

Frailty and surgery

Surgery in people aged over 65 years has led to many postoperative gains, although mortality and morbidity is higher than in younger counterparts. The problem is the vulnerability that comes with age, so these patients with complex needs require multidisciplinary care for the best outcomes.

As the population ages, the proportion of older people undergoing surgery is increasing rapidly, mainly as a result of the higher prevalence of surgical conditions as people age, the increase in surgical and anaesthetic techniques and patient expectations (Klopfenstein et al, 1998; Etzioni et al, 2003; Partridge et al, 2012). Despite decreases in adverse postoperative outcomes in older people (Goldstein et al, 2010; Kurian et al, 2010), they still represent a higher proportion of adverse outcomes than their younger counterparts, attributed mainly to the higher rate of medical complications in the former (Leung and Dzankic, 2001; Polanczyk et al, 2001; Hamel et al, 2005).

While age is a significant predictor of surgical outcome (Daskivich et al, 2013), the distinction existing between chronological age and physiological age means that age alone does not provide a complete risk/benefit picture in preoperative assessment. The decline and vulnerability associated with ageing captures the importance; actually, chronological age becomes less strongly associated with mortality after adjusting for other demographic and health characteristics (Fried et al, 1998). Comorbidity has also been linked to poor surgical outcome (Barnett et al, 2012; Roche et al, 2005) and frailty has emerged as a risk factor to be considered (Makary et al, 2010; Hewitt et al, 2015). Both frailty and comorbidity increase with age, so older people should be properly risk assessed before surgery. However, a national UK report from the National Confidential Enquiry into Patient Outcome and Death has shown a deficiency of care provided to this group. This report noted that frailty was not factored into risk assessment and optimal planning of care, and went on to reiterate that comorbidity, frailty and disability need to be recognized as independent risk factors in the elderly patient undergoing surgery (Wilkinson et al, 2010).

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Predicting risk for elderly surgical patients is not straightforward and the available tools, despite their strengths, have their weaknesses; most focus on single organ systems or a solitary event, or are established from clinical trials that excluded the elderly population (Kim et al, 2014). As part of the surgical risk assessment and of a collaborative approach between specialties, the British Geriatric Society advocates that older surgical patients be risk assessed using not only established tools as the American Society of Anaesthesiology (ASA) classification system and Physiological and Operative Score for the enumeration of Mortality and Morbidity (POSSUM), but also objective measures such as the comprehensive geriatric assessment and frailty assessment. The comprehensive geriatric assessment, being a systematic, multidimensional assessment that focuses on somatic, psychological, functional and social factors, improves diagnostic accuracy and provides a personalized approach to patient care. In this light, the first risk prediction score to use frailty as a predictor, and based on comprehensive geriatric assessment, was developed in July 2014 (Kim et al, 2014). This multidimensional frailty score predicted all-cause mortality with a sensitivity of 84.0% and a specificity of 69.2%.

Surgical stress

Physical and psychological post-surgical stress can have profound effects on the patient, leading to imbalance in autonomic, endocrine, metabolic and immune functions. Such imbalance is not just age related, but also depends on the patient's preoperative physiological state and the type of surgery.

As a surgical response, there is a hypothalamic activation of the sympathetic autonomic nervous system by afferent neural input from the injured area leading to secretion of adrenaline from the adrenal medulla and noradrenaline from the presynaptic nerve endings (Kehlet, 1997). These neurotransmitters, with direct action on the myocardium and vasculature, can cause tachycardia, hypertension and potentially dysrhythmias. In susceptible hearts, these could lead to myocardial ischaemia as oxygen demand by the myocardium might outstrip supply. There is also a direct activation of the cardiac sympathetic nerves leading to coronary vasospasm,

with a potential worsening of cardiac ischaemia. Also, catecholamines, which can lead to a hypercoagulable state, add to the potential of an increased coagulation burden on a susceptible heart.

Noradrenaline spills into the circulatory system which also causes modification of the functions of the kidneys, adrenal cortex, pancreas and liver. Renin is released from the kidneys causing the conversion of angiotensin I to angiotensin II. The latter stimulates production of aldosterone which causes sodium reabsorption from the distal convoluted tubules (Burton et al, 2004). In the pancreas, glucagon is released leading to the breakdown of glycogen in the liver and muscle, which causes increased levels of glucose and lactate and also an increase in free fatty acids mobilized from available fatty stores.

The hypothalamic–pituitary–adrenal axis, activated by the afferent nerve input, leads to the production of growth hormone and adrenocorticotrophic hormone. Apart from stimulating protein synthesis, lipolysis, glycogenolysis in the liver and inhibiting protein breakdown, growth hormone also has an anti-insulin effect by inhibiting glucose uptake and use by cells. Adrenocorticotrophic hormone, on the other hand, stimulates cortisol release from the adrenal cortex that promotes protein breakdown and lipolysis. This cortisol release starts just a few minutes after the onset of surgery and rises rapidly. Also the usual negative feedback fails so levels of adrenocorticotrophic hormone and cortisol become quite high (Burton et al, 2004).

The overall picture of the stress response on glucose metabolism is one of hyperglycaemia resulting from an increase in glucose production and a reduction in glucose utilisation. Cortisol and catecholamines are important in this as they promote glycogenolysis and gluconeogenesis and this hyperglycaemia is poorly regulated by the initial failure of insulin secretion (as a result of the α_2 -adrenergic inhibitory effects of catecholamine) followed by late occurrence of insulin resistance (as a result of a defect in the insulin receptor/intracellular signalling pathway). The level of hyperglycaemia reflects the severity of the surgery and the effect of the consequent complications. Glucose concentrations above 12 mmol/litre could lead to impaired wound healing and increased infection rate.

Protein metabolism is also affected. There is an initial inhibition of protein anabolism followed by increased protein catabolism if the stress response is extensive. This protein catabolism is enhanced by increased levels of cortisol and cytokine concentrations and can be quite severe in some major abdominal surgeries, leading up to as much as 0.5 kg loss of lean body mass per day. This is mainly skeletal muscle, although visceral muscle protein may also be catabolised to release essential amino acids. The amino acids released are used to form acute phase proteins in the liver. Albumin production is reduced, however, leading to hypoalbuminaemia with the consequent problems in maintenance of extracellular volume.

Frailty

Most people conceptualize a person with frailty as weakened, enfeebled and emaciated. While this might be true in some cases, it does not depict the whole picture. There has been a lot of debate on what it is, but it can best be defined as a condition, or syndrome, which results from multi-system reduction in reserve capacity to the extent that a number of physiological functions are close to or past the threshold of clinical organ failure (Campbell and Buchner, 1997). This distinguishes frailty from comorbidity and disability. Although the three may co-exist in the same person, there are about 20% of older people living with frailty without comorbidities or disability (e.g. inability to perform one or more activity of daily living). In frailty, an insult (infection, falls, surgery, new medication) leads to a disproportionate change in the patient's health state (increased dependence, confusion, falls, poor mobility, hospitalization, institutionalization and death). Over time, these patients respond less well to these stresses, especially surgical stress.

Epidemiology

Frailty increases substantially with age and is particularly higher in subjects older than 80 years. Around 10% of people aged over 65 years in the community have frailty, rising to between a quarter and a half of those aged over 85 years and is more prevalent in women (9.6%) than men (5.2%) (Clegg et al, 2013). Out of the approximately 400 000 care home residents in the UK, the majority are deemed frail and about 27% of patients in surgical wards have either mild, moderate or severe frailty (McCarthy et al, 2014; Hewitt et al, 2015).

Frailty models

There are two main models of frailty, the frailty phenotype and the cumulative deficit models. The frailty phenotype, developed using data from the Cardiovascular Health Study of four communities in the USA (Fried et al, 2001), define frailty as a clinical syndrome in which three or more of the following five parameters are present:

1. Unintentional weight loss (>5%/year)
2. Self-reported exhaustion (3–4 days/week or most of the time)
3. Low physical activity or low level expenditure
4. Slow gait speed
5. Weak grip strength.

If only one or two parameters are present, the patient is said to be pre-frail. The central feature of this model is the loss of skeletal muscle function (sarcopenia) and there is growing evidence for the varied causes of this.

The cumulative deficit model of frailty, on the other hand, assumes an accumulation of deficits which can increase with age and which combine to give the frailty index (Rockwood et al, 2002). These deficits, which must have increasing frequency with age, lead to a worse outcome and not saturate easily, range from symptoms like loss of hearing or low mood, through signs such as

tremor, through to various diseases such as dementia. Put simply, the frailty index is the ratio of deficits present to the total number looked for: so 10 deficits out of a possible 36 looked for will give a frailty index of 10/36 (0.28). This model is broader than the phenotype model in defining frailty as it encompasses comorbidity and disability as well as cognitive, psychological and social factors.

Measuring frailty

Frailty measurement is more feasible preoperatively for elective surgeries and less so for emergency ones. However, this is set to change with the introduction of the electronic frailty index using information from the general practice database (Clegg et al, 2014).

There are numerous validated tools for the measurement of frailty. They are either scoring systems based on various aspects of physical, cognitive or functional capability (Fried et al, 2001; Rolfson et al, 2006; Rockwood and Mitnitski, 2007; Ravaglia et al, 2008; de Vries et al, 2011) or single surrogate measures based on assessment of functional status. These surrogate measures include gait speed (abnormal if it takes more than 5 seconds to walk 4 metres on the flat) (Afilalo et al, 2010), the timed-up-and-go test (abnormal if it takes more than 10 seconds to get up from a chair, walk 3 metres, turn, walk back and sit on the chair) and grip strength. They are simple enough to use in busy clinical settings and can define frailty and the patient being 'at risk' of poor surgical outcome (Klidjian et al, 1980), but do not point the clinician to areas of frailty modification.

However, frailty measurement in the older surgical patient should be undertaken in light of the two main reasons for the preoperative identification of frailty: risk stratification and identification of factors for potential modification. In this light, the Edmonton Frail scale is recommended for its brevity and clinical feasibility, and has aspects that are amenable to preoperative optimization (medication review, cognition, nutrition or pre-emptive provision of social support) (Rolfson et al, 2006; Dasgupta et al, 2009). This scale is easy to administer, and is available as an iPhone/iPad and Android app.

Frailty and surgery

It has been known for many years that some older people lack the physiological reserves to withstand surgery. However, there was a lack of standardized definitions for this vulnerability. Frailty has advanced this science as many studies have demonstrated that increasing frailty has worsening outcomes in terms of postoperative complications, increased length of stay, mortality and inability to be discharged home (Dasgupta et al, 2009; Makary et al, 2010; Ganapathi et al, 2014; Sepelhi et al, 2014). A 2014 study in Alberta, Canada looked at both the short-term and long-term postoperative outcome of frail and non-frail patients (Bagshaw et al, 2014). While in the short term it confirmed the link between frailty and poor surgical outcome, it also showed that this effect lasts long term. For the people who survived the surgery and intensive

care unit stay, frailty was associated with a mortality of 48% *vs* 25% for non-frail patients 12 months later and only 15% of the frail patients who lived independently preoperatively were still living independently at 12 months.

From frailty studies, it is now believed that the phenomenon where some older people have worse postoperative outcome is the result of a phenotype that identifies those with decreased physiological reserves in multiple organ systems. As seen above, this phenotype has been associated with dysregulation in many physiological systems including a generalized inflammatory state, dysregulated cortisol, altered heart rate variability, and changes in immune status and hormonal status way above the normal stress response. This all relates to a vicious cycle of dysregulated energetics that has the potential to spiral down with poor control mechanisms (Fried et al, 2001).

This ability to adapt to surgical stress is not only dependent on the degree of frailty but also the type of surgery, which is a stronger influence on outcomes after major surgery than minor surgery (Makary et al, 2010).

The decision to operate on an older person, therefore, is one that should be taken with careful considerations. For despite the worsening outcome demonstrated in older people living with frailty, there have equally been dramatic postoperative functional gains demonstrated in the most disabled of them (Brander et al, 1997; O'Toole et al, 2002). An understanding of frailty is therefore necessary for the better selection of patients, an understanding of the preoperative risk and an appropriate discussion of risk/benefit to patients and their families.

Can frailty be modified?

Although frailty is dynamic, the natural tendency among community dwelling older people is for it to get worse rather than better (Gill et al, 2006). However, individuals have been known to become less frail spontaneously. There is evidence showing that exercise (progressive resistance training and strength) and nutrition can impact positively on frailty; they form the basis of prehabilitation and this strategy has been shown to reduce postoperative complications (Valkenet et al, 2011; Pouwels et al, 2014).

The role of nutrition is becoming clearer, particularly protein, calories and micronutrients. Preoperative replacement of vitamin B₁₂, folate, iron and vitamin D (in vitamin D-depleted patients) improves outcome.

Overall, a preoperative comprehensive geriatric assessment is the best strategy for optimizing older people for surgery and also reducing adverse postoperative outcome (Partridge et al, 2014). The use of preoperative comprehensive geriatric assessment, incorporating predictions of adverse outcomes combined with target interventions, is the basis of the Pro-Active Care of Older People Undergoing Surgery (POPS) model in Guy's and St. Thomas Hospital in London, and this model has shown great improvement in postoperative outcome

(Harari et al, 2007). The success of the POPS model, with involvement of physicians specialized in medicine for the elderly, adds to the evidence of improved patient outcome when these physicians work in collaboration with surgeons in managing older hip fracture patients (British Orthopaedic Association, 2007). This strengthens the argument that management of older patients is better using a multidisciplinary approach including surgeons, intensivists, anaesthetists and physicians specialised in medicine for elderly and others.

Preoperative optimization, however, should be balanced against the risk of delaying surgery to achieve this. In emergency situations, for instance hip fracture or emergency laparotomy, a delay could lead to worse postoperative outcome suggesting that such optimization and surgery should go on simultaneously (Stoneham et al, 2014).

Conclusions

Frailty has emerged to explain the vulnerability that has been witnessed in some older surgical patients. Its recognition is therefore important pre-surgery for proper risk categorization and institution of appropriate measures to optimize older people before surgery and continuous management post-surgery. Although there are already validated tools for this recognition, this would be made easier still by the introduction of the electronic frailty index based on the general practice database.

As older patients present with complex needs, the provision of continuous, coherent quality care requires a close working with a multidisciplinary team comprising of GPs, emergency medicine doctors, surgeons, elderly medicine physicians, anaesthetists and intensivists.

While much is now known about frailty, there is need for more research in this field, particularly on measures that could change outcome. **BJHM**

Conflict of interest: none.

Afilalo J, Eisenberg MJ, Morin JF et al (2010) Gait speed as an incremental predictor of mortality and major morbidity in elderly patients undergoing cardiac surgery. *J Am Coll Cardiol* **56**(20): 1668–76 (doi: 10.1016/j.jacc.2010.06.039)

Bagshaw SM, Stelfox HT, McDermid RC et al (2014) Association between frailty and short- and long-term outcomes among critically ill patients: a multicentre prospective cohort study. *CMAJ* **186**(2): E95–102 (doi: 10.1503/cmaj.130639)

Barnett K, Mercer SW, Norbury M, Watt G, Wyke S, Guthrie B (2012) Epidemiology of multimorbidity and implications for health care, research, and medical education: a cross-sectional study. *Lancet* **380**(9836): 37–43 (doi: 10.1016/S0140-6736(12)60240-2)

Brander VA, Malhotra S, Jet J, Heinemann AW, Stulberg SD (1997) Outcome of hip and knee arthroplasty in persons aged 80 years and older. *Clin Orthop Relat Res* **345**: 67–78

British Orthopaedic Association (2007) *The Care of Patients with Fragility Fracture*. British Orthopaedic Association, London

Burton D, Nicholson G, Hall G (2004) Endocrine and metabolic response to surgery. *Continuing Education in Anaesthesia, Critical Care & Pain* **4**(5): 144–7 (doi: 10.1093/bjaceaccp/mkh040)

Campbell AJ, Buchner DM (1997) Unstable disability and the fluctuations of frailty. *Age Ageing* **26**(4): 315–18 (doi: 10.1093/ageing/26.4.315)

Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K (2013) Frailty in

KEY POINTS

- Frailty is an independent risk factor for poor surgical outcome.
- Preoperative surgical assessment of older patients should include frailty assessment.
- Frailty is dynamic and can be modified positively.
- A multidisciplinary team approach in the management of older surgical patients ensures the best outcome.

elderly people. *Lancet* **381**(9868): 752–62 (doi: 10.1016/S0140-6736(12)62167-9)

Clegg A, Bates C, Young J, Teale E, Parry J (2014) Development and validation of an electronic frailty index using existing primary care health record data. *Age Ageing* **43**(suppl 2): ii19 (doi: 10.1093/ageing/afu131.1)

Dasgupta M, Rolfson DB, Stolee P, Borrie MJ, Speechley M (2009) Frailty is associated with postoperative complications in older adults with medical problems. *Arch Gerontol Geriatr* **48**(1): 78–83 (doi: 10.1016/j.archger.2007.10.007)

Daskivich TJ, Fan KH, Koyama T et al (2013) Effect of age, tumor risk, and comorbidity on competing risks for survival in a U.S. population-based cohort of men with prostate cancer. *Ann Intern Med* **158**(10): 709–17 (doi: 10.7326/0003-4819-158-10-201305210-00005)

de Vries NM, Staal JB, van Ravensberg CD, Hobbelen JS, Olde Rikkert MG, Nijhuis-van der Sanden MW (2011) Outcome instruments to measure frailty: a systematic review. *Ageing Res Rev* **10**(1): 104–14 (doi: 10.1016/j.arr.2010.09.001)

Etzioni DA, Liu JH, Maggard MA, Ko CY (2003) The aging population and its impact on the surgery workforce. *Ann Surg* **238**(2): 170–7 (doi: 10.1097/01.SLA.0000081085.98792.3d)

Fried LP, Kronmal RA, Newman AB et al (1998) Risk factors for 5-year mortality in older adults: the Cardiovascular Health Study. *JAMA* **279**(8): 585–92 (doi:10.1001/jama.279.8.585)

Fried LP, Tangen CM, Walston J et al; Cardiovascular Health Study Collaborative Research Group (2001) Frailty in older adults: evidence for a phenotype. *J Gerontol A Biol Sci Med Sci* **56**(3): M146–56 (doi: 10.1093/gerona/56.3.M146k)

Ganapathi AM, Englum BR, Hanna JM, Schechter MA, Gaca JG, Hurwitz LM, Hughes GC (2014) Frailty and risk in proximal aortic surgery. *J Thorac Cardiovasc Surg* **147**(1): 186–191.e1 (doi: 10.1016/j.jtcvs.2013.09.011)

Gill TM, Gahbauer EA, Allore HG, Han L (2006) Transitions between frailty states among community-living older persons. *Arch Intern Med* **166**(4): 418–23 (doi: 10.1001/archinte.166.4.418k)

Goldstein LJ, Halpern JA, Rezayat C, Gallagher KA, Sambol EB, Bush HL Jr, Karwowski JK (2010) Endovascular aneurysm repair in nonagenarians is safe and effective. *J Vasc Surg* **52**(5): 1140–6 (doi: 10.1016/j.jvs.2010.06.076)

Hamel MB, Henderson WG, Khuri SF, Daley J (2005) Surgical outcomes for patients aged 80 and older: morbidity and mortality from major noncardiac surgery. *J Am Geriatr Soc* **53**(3): 424–9 (doi: 10.1111/j.1532-5415.2005.53159.x)

Harari D, Hopper A, Dhesi J, Babic-Ilman G, Lockwood L, Martin F (2007) Proactive care of older people undergoing surgery ('POPS'): Designing, embedding, evaluating and funding a comprehensive geriatric assessment service for older elective surgical patients. *Age Ageing* **36**(2): 190–6 (doi: 10.1093/ageing/af1163k)

Hewitt J, Moug SJ, Middleton M, Chakrabarti M, Stechman MJ, McCarthy K; Older Persons Surgical Outcomes Collaboration (2015) Prevalence of frailty and its association with mortality in general surgery. *Am J Surg* **209**(2): 254–9 (doi: 10.1016/j.amjsurg.2014.05.022)

Kehler H (1997) Multimodal approach to control postoperative pathophysiology and rehabilitation. *Br J Anaesth* **78**(5): 606–17 (doi: 10.1093/bja/78.5.606)

Kim SW, Han HS, Jung HW, Kim KI, Hwang DW, Kang SB, Kim CH (2014) Multidimensional frailty score for the prediction of postoperative mortality risk. *JAMA Surg* **149**(7): 633–40 (doi: 10.1001/jamasurg.2014.241)

Klidjian AM, Foster KJ, Kammerling RM, Cooper A, Karran SJ


- (1980) Relation of anthropometric and dynamometric variables to serious postoperative complications. *BMJ* **281**(6245): 899–901
- Klopfenstein CE, Herrmann FR, Michel JP, Clergue F, Forster A (1998) The influence of an aging surgical population on the anaesthesia workload: a ten-year survey. *Anesth Analg* **86**(6): 1165–70
- Kurian AA, Suryadevara S, Vaughn D, Zebley DM, Hofmann M, Kim S, Fassler SA (2010) Laparoscopic colectomy in octogenarians and nonagenarians: a preferable option to open surgery? *J Surg Educ* **67**(3): 161–6 (doi: 10.1016/j.jsurg.2010.02.009)
- Leung JM, Dzankic S (2001) Relative importance of preoperative health status versus intraoperative factors in predicting postoperative adverse outcomes in geriatric surgical patients. *J Am Geriatr Soc* **49**(8): 1080–5 (doi: 10.1046/j.1532-5415.2001.49212.x)
- Makary MA, Segev DL, Pronovost PJ et al (2010) Frailty as a predictor of surgical outcomes in older patients. *J Am Coll Surg* **210**(6): 901–8 (doi: 10.1016/j.jamcollsurg.2010.01.028)
- McCarthy K, Moug S, Stechman M, Hewitt J (2014) The prevalence of frailty in the acute general surgical setting. *Age Ageing* **43**(suppl 2): ii16 (doi: 10.1093/ageing/afu129.1)
- O'Toole GC, Abuzukuk T, Murray P (2002) Elective total hip arthroplasty in patients aged 85 years and older. *Ir Med J* **95**(4): 106–7
- Partridge JSL, Harari D, Dhese JK (2012) Frailty in the older surgical patient: a review. *Age Ageing* **41**(2): 142–7 (doi: 10.1093/ageing/afr182)
- Partridge JS, Harari D, Martin FC, Dhese JK (2014) The impact of pre-operative comprehensive geriatric assessment on postoperative outcomes in older patients undergoing scheduled surgery: a systematic review. *Anaesthesia* **69**(Suppl 1): 8–16 (doi: 10.1111/anae.12494)
- Polanczyk CA, Marcantonio E, Goldman L, Rohde LE, Orav J, Mangione CM, Lee TH (2001) Impact of age on perioperative complications and length of stay in patients undergoing noncardiac surgery. *Ann Intern Med* **134**(8): 637–43 (doi: 10.7326/0003-4819-134-8-200104170-00008)
- Pouwels S, Stokmans RA, Willigendael EM, Nienhuijs SW, Rosman C, van Ramshorst B, Teijink JA (2014) Preoperative exercise therapy for elective major abdominal surgery: a systematic review. *Int J Surg* **12**(2): 134–40 (doi: 10.1016/j.ijsu.2013.11.018)
- Ravaglia G, Forti P, Lucicesare A, Pisacane N, Rietti E, Patterson C (2008) Development of an easy prognostic score for frailty outcomes in the aged. *Age Ageing* **37**(2): 161–6 (doi: 10.1093/ageing/afm195)
- Roche JJ, Wenn RT, Sahota O, Moran CG (2005) Effect of comorbidities and postoperative complications on mortality after hip fracture in elderly people: prospective observational cohort study. *BMJ* **331**(7529): 1374 (doi: 10.1136/bmj.38643.663843.55)
- Rockwood K, Mitnitski AB, MacKnight C (2002) Some mathematical models of frailty and their clinical implications. *Rev Clin Gerontol* **12**(2): 109–17
- Rockwood K, Mitnitski A (2007) Frailty in relation to the accumulation of deficits. *J Gerontol A Biol Sci Med Sci* **62**(7): 722–7
- Rolfson DB, Majumdar SR, Tsuyuki RT, Tahir A, Rockwood K (2006) Validity and reliability of the Edmonton Frail Scale. *Age Ageing* **35**(5): 526–9 (doi: 10.1093/ageing/af041)
- Sepehri A, Beggs T, Hassan A, Rigatto C, Shaw-Daigle C, Tangri N, Arora RC (2014) The impact of frailty on outcomes after cardiac surgery: a systematic review. *J Thorac Cardiovasc Surg* **148**(6): 3110–17 (doi: 10.1016/j.jtcvs.2014.07.087)
- Stoneham M, Murray D, Foss N (2014) Emergency surgery: the big three—abdominal aortic aneurysm, laparotomy and hip fracture. *Anaesthesia* **69** (Suppl 1): 70–80 (doi: 10.1111/anae.12492)
- Valkenet K, van de Port IG, Dronkers JJ, de Vries WR, Lindeman E, Backx FJ (2011) The effects of preoperative exercise therapy on postoperative outcome: a systematic review. *Clin Rehabil* **25**(2): 99–111 (doi: 10.1177/0269215510380830)
- Wilkinson K, Martin IC, Gough MJ et al (2010) An age old problem. A review of care received by elderly patients undergoing surgery. www.ncepod.org.uk/2010report3/downloads/EESE_fullReport.pdf (accessed 15 June 2015)

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