

The surgical epidemic

ABSTRACT

This article outlines the growing demand for surgical services globally, both in developing and developed countries. The implications of this increasing demand are explored, with particular attention focused on the enduring burden of perioperative complications. The role of critical care in ensuring the safe delivery of surgical services is also examined. Solutions to the 'surgical epidemic' are proposed including the role of perioperative medicine in reconfiguring services to provide safe surgical care.

Global perceptions of surgical safety are changing in both developed and low and middle income countries. This has led to two distinct sets of challenges.

In developed countries, there is an ever-increasing volume of complex, high-risk surgery being performed. This high-risk surgical population accounts for the majority of major morbidity and mortality after surgery. In contrast, low and middle income countries face a different set of problems. As defined by the Lancet Commission, these problems relate to either delays in access (seeking, reaching and receiving care) and/or infrastructure problems for performing key procedures.

Around the world, an estimated 300 million operations are performed per year with 3% associated with a serious adverse event (Weiser et al, 2008). This is a number of patients greater than the entire population of Denmark who suffer potentially avoidable complications after surgery every year.

In the UK, an estimated 10 million procedures are undertaken annually, and 250 000 (15%) of these patients are deemed 'high risk' but account for the majority (80%) of the mortality after surgery. The Office for National Statistics (2015) projects that the number of people of State Pension Age and over will increase by almost 33% by mid 2039, despite increases to the State Pension Age. As a result, patients are presenting for

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surgery later in life with multiple comorbidities, resulting in an increase in both the volume and complexity of the high-risk surgical population. To provide safe surgical services, health-care systems must evolve to meet this challenge.

Global perspective

Worldwide approximately 5 billion people do not have access to safe surgery (Meara et al, 2015). The lack of access to surgical services is estimated to contribute to 32.9% of all deaths worldwide. This constitutes a greater burden on the global health system than malaria, HIV/AIDS and tuberculosis combined (Huber, 2015).

The scale of this problem is increasingly recognized. In the first edition of Disease Control Priorities in Developing Countries, published in 1993, the only surgical condition acknowledged is in the chapter on injury (Jamison et al, 1993). In contrast, Disease Control Priorities, published in 2015, has an entire volume focused on surgery (Debas et al, 2015). Alongside the Lancet Commission (Meara et al, 2014), this has changed the idea of surgery from an additional extra to 'an indivisible, indispensable part of health care' (Kim, 2014).

Of the 300 million surgical procedures performed worldwide, the Lancet Commission estimates that 6.3% of these occur in countries constituting the poorest 37.3% of the world's population. This is an increase by a third in only 8 years. It is accompanied by a corresponding increase in the number of potentially avoidable surgical complications. This creates a huge burden of potentially preventable disease with long-term effects on survival (Khuri et al, 2005). So, there is a dual problem of preventable disease associated with untreated surgical conditions and preventable morbidity from badly treated surgical conditions.

In order to meet demand for surgical services globally, it is estimated that an additional 143 million surgical procedures per year need to be performed. The cost of providing greater surgical access is likely to be offset by the concomitant increase in the individual country's economic productivity (Meara et al, 2015).

In high income countries, where surgical services are more readily accessible, a different conundrum exists, that of substantial morbidity associated with perioperative complications. Perioperative complications are associated with long-term poorer clinical outcomes, suffering, cost and lost productivity. In order to limit these effects, surgical services need to be reconfigured in order to be as safe and effective as possible.

Safety of surgical services

The drive to deliver greater access to surgical services must also be accompanied by a responsibility to ensure the delivery of safe and high-quality services. In the UK, approximately 10 million procedures are performed per annum (Weiser et al, 2008). In 2014 this was at an estimated cost of £16 billion (Royal College of Anaesthetists, 2015). The associated inpatient surgical mortality is approximately 1% (Findlay et al, 2011).

Pearse et al (2006) analysed surgical inpatient procedures and intensive care admissions over a 5-year period in 94 NHS hospitals, concluding that a high-risk surgical population accounts for only 12.5% of all procedures but for more than 80% of all deaths.

Of these high-risk patients, elderly patients make up a large proportion, and yet only receive 'good care' 36% of the time (Wilkinson et al, 2010). One in five high-risk patients present for surgery without being seen in an anaesthetic high-risk clinic, and fewer than one in five high-risk patients having non-cardiac surgery are admitted to critical care postoperatively (Findlay et al, 2011).

Perioperative mortality in Europe

To gain a European perspective on this issue, the European Surgical Outcomes Study examined mortality rates and the use of postoperative critical care facilities across Europe (Pearse et al, 2012). A total of 498 hospitals in 28 European nations participated over a 7-day period in 2011. Data were collected on patients undergoing inpatient, non-cardiac surgery with the primary outcome being in-hospital mortality.

The results of this cohort study showed an overall crude mortality rate of 4%, higher than anticipated. Critical care utilisation was also called into question with only 5% of patients having a planned admission to an intensive treatment unit postoperatively. Perhaps even more surprisingly, 73% of all patients who died were never admitted to a critical care facility. Of those inpatient deaths, 43% died after being discharged to ward-based care from an intensive treatment unit. While the results of this study have proven controversial (Doherty et al, 2013), it has stimulated debate and has served to highlight how limited our current knowledge is on postoperative outcomes and the manner in which critical care is used for elective postoperative patients.

More recently, in an attempt to truly define the scale of this problem, the follow up International Surgical Outcomes Study was published, assessing postoperative morbidity and mortality across 27 different countries (International Surgical Outcomes Study group, 2016).

Does admission to critical care postoperatively make a difference?

The value of routine critical care admission postoperatively is unclear (Wunsch et al, 2016). In the International Surgical Outcomes Study, despite there being reduced

critical care facilities in low and middle income countries, the mortality rates were similar to high income countries with greater critical care resources.

More recently, the International Surgical Outcomes Study data were interrogated specifically to examine the association between the provision and use of critical care resources and in-hospital mortality (Kahan et al, 2017). This analysis failed to demonstrate any evidence of patient survival benefit associated with admission to critical care after surgery. While the study authors urge caution in interpreting these results, it is clear that simply increasing critical care capacity as an isolated measure will not provide the solution to improving perioperative care.

The SNAP-2: EpiCCS (The 2nd Sprint National Anaesthesia Project: Epidemiology of Critical Care provision after Surgery) observational study in the UK will hopefully further clarify the role of critical care on postoperative outcomes.

Failure to rescue

Failure to rescue is now a widely recognized phenomenon (Ghaferi et al, 2009). It examines the mortality of patients who develop complications after surgery and is defined as death following a complication of surgery. It is regarded as an excellent process measure and clinical quality indicator, for example, in hospitals with similar condition-specific complication rates but different associated mortality (Ghaferi and Dimick, 2015). When used as a process measure, failure to rescue can reflect the resources and infrastructure of health-care systems and how adept those systems are at dealing with complications when they occur. In contrast, analysis of traditional measures like mortality statistics may not yield meaningful information about hospital processes. In the International Surgical Outcomes Study, one in six patients developed one or more complications postoperatively. Failure to rescue was a secondary outcome in the study with one in 35 patients who developed a postoperative complication subsequently dying in hospital.

As discussed above the role of critical care is uncertain and many as yet unanswered questions remain. How can low and middle income countries with limited critical care resources have similar mortality rates to countries with sophisticated, well-funded intensive treatment units? Why are high-risk patients not routinely admitted to critical care postoperatively and more importantly, do they really need it? How can a patient who dies in the postoperative period not have any interaction with critical care services? And by using alternative, novel process measures like failure to rescue, can limited resources be better distributed and used?

Long-term consequences of perioperative complications

The consequences of postoperative complications extend beyond death in hospital. In a landmark study, the most important determinant of decreased long-term survival

KEY POINTS

- The volume of surgery is increasing worldwide.
- Complications after surgery are common.
- Complications cause appreciable morbidity and mortality.
- Recognizing this and reconfiguring services can prevent some of this avoidable harm.

after surgery, even accounting for preoperative risk factors, was the development of a postoperative complication within 30 days of surgery (Khuri et al, 2005). With the high rates of complications discussed above this shows the huge burden that elective surgery places on health-care systems worldwide.

Strategies to improve surgical care

In low and middle income countries, the response to these problems is predominantly focused on investment in infrastructure and personnel to provide the further 143 million procedures required. It is thought that a further 2.2 million health-care providers will be necessary to facilitate this at a cost of \$350 billion by 2020 (Meara, 2015). This may seem expensive but the alternative is even more costly with \$12.3 trillion being lost in economic productivity.

In developed countries, as the long-lasting consequences of perioperative complications are increasingly recognized, the response to this problem has taken many forms with greater focus on the highest risk patients. Notable initiatives like the National Emergency Laparotomy Audit and the National Hip Fracture Database have been developed with the explicit aim of improving outcomes after high-risk surgery. The National Emergency Laparotomy Audit aims to achieve this by highlighting variation in the structure and organization of perioperative care across the UK and then feeding back these data to the individual institution. These data then allow the individual institution, using quality improvement methodologies, to reorganize their services in order to ensure the delivery of better quality care for patients undergoing emergency abdominal surgery.

While the emergency surgical population is at the highest risk of complications, by far the greatest burden of avoidable complications after surgery lies within the elective surgical population as a consequence of the significantly greater volume of elective surgery carried out. In order to address this paradox, the Royal College of Anaesthetists (2015) set out its vision document for the development of perioperative medicine as a medical sub-specialty with the specific aim of reducing the burden of preventable surgical harm.

Within perioperative medicine, there are individual exemplars of multidisciplinary, integrated, holistic models of care that provide a high quality service for patients. (Partridge et al, 2014). Enhanced recovery after surgery is an example of the re-organization of care into structured

and multidisciplinary perioperative pathways in which interventions are delivered preoperatively, intraoperatively and postoperatively in order to improve outcomes. While enhanced recovery is often anaesthesia-led, physician-led models of perioperative care have also been successful in improving outcomes after surgery such as the Proactive Care of Older People Having Surgery service (Dhesi, 2013). In the UK, 'surgical schools' have been established in order to educate patients about their perioperative journey and to attempt to optimize them using exercise, known as prehabilitation, before their surgery.

The need for the reorganization of perioperative care has been recognized in a number of health-care systems worldwide. In the USA, enhanced recovery is rapidly gaining traction and the perioperative surgical home is one example of a novel, integrated model of perioperative care. Similar care models have also been developed in Australia.

Conclusions

In the developing world, the Lancet Commission detailed the dual problems of both under-utilization of services and excessive morbidity after surgery. In the developed world, there is an increasing significant burden of potentially avoidable postoperative mortality and morbidity. Prevention of complications of surgery and failure to rescue are key to improving perioperative care and outcomes for surgical patients.

Within the medical community, the skillset to improve surgical outcomes does exist currently. However, in order to achieve this, a re-organization of services is likely required with a strong, individualized, multidisciplinary focus throughout each patient's journey.

A paradigm shift towards continuous, coordinated, integrated care that seeks to identify the high-risk patient and prevent avoidable morbidity in the perioperative period is the foundation upon which perioperative medicine is built. Developing such models, in time, will allow us to work collaboratively towards the shared goal of improving surgical outcomes. **BJHM**

Conflict of interest: none.

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