

LIFE AT THE SHARP END: SURGICAL MORTALITY RISK



John Lefebvre, MD, FRCPC
Chief Regional Medical Director
RGA International Corporation
Toronto, Canada
jlefebvre@rgare.com



Yunus Piperdy, BSc, FCII
Underwriting Research and Development Manager
RGA UK Services
London, United Kingdom
ypiperdy@rgare.com

Postponement is not always the right answer

For many operative procedures it is not always necessary for life underwriters to postpone acceptance of the risk. Most common elective surgical treatments are considered to be quite safe in the modern era, and an applicant who is healthy enough to undergo surgery could be an attractive risk. An ageing population with increased access to surgical care and the relentless introduction of new surgical techniques means we need to understand the risks and carefully consider all the factors before accepting or postponing an applicant awaiting surgical treatment.

Surgical risk factors

Apart from the nature of the surgical procedure itself and risk from general anaesthesia, the major surgical risk factors are age, the underlying disease process and the presence of co-morbidities. Perioperative complications can include bleeding, perforation of organs, heart attack and brain injury.

Often the risk from the underlying disease process is of greatest significance in regards to mortality. Prognosis in vascular, neurological and intestinal disorders is largely dependent on the severity of the underlying condition; here the need for surgical intervention often implies a worsened short-term prognosis.

Common causes of postoperative mortality include thromboembolic events, major infections and cardiac complications. Postoperative risk is highest during the first few days to weeks, but the risk of major complications can remain for 30 to 90 days and beyond. Also

Executive Summary *Life underwriters and medical directors are likely to see an increase in the number of cases involving surgical mortality risk. This is a natural consequence of an ageing population, continuous medical advancements and better access to surgical treatments. Therefore it is becoming ever more important to understand the key factors in surgical mortality risk. We focus on a few common types of elective surgery likely to be seen by life underwriters.*

if the original procedure fails, there is a risk that a repeat operation will be needed.

In terms of underwriting risk assessment, investigative or diagnostic operative procedures are completely different. Regardless of the operative risk, postponement is the only option for many such procedures, as the operative findings could change the picture totally—e.g., if a malignancy is discovered.

Finally, even though underwriting ratings may already take account of mortality from surgical treatments, underwriters need to remain on guard against anti-selection—e.g., high sum assured applications submitted just before an operation is required.

Type of surgical treatment

The type of surgical treatment is strongly correlated to the risk of postoperative mortality as shown in Table 1 (next page). Noordzij et al analysed postoperative mortality from a registry of 3.7 million surgical procedures in 102 hospitals in The Netherlands between 1991 and 2005. They measured postoperative

Type of surgery	Mortality rate / 1000
Abdominal	
hernia	2.4
appendectomy	7.4
cholecystectomy	13.8
biliary duct	15.8
intestinal	35.2
oesophagus	40.2
pancreatic	59.3
gastric	65.3
liver	72.7
spleen	89.6
liver transplant	185.1
Orthopaedic	
knee	1.2
hip	8.0
Urologic	
prostate	2.0
bladder	4.9
renal transplant	10.0
renal	17.7
Neurologic	
prolapsed intervertebral disc	0.7
vascular	23.0
brain	59.3
Vascular	
carotid	3.8
peripheral	10.7
aortic	34.6
Cardiac	
CABG	9.5
valvular	21.7
heart transplant	84.6
congenital	123.0
Endocrinology	
thyroid	3.4
pituitary	9.9
adrenal	14.5
Respiratory	
non-transplant	26.7
lung transplant	147.8
Other	
breast	1.0
gynaecology	2.2
ENT	8.0

Table 1 – Adapted from *Postoperative Mortality in The Netherlands – Noordzij et al 2010*^[1]

mortality within 30 days of surgery, adjusting for age, gender and major co-morbid conditions such as heart disease, stroke and diabetes.

This study confirms operative mortality varies widely according to the type of procedure. After adjustment

for differences in distribution of demographic characteristics and co-morbidities, Noordzij et al concluded there was a more than 256-fold difference in the incidence of all-cause death between the highest and lowest risk categories. The safest operations were for breast, prostate, prolapsed disc and abdominal hernia, with transplant surgery being the riskiest. This would appear to be in keeping with a greater surgical risk, the more significant the underlying disease process.

As the study was restricted to elective procedures, the findings are particularly useful for underwriting. However, the study was limited to open surgical procedures requiring in-patient admission; this may overestimate surgical mortality rates where a procedure is performed on an outpatient basis or where keyhole surgery is performed—e.g., cholecystectomy.

Anaesthetic risk

Mortality risk from anaesthesia is believed to be low. Studies generally support this assumption but mortality risk can vary according to preoperative health status. Also some of the variation in mortality rates may be due to differences in definition of death due to anaesthesia. Using a definition of death during or within two post-procedure days, Robert Lagasse reports an overall perioperative mortality rate of approximately 1 death per 500 anaesthetics (or 2 per 1000). This is based on 184,472 anaesthetics between 1992 and 1999^[2].

Although an overall perioperative mortality rate of 2 per 1000 is high in the Lagasse study, the picture is completely altered after adjusting for physical status. His analysis demonstrates much lower perioperative mortality rates after adjusting for preoperative physical status as per Table 2 (next page).

In the two best groups (Class 1 and 2) perioperative mortality within 2 days is reduced to 0.2 deaths per 1000. Lagasse also reported similar results from other studies.

Older is riskier?

As with many other underwriting risks, surgical mortality rates increase progressively with age. However, the evidence is not so clear-cut and much of this increased risk is due to co-morbid conditions rather than old age per se.

Turrentine et al used the American College of Surgeons National Surgical Quality Improvement Program database to study postoperative complications in the elderly^[4]. Figure 1 (next page) shows an exponential increase in the surgical mortality rate in

Physical Status Classification System (Version 2, 1980)	
Class	
1	Normal healthy patient
2	Mild systemic disease
3	Severe systemic disease
4	Severe systemic disease that is a constant threat to life
5	Not expected to survive without the operation

Table 2: American Society of Anesthesiologists [1]

able risk at older ages. An elderly applicant deemed healthy enough to undergo elective surgery could be an attractive underwriting case. In practice the degree of mortality risk will depend largely on the type of surgical treatment, underlying disease process, and the nature and number of co-morbid conditions.

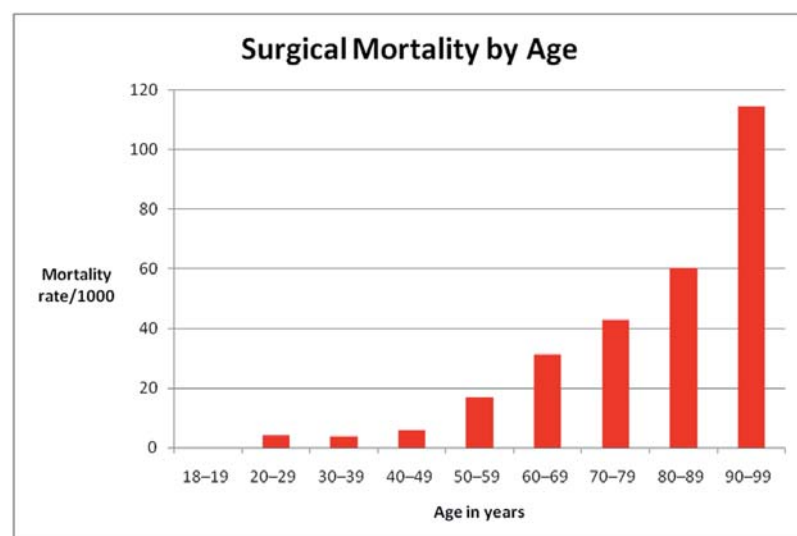


Figure 1 - Surgical mortality by age (adapted from Turrentine et al, 2006)

relation to increasing age. Although other risk factors such as high levels of co-morbidity and the higher proportion of emergency procedures were important causes of death at older ages, they concluded that increasing age itself was an independent risk factor for postoperative mortality.

The importance of co-morbid conditions in older patients is also illustrated in a small study of 50 patients aged 70 to 95^[5]. The patients had undergone major orthopaedic procedures for osteoarthritis of the femoral head or femoral neck fractures. Thirty days after discharge from hospital, 8 of 50 patients (16%) were reported dead. The cause of death in the majority of cases was directly related to their previous medical history.

Old age is undoubtedly an adverse risk factor in surgical mortality risk. Nevertheless, acceptance for a surgical procedure could be an indication of a favour-

Common elective operations

Mortality data for four common elective operative procedures are listed in Table 3 below.

We analysed in-patient mortality data using the Hospital Episode Statistics (HES) database for England. Our overall findings are basically consistent with published mortality rates. However, it is essential to analyse findings from each study individually. Direct comparison of mortality rates between studies may be misleading as differences could be due to definition of operative mortality, or exclusion of certain types of operations or age groups.

While Noordzij et al reported high mortality rates for open cholecystectomy, the data from the American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) confirms a much lower mortality rate for laparoscopic cholecystectomy. The HES data is largely based on laparoscopic procedures, and the mortality rate is equally low.

It is also important to note the above data are for all operations including emergency procedures. The difference between elective and emergency procedures is clearly illustrated in another study by Nilsson et al who studied mortality after groin hernia surgery based on more than 100,000 operations recorded by the Swedish Hernia Register between 1992 and 2005^[10]. They found that while there was an increased mortality risk for hernia repair, this was due to excess mortality following emergency operations. They reported the 30-day standardised mortality ratio (SMR)

Operation type	Mortality rate / 1000				
	HES [1]	NJR [2]	Veterans NSQIP [3]	Noordzij et al [1]	ACS NSQIP [4]
Cholecystectomy	2.6	n/a	n/a	13.8 (O)	2.7 (L) 28.2 (O)
Hernia (not hiatus)	2.4	n/a	n/a	2.4	n/a
Hip replacement	3.2	2.7	7.2	8.0	n/a
Knee replacement	1.7	2.2	6.2	1.2	n/a

Table 3: Mortality rate for common elective operations
L = Laparoscopic, O = Open, n/a = not applicable

does not exceed that of the general population after elective operations for femoral or inguinal hernia.

One limitation of the HES database we looked at is a possible underestimate of mortality rates, as it only records in-hospital mortality, while other data sources include mortality up to 30 days after the operation.

Nevertheless, HES is a valuable source of data as it allows drill-down analysis of postoperative mortality rate by age as shown in Table 4.

the first 30 days.

Sharp end doesn't always mean a sharp exit

Surgical mortality risk is low for most elective operations, particularly if the applicant is otherwise healthy. Old age remains an adverse factor for surgical mortality risk, although it's difficult to determine how much this risk is increased due to the higher rate of co-morbid conditions and emergency procedures performed in the elderly, and the increased severity of the underlying disease process. In the future, as more and more procedures are performed on

Age	Mortality rate / 1000*			
	Cholecystectomy	Hernia (not hiatus)	Hip replacement	Knee replacement
18-65	0.6	0.3	0.6	0.4
66-70	3.5	1.1	1.2	0.7
71-75	6.3	2.6	2.0	1.3
>75	20.4	12.0	9.3	4.6
All	2.6	2.4	3.2	1.7

Table 4: Hospital Episode Statistics for England, 2003-10 (RGA analysis of HES data) [1]

The HES data confirms mortality risk increases with age. As discussed above, much of this increase is likely due to a higher rate of co-morbid conditions and emergency procedures at older ages, and the increased severity of the underlying disease process.

HES data also allow detailed analysis of mortality risk during the in-patient period and how it decreases with time. The data confirm the highest risk is in the immediate postoperative period. Figure 2 compares mortality rates for hip and knee replacements for lives at all ages. Most mortality occurs during the first week, and nearly all of the excess mortality is within

healthy elderly patients, better data about surgical mortality risk will become available to allow better risk stratification.

Anaesthetic-related mortality risk is negligible in healthy lives. The data also show perioperative and postoperative mortality risk is probably within an acceptable range for many common elective operations.

Caution is required to avoid anti-selection, particularly if there are major co-morbidities or if an emergency procedure could be performed in the interim.

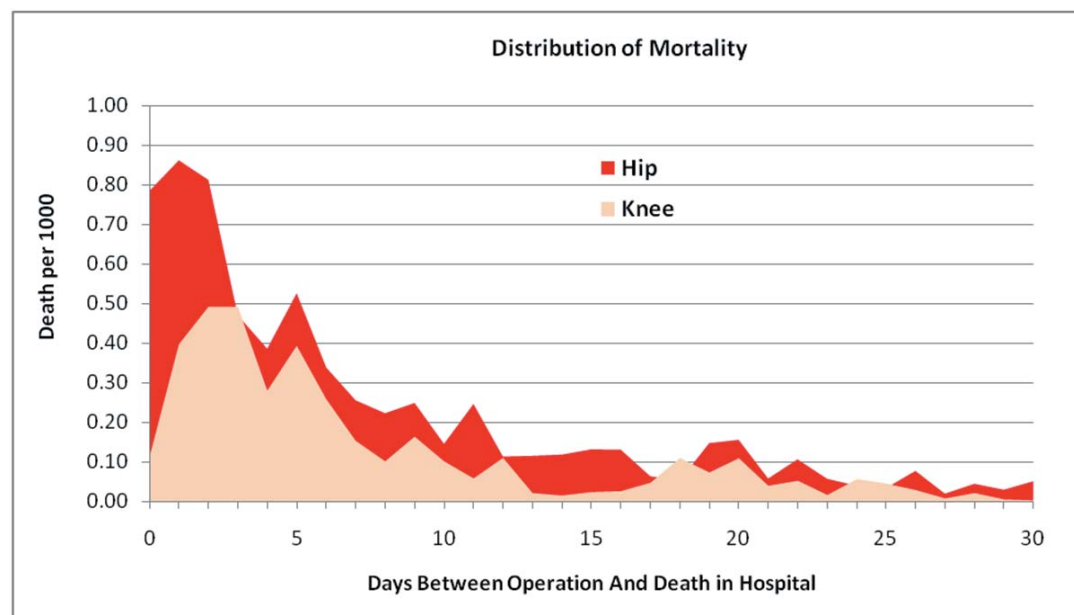


Figure 2 - Distribution of surgical mortality for hip and knee replacements by duration (Hospital Episode Statistics for England, 2003-10 (RGA analysis of HES data) [12])

As new and improved surgical treatments and techniques are introduced, elective surgical mortality risk is likely to further reduce, allowing better opportunities for underwriters to accept cases that were once automatically postponed.

References

- 1 Postoperative Mortality in The Netherlands. Noordzij et al, 2010, *Anesthesiology* 2010; 112:1105–15
- 2 Anesthesia Safety: Model or Myth? A Review of the Published Literature and Analysis of Current Original Data, Robert S. Lagasse, M.D., *Anesthesiology* 2002; 97:1609–17
- 3 American Society of Anesthesiologists: www.asahq.org/for-members/clinical-information/asa-physical-status-classification-system.aspx (last accessed September 2012)
- 4 Surgical Risk Factors, Morbidity, and Mortality in Elderly Patients, Turrentine et al, *jamcollsurg*.2006.08.026
- 5 Early postoperative mortality in the elderly: a pilot study, Asouhidou et al, *BMC Research Notes* 2009, 2:118
- 6 Hospital Episode Statistics, Internal Analysis, Qian Zhao and Peter Banthorpe, RGA UK, 2012
- 7 National Joint Registry for England and Wales, 8th Annual Report 2011
- 8 Racial/Ethnic Differences in Surgical Outcomes in Veterans Following Knee or Hip Arthroplasty, Ibrahim et al, *Arthritis and Rheumatism*, Vol. 52, No. 10, October 2005, pp 3143–3151
- 9 A Current Profile and Assessment of North American Cholecystectomy: Results from the American College of Surgeons National Surgical Quality Improvement Program, Ingraham et al, *jamcollsurg*.2010.04.003
- 10 Mortality After Groin Hernia Surgery, Nilsson et al, *Annals of Surgery*, Volume 245, Number 4, April 2007
- 11 Hospital Episode Statistics, Internal Analysis, Qian Zhao and Peter Banthorpe, RGA UK, 2012
- 12 Hospital Episode Statistics, Internal Analysis, Qian Zhao and Peter Banthorpe, RGA UK, 2012

About the Authors

Dr. John Lefebre, MD, FRCPC, is the Chief Regional Medical Director for RGA International Corporation and is responsible for Europe, South Africa, India and the Middle East. He has extensive clinical experience in teaching hospitals in Canada, and practiced clinical medicine in Toronto, where he was the associate director for the MDS executive health care program. Dr. Lefebre is an emergency medicine specialist and has over 20 years of insurance medicine experience. Prior to joining RGA, he was chief medical director with two other reinsurers. Dr. Lefebre completed his medical training at the University of Alberta and his post-graduate residency at the University of Toronto.

Yunus (Pip) Piperdy, BSc, FCII, is underwriting research and development manager for RGA UK. He specialises in medical research, underwriting systems and product design. His main focus is to ensure underwriting guidelines remain suited to client needs. With more than 25 years medical underwriting experience, Pip has worked in senior underwriting roles for both direct and reinsurance companies. He has been involved in all aspects of life, disability and annuity risk management, including development of underwriting manuals and expert systems. Pip is the UK editor of *ON THE RISK* and enjoys writing articles about underwriting. He is an active member of insurance industry committees and currently sits on the ABI Genetics and Select 74 underwriting committees.