 2 and up to 7 to 8, the probability of moderate to severe OSA increases from 18% to 60%. The sensitivity of STOP-

Bang score ≥ 3 to detect moderate to severe OSA (apnea-hypopnea index [AHI] > 15) and severe OSA (AHI > 30) is 93% and 100%, respectively. Corresponding negative predictive values are 90% and 100%.[26]

Mini-cog: The mini cog is a cognitive screening tool that has been suggested as a possible detection tool for dementia and cognitive impairment. A systematic review in 2015 showed it to be comparable to the mini mental state examination in identifying patients with dementia[27]. This 3 minute examination consists of 2 parts, word recall and clock drawing. Though this widely used in both general and hospital setting, a Cochrane review found it to have a sensitivity and specificity of 76% and 73% respectively[28]. This would mean that around 24% of patients will either be diagnosed incorrectly or diagnosis missed using the mini-Cog. Like many screening tools it forms part of a wider picture built up using history, examinations, investigations and clinical acumen.

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