Care of the critically ill patient

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Abstract

Modern intensive care medicine requires a multidisciplinary approach to look after critically ill patients. Dedicated critical care units offer a variety of facilities to monitor and support organ functions, allowing diagnosis and treatment of life-threatening conditions in a controlled environment. This article describes the main principles of intensive care medicine, giving an overview of a systematic approach to assessment and treatment of organ dysfunction and highlights some of the complex ethical and organisational challenges.

Keywords Cardiovascular support; critical care; critically ill; intensive care; renal replacement therapy; respiratory support

Principles of critical care

Critical care is the process of looking after patients who suffer from life-threatening conditions or are at risk of developing these. The intensive care unit (ICU) is a distinct geographical entity in which high-level nursing, advanced monitoring and organ support are provided to improve patient morbidity and mortality. However, effective intensive care demands an integrated approach that stretches beyond the boundaries of the ICU. It requires prevention, early warning and response systems, a multidisciplinary approach before and during an ICU stay, as well as comprehensive follow-up or palliative care if needed.

The cornerstones of medical intensive care management are optimization of a patient's physiology, the provision of advanced organ support, and the identification and treatment of underlying pathological processes. This is best achieved through a multidisciplinary team approach, with shared responsibility between the admitting 'parent' team and a specialized critical care team coordinated by an intensive care physician.

Organization of critical care services

Prevention and 'critical care without walls'

Early recognition of acutely ill patients in hospitals is a challenging task but can potentially improve outcomes. The use of early warning scores and 'track and trigger' systems has now been widely implemented in many countries. Rapid optimization of care on the ward and early senior involvement are essential to avoid harm to the patient thereby minimizing any deterioration and need for subsequent critical care admission. Medical emergency and critical care outreach teams may play an important role in facilitating early aggressive ward care as well as helping with education and development of skilled ward staff. Whilst intuitively a good idea, clear evidence for the benefit of these teams in terms of patient outcome is still lacking.

Referral and admission to the ICU

The decision to admit an acutely deteriorating patient to the ICU is complex and warrants senior involvement, both from the parent specialty and a critical care physician. The primary question is whether an ICU admission and escalation of care is in the patient's best interest. Whilst considerable effort has been spent to predict outcomes with scoring systems — based on disease process, physiological parameters prior to admission, age and comorbidities — these do not necessarily apply to individual patients and may not be relevant in the acute setting.

For each emergency referral the following issues need to be considered:

- Is there a reversible pathological process?
- Does the patient have the physiological reserve to withstand the insults of their illness and the necessary treatment?
- Is there a reasonable chance of recovery with the prospect of return to an acceptable quality of life as viewed by the patient?
- Has the patient expressed any wishes regarding their care? Do they have an advanced directive?

For any admission, whilst many advanced technical ICU interventions are possible, these may come at the cost of considerable distress to the patient, with both physical and psychological impact during and beyond their ICU stay. The inherent ethical conflicts of beneficience (chance of good outcome), non-maleficience (ICU often involves distressing/painful interventions), autonomy (patients often lack the capacity to express their wishes) and justice (responsibility with resource allocation) need to be finely balanced. These factors are complex and need individual, careful and experienced consideration for each patient.

Broadly speaking, two types of critical care admissions are recognised:

- Planned admissions: Patients requiring optimization and monitoring of their physiological condition before or after an intervention (e.g. a patient with idiopathic pulmonary hypertension awaiting a caesarean section; a patient after elective repair of an abdominal aortic aneurysm).
- Emergency admissions: Patients with established organ failure needing monitoring and support of one or more vital organ functions (e.g. a patient with septic shock secondary to pneumonia requiring invasive ventilation and haemodynamic support; a patient after emergency repair of a ruptured abdominal aortic aneurysm requiring post-operative stabilization).

On the whole, surgical patients requiring critical care have a lower in-hospital mortality than medical patients. Recent UK data estimated this at 4% for planned and 18% for emergency surgery, with 31% for medical patients.[1]

Levels of care: Modern critical care medicine offers a large variety of advanced monitoring and organ support capabilities (Table 1). These depend on the design and scope of individual

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units as well as the perceived benefits for individual patients. Below, two levels of critical care are described.

High-dependency unit (HDU): Admission for single-organ support (not including invasive ventilation). Provides an environment for close monitoring of patients with or at risk of developing organ failure. Sometimes termed 'Level 2' care.

- Respiratory: non-invasive ventilation, arterial blood gases
- Cardiovascular: low-dose vasopressors, arterial and central venous pressure monitoring
- Renal: close fluid balance control, renal replacement therapy (depending on unit set-up)

Intensive care unit (ICU): Admission for multi-organ support or delivery of advanced monitoring techniques. Sometimes termed 'Level 3' care.

- Respiratory: invasive and non-invasive ventilation, extracorporeal membrane oxygenation (ECMO) (in selected centres)
- Cardiovascular: vasopressor and inotropic support, advanced cardiac output monitoring, ECMO, intra-aortic balloon pump, ventricular assist devices
- Renal: renal replacement therapy
- Neurological: intracranial pressure monitoring, electroencephalography, advanced neurological monitoring

Outreach and follow-up

Critical care outreach teams not only have a role in preventing and facilitating intensive care admissions but they also serve as a useful means to ensure high-quality care and follow-up after discharge from the ICU. There is now also an evolving trend to establish long-term follow-up after hospital discharge via critical care outpatient clinics. These may help to understand, alleviate and prevent the detrimental long-term effects of critical illness in the future.

The surgeon on ICU

The role of the surgeon within the critical care team is crucial for advice on individual aspects of the patient care such as specific management of the surgical condition, wound care, nutrition, management of anti-coagulation in the immediate postoperative period. Moreover, strategic decisions on the overall care of surgical patients, and a duty to communicate these to patients and relatives, rest jointly on both surgeon and intensive care physician.

Overview of some critical care organ support and monitoring options

Organ system	Common on ITU	Available in specialized units
Respiratory	Continuous positive airway pressure (nasal, hood, mask) Non-invasive ventilation Invasive ventilation (various techniques) Recruitment manoeuvres Percutaneous tracheostomy Bronchoscopy, broncho-alveolar lavage Prone ventilation	Extracorporeal membrane oxygenation (ECMO) Oscillatory ventilation Extracorporeal CO_2 removal
Cardiovascular	Intravenous fluid management Vasopressors and inotropes Arterial and central venous catheters Cardiac output monitoring: pulse contour analysis (LiDCO, PiCCO and others), oesophageal Doppler, pulmonary artery flotation catheter Cardiac pacing Echocardiography (trans-thoracic and trans-oesophageal) Therapeutic cooling/temperature control	Intra-aortic balloon counterpulsation pump ECMO Ventricular assist devices
Renal	Urine output monitoring Renal replacement therapy including continuous veno-venous haemo (dia-)filtration or intermittent haemodialysis, peritoneal dialysis	
CNS	Neurological observations Raw electroencephalography (EEG) (or EEG derived) monitoring Intracranial pressure monitoring	Jugular venous oximetry Transcranial Doppler Cerebral microdialysis Cerebral tissue oxygenation monitoring
Gastrointestinal	Enteral and parenteral nutrition, immune-enhancing nutrition Intra-abdominal pressure monitoring	Molecular adsorption recirculating system (MARS) in liver failure
Other	Epidural analgesia Plasma exchange Neuromuscular monitoring	

Table 1