A surgeon's guide to peri-operative death

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Abstract

Peri-operative deaths are a highly emotive issue with devastating consequences for the family and for the medical and nursing staff who have looked after the patient. They are being increasingly scrutinized. Some of these deaths are inevitable and largely attributable to underlying pathology of an advanced or complex nature; others occur as a result of inexpert care or surgical mishap. For the latter the autopsy is of particular value, establishing the cause of death for the family and educating the surgical staff so that mistakes can be avoided in the future. A knowledge of the risk factors for a poor surgical outcome, and how they are identified and evaluated, will help the pathologist to advise the Coroner in particular in identifying those deaths that have arisen as a consequence of recognized complications of necessary medical treatment. Further, and even more importantly, the autopsy may identify factors avoidable in subsequent operations and thus benefit the living. This review discusses the most common causes of peri-operative death, and considers preventative measures, scoring systems and surgical audits designed to improve outcomes.

Keywords coroner's office; mortality; post-operative death; risk factors; scoring systems

Introduction

Peri-operative deaths are a highly emotive issue with devastating consequences for the family and for the medical and nursing staff who have looked after the patient. Some deaths are sadly inevitable and surgery is often a 'last ditch' approach to salvage an irretrievable situation. These deaths are largely attributable to underlying pathology of an advanced or complex nature. Timely surgery, delivered expertly, with the back-up of a senior anesthetist and a critical care unit, may however alter the clinical course towards a positive outcome. Other deaths occur as a result of inexpert care or surgical mishap. It is in these deaths that the autopsy is of particular value, establishing the cause of death for the family and educating the surgical staff so that mistakes can be avoided in the future.

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A large number of patients die under surgical care in the UK. The vast majority of these patients have been admitted as an emergency and less than half will have had an operation. Elective or planned surgery causes less peri-operative mortality that emergency surgery, but adverse outcomes will still occur, either as a direct result of the surgical technique or as an additional event in the peri-operative period.

Deaths as a result of surgery have come under greater scrutiny and this is likely to continue. Autopsy of patients who have died under the care of a surgical team is highly valuable as the results of this examination will lead to greater accuracy in the certified cause of death. In the correct setting the autopsy findings are of immense educational benefit to the surgical team and can act as a driver to increase the standard of surgery. A general decline in the number of postmortems performed per year needs to be reversed as a healthy symbiotic relationship between surgeon and pathologist is essential to improve outcome for our patients. As illustrated by the Shipman murders, the current system has very little capacity to detect trends in deaths, but the draft Coroners Bill Laws currently being considered have the potential to alter that, and accurate data from good autopsies could support the accumulation of valuable information for monitoring changes in surgical mortality.

Most autopsies in England, Wales and Northern Ireland are carried out for the Coroner, who has a legitimate interest in postoperative deaths because they are potentially unnatural. Coroners vary in their willingness to allow detailed investigation, for example by histological examination. However, after postoperative deaths, the retention of tissues for microscopy and so on can usually be justified because the distinction between natural and unnatural death needs to be made beyond reasonable doubt.[1]

This review aims to cover the most common causes of peri-operative death. It will also look at preventative measures, scoring systems and surgical audits designed to improve outcomes.

Specific risk factors for mortality

Age

It is well recognized that operating on elderly patients carries an increased risk of peri-operative morbidity and mortality. Of patients who die in hospital following surgical admission, around one-quarter will be over 85 years old. This number has increased and will continue to do so as the post world war II baby boom generation advances into old age. Elderly patients are more likely to be admitted as an emergency, have more advanced disease and will have less physiological reserve. In patients who are very old (> 89 years) the mortality is double that seen in 'younger' old people (70–89 years).[2]

Venous thromboembolism

Each year 25,000 people in England die from venous thromboembolism (VTE). This figure includes patients admitted under physicians as well as those admitted for surgery, and is 25 times the number of patients who die as a result of methicillin-resistant *Staphyloccous aureus* (MRSA) infection.[3] The degree of risk of thromboembolism is dependent on a number of patient- and procedure-related factors. The summation of these factors will define which patients are at the greatest risk of VTE.

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Deep vein thrombosis (DVT) occurs in more than 20% of patients having major surgery and more than 40% of patients having major orthopaedic surgery. It is estimated that up to 5% of patients following high-risk surgery will develop a pulmonary embolism (PE).[4] Table 1 displays the incidence of DVTs and PEs from randomized controlled trials (RCTs) where the patients received no VTE prophylaxis. It is evident that the highest risk surgical procedures are all types of orthopaedic surgery. The sample size in some of these RCTs was too small to give an accurate incidence of PE. Other factors to be considered include the presence of malignancy, the length of the operation and the length of hospital stay. Patients who have lengthy postoperative stays are more likely to have VTE and the more likely it is that their VTE is recorded.

Risk factors for VTE include advancing age, obesity, a past history of VTE, thrombophilias (Factor V Leiden mutation, antithrombin, protein S and protein C deficiency, prothrombin gene mutation, hyperhomocysteinanemia), smoking and the presence of varicose veins. Others include the taking of oral contraceptives, a recent myocardial infarction, hypertension and congestive cardiac failure. Prolonged travel of more than 3 h and a diagnosis of cancer also increase the patient's risk of developing VTE.

Methods of prophylaxis include both mechanical and chemotherapeutic approaches. Mechanical prophylaxis includes graduated compression stockings and intermittent pneumatic compression devices. The most commonly utilized chemotherapeutic regimens are based on low molecular weight heparins. Patients should remain well hydrated and be encouraged to mobilize out of bed as soon as practicable.

Risk of deep vein thrombosis (DVT) and symptomatic embolism by type of surgery, from the no prophylaxis arm of randomized controlled trials

	Deep vein thrombosis incidence (%)	Pulmonary embolism incidence (%)
Cardiac	14	N/A
Vascular	19	N/A
General	24	1
Gynaecology	16	1
Neurological	20	N/A
Orthopaedic (elective hip)	44	3
Orthopaedic (hip fracture)	37	6
Orthopaedic (elective knee)	27	N/A
Orthopaedic (mixed)	47	19
Urological	10	9
Mixed	22	1
All	29	3

Table 1

Trauma

Accidents are the commonest cause of loss of life in the young (< 40 years old), and the fourth leading cause of death in developed societies. The chance of survival and recovery is highly dependent on the immediate care that this group receives. Road traffic accidents account for over a third of all deaths due to injury.[5] A number of Royal College and government audits have highlighted deficiencies of care in this cohort of patients and the adoption of Advanced Trauma Life Support (ATLS), the formation of 'trauma teams' and 'trauma centres' is hoped to address these.[6]

Common causes of death include failed intubation or partial obstruction of the airway and severe haemorrhage. Rapid intervention by suitably qualified pre-hospital personnel may improve airway management. Patients who have ongoing fluid requirements and haemodynamic instability require immediate surgical intervention. Laparotomies for trauma are very challenging and the best outcomes occur when a consultant surgeon performs the surgery.

Mesenteric ischaemia

Acute mesenteric ischaemia is a catastrophic event which carries a high mortality rate (60–80%).[7] It is caused by the sudden interruption of the blood flow to the gastrointestinal tract. It occurs after embolism or thrombosis, or through low blood flow. Early diagnosis is problematic with mesenteric angiography and early laparotomy giving the highest chance of detection.

Three major blood vessels supply the gastrointestinal tract: the coeliac trunk, the superior mesenteric and inferior mesenteric arteries. The intestinal mucosa has a high metabolic rate and therefore requires around 20–25% of cardiac output, making it very susceptible to changes in perfusion. Ischaemia leads to disruption of the mucosal barrier, allowing bacterial translocation, release of vasoactive mediators, systemic inflammatory release syndrome, myocardial depression, multiorgan failure and death.

Arterial embolus is the leading cause of gut ischaemia (> 50%). The risk factors are well known and include coronary artery disease, cardiac failure, valvular heart disease, atrial fibrillation and a past history of emboli. Non-occlusive ischaemia (25%) occurs in low flow states and splanchnic vasoconstriction. This is seen in patients in the critical care unit and those who have had cardiac surgery. Haemodynamic instability whilst on cardiopulmonary bypass is a risk factor for those who may later develop ischaemic bowel.[8] Venous thrombosis (5–15%) is a less frequent cause of 'dead bowel': any disorders that can cause a hypercoaguable state may be implicated. These include trauma, heart failure, renal failure, portal hypertension and acute inflammatory conditions such as pancreatitis.

The diagnosis of mesenteric ischaemia is difficult.[9] It is to be suspected when the abdominal pain experienced by the patient is out of proportion to their physical signs. Computer tomography (CT) scans may be useful and may demonstrate a thickened gut wall with intramural gas, portal venous gas and viscous perforation. A rising serum lactate occurs with necrosis but is a non-specific marker.

Early surgery is the only management with any hope of salvaging this situation. The surgeon faces three possible situations. First, ischaemic necrosis of the majority of the entire small and large bowel is incompatible with survival and the surgeon can only close the abdomen and organize palliation. The second scenario is where a proportion of the bowel is necrotic and once resected the patient is left with a sufficient length of bowel to support their nutritional needs. In this circumstance the surgeon may elect either to perform an anastomosis or to bring out one or two stomas to the anterior abdominal wall, the decision largely

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