Update in
Anaesthesia

Systematic assessment of an ICU patient

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Summary

- A structured approach to assessment and management improves outcome.
- Management should incorporate best evidence and current care 'bundles'.
- Checklists, such as FASTHUG, can aid the complete assessment of the ICU patient's needs.
- Good documentation and communication between health professionals, the patient and family are vital parts of a daily review.
- Many of the disease processes and therapies described are discussed in more detail in later articles in this edition.

INTRODUCTION

The Surviving Sepsis Campaign[1] and World Health Organisation surgical checklist[2] have demonstrated that use of a systematic review and checklist approach, to optimise patient management and safety, improves outcome. Reducing surgical mortality is dependent upon the ability to recognise and 'rescue' patients who develop complications.[3,4] Improved survival of patients treated in critical care has been attributed to improvements in the processes of care, rather than the introduction of individual therapies or diagnostic modalities.[5] Furthermore, the strict implementation of dedicated processes of care, often called *care bundles*, improves ICU and hospital mortality.[6] In this article, we describe a head-to-toe assessment and treatment strategy to guide the daily or night review of intensive care patients. This systematic assessment incorporates the current evidence and care bundles that contribute to improve outcome.

HISTORY

If the patient is awake, introduce yourself and explain who you are and what you intend to do. Whether they are awake or asleep, try to avoid focusing intently on the monitors and charts, thereby ignoring the patient. Although we have more monitoring and tests available to us, the focus of our attention should always be the patient, their symptoms and clinical signs.

The patient's presenting complaint (e.g. pneumonia) will usually be the primary focus of your assessment, but after the first few days of admission the emphasis may shift to other priorities; a patient may recover from intra-abdominal sepsis but be left with respiratory failure due to acute respiratory distress syndrome (ARDS) or underlying airways disease. Details of the past medical history and the presentation of the primary pathology may be difficult to obtain, but information should be sought from relatives, the ambulance crew, referring hospitals and general practitioners or hospital specialists caring for the patient's chronic medical conditions.

When you encounter a patient for the first time, it is worth sitting down to read the current and old hospital notes in full (including specialists letters and old investigations), in order to form a complete picture of the patient's medical history. The physician's traditional wisdom that 90% of the diagnosis is in the history is equally applicable to patients on the intensive care unit. Some patients will only be able to answer your questions for a short period before clinical deterioration or sedation prevents this. The information that you obtain from them may be vital, for example sudden onset of chest and abdominal pain whilst vomiting in a septic patient, suggests a perforated oesophagus, a diagnosis that can easily be missed without a suggestive history. If a patient's response to treatment is not as predicted, review the presentation and consider whether the working diagnosis is correct.

Decisions made regarding admission to ICU, require some knowledge of patient's physiological reserve, their quality of life and their own attitude to such treatments. These decisions should be made and documented pre-emptively rather than when a catastrophic deterioration occurs.

Patients may remain in the ICU for some weeks. Experienced intensivists are able to plot the next few days of a patients ICU stay, allowing goals to be set for certain aspects of the patient's illness. In spite of this, unexpected events occur relatively frequently and it is important have flexibility to focus on whatever issues arise.

EXAMINATION

Physical examination of the patient and their observations can often occur together. A systematic approach must be used and a 'head-to-toe' system is appropriate. Each section focuses on history, clinical examination and observations. Even though this approach is 'labour-intensive' it is this type of attention to detail that may make a difference in a patient's progress in ICU. For example, identifying and removing a cannula that has been in for 5 days, is not being used and shows erythema around it, may prevent an episode of *Staphylococcal* bacteraemia.

Try to avoid making assumptions about other what other medical staff have done; if a trauma patient has been moved rapidly from the emergency department to theatre for abdominal bleeding, when they arrive

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in the ICU and there is no documentation that a secondary trauma survey was completed, then the ICU team must take responsibility to perform it. Most would choose to assess the primary organ failure first, so in a head-injured patient, start with the central nervous system.

Head/central nervous system

General considerations

If the patient's primary pathology is a head injury, cranial surgery or a cerebral event then your assessment should be adjusted accordingly. The patient's Glasgow Coma Score (GCS) should be recorded - for head-injured patients this is most usefully done when sedation has been stopped. If a painful stimulus is applied to assess the motor response, avoid repeating this procedure by different clinicians more than once a day. A full cranial and peripheral nerve examination should be performed daily where indicated - for example in those with fluctuating neurology due to a cerebral abscess or Guillain-Barré syndrome. Note the pupil size and reaction.

Over-sedation is undesirable for a number of reasons and performing daily sedation breaks reduces length of stay on ICU.[7] A sedation score such as the Richmond Agitation-Sedation Scale (RASS) may be used to monitor and titrate sedation appropriately.[8] Delirium occurs in 15-80% of critical care patients. It increases mortality and causes cognitive decline in the long-term.[9] Delerium should be regularly sought and quantified using the CAM-ICU score and management steps, such as treatment with haloperidol, applied if appropriate.[10,11]

Despite the availability of adequate methods of analgesia and appropriate monitoring, pain control can be poor in ICU. Pain scores should be recorded and analgesia reviewed daily, particularly in postoperative patients. Most of the techniques that are applicable for postoperative patients on the surgical ward can be used in ICU and it is useful for intensivists to learn regional techniques such as rectus sheath and epidural insertion. Simple analgesics such as paracetamol should be prescribed routinely, although non-steroidal anti-inflammatory drugs are usually avoided in the critically ill.

Patients with intracranial pathology

Patients at risk of raised intracranial pressure should ideally be treated at centres with specialist input and, where available, intracranial pressure (ICP) monitoring should be considered for those requiring sedation and at risk of high ICP. Local policies targeting cerebral perfusion pressure (CPP, usually >60mmHg) should be followed when the ICP is greater than 20-25mmHg or when there is clinical or radiological evidence of a raised ICP.

Standard neuro-protection includes treating patients head-up 30 degrees with the endotracheal tube taped rather than tied (to minimise obstruction to cerebral venous drainage), ventilation to a $PaCO_2$ of 4.5-5kPa and the maintenance of a PaO_2 greater than 8kPa. Glucose should be in the normal range and steps should be taken to avoid hyperthermia. Disorders of sodium metabolism are common in brain injury. Serum sodium should be maintained at the upper normal range. Ensure adequate sedation, analgesia and muscle relaxation.

Seizures need prompt treatment and phenytoin is the preventative anti-epileptic of choice. The administration of mannitol and hypertonic saline is controversial, but they are often reserved for use in patients with high ICP or suggestive physical signs, for example a blown (fixed, dilated) pupil.[16] Hyperventilation is a short-term measure to reduce critically high ICP before surgical intervention, but should be considered a rescue therapy only.

In many centres around the world, ICP monitoring is not available, so patients with severe head injury are sedated and managed as above for 48 to 72 hours. After this time, daily sedation breaks allow assessment of their underlying condition.

Respiratory and ventilation

General considerations

A past medical history of respiratory disease, including lung function tests, and current respiratory issues should be noted. The patient's airway and respiratory system should be examined. If an endotracheal tube is in place, note that the length at the teeth is as documented at insertion and check its position is correct on the most recent chest Xray. Often it is only possible to auscultate the chest anteriorly and in the axillae. The ventilator settings should be inspected and the measured tidal volume, minute volume, peak and plateau pressures noted. Note whether the patient appears comfortable on these ventilator settings, in particular whether they are 'fighting' (co-ordinating poorly with) the ventilator or display an increased work of breathing. The patient's saturations and, where available, arterial blood gases should be inspected and trends noted. Regular arterial gas measurements of PaO_2 and $PaCO_2$, assessment of the PaO_2:FIO_2 ratio and pH are useful in guiding your ventilation strategy.

If the clinical appearance, oxygenation or blood gases are not satifactory, then you must address this by altering the ventilator mode, settings or level of sedation to improve the situation. Set targets for gas exchange; these should be specific to each patient, so that a patient with severe COPD may have a target SaO_2 of 88% or above.

Acute respiratory distress syndrome (ARDS)

ARDS occurs in up to 14% of ventilated patients, and carries a mortality of 40-60%.[12] It arises as a complication in both pulmonary and non-pulmonary conditions and is diagnosed according to specific criteria (see Box 1).

Low tidal volume ventilation of $6ml.kg^{-1}$ and a conservative fluid management strategy should be used in patients with ARDS.[13,14] Aim for plateau pressures below $30cmH_2O$, allowing hypercapnia if necessary.[15] High PEEP has been shown to be beneficial for patients with confirmed ARDS (PaO_2/FIO_2 < 200mmHg),[16] and in severe left ventricular failure. Early paralysis with neuromuscular blocking agents may improve outcome in patients with ARDS with a PaO_2/FIO_2 ratio < 150mmHg.[17]

Weaning

The ICU clinicain should implement a strategy for gradual weaning of ventilation, from mandatory positive pressure ventilation to a progressive reduction in pressure support, to levels that simply compensate for the resistance of the endotracheal tube and the circuit. Tracheostomy is often used in the ICU to aid weaning from ventilation, and most are now placed using a percutaneous dilational

Box 1. *Proposed new definition of ARDS (European working group and awaiting formal publication).*

	Mild ARDS	Moderate ARDS	Severe ARDS
Timing	Acute onset within 1 week of a known clinical insult or new/worsening respiratory symptoms		
Hypoxaemia	PaO_2/FiO_2 201-300mmHg with PEEP/CPAP ≥ 5cmH_2O	PaO_2/FiO_2 ≤ 200mmHg with PEEP ≥ 5cmH_2O	PaO_2/FiO_2 ≤ 100mmHg with PEEP ≥ 10cmH_2O
Origin of oedema	Respiratory failure not fully explained by cardiac failure or fluid overload		
Radiological abnormalities	Bilateral opacities	Bilateral opacities	Opacities involving at least 3 quadrants
Additional Physiological Derangement	N/A	N/A	Minute volume >10L.min^{-1} or compliance < 40ml.cmH_2O^{-1}

technique. The strength of a patient's cough, their secretion load and swallow function should be assessed. In patients with a tracheostomy, the ability of the patient to tolerate deflation of the cuff and use of the speaking valve are important indicators of weaning progression. Where available, extubation to non-invasive ventilation may reduce the risk of reintubation in patients with COPD.[18]

Circulation

A comprehensive examination of the cardiovascular system should be performed daily. This should include auscultation of the heart sounds and lung bases. Peripheral perfusion, pulses and the presence of peripheral oedema should be noted. Oedema will be present in the lower back and sacrum of a patient that has been supine for a prolonged period and this is a common finding in those who have been critically ill. Spontaneous clearance of oedema, with an accompanying diuresis, is usually a sign that an acute episode of sepsis is resolving.

It is useful to chart observations of heart rate, blood pressure, capillary refill and interventions, such as fluid and inotrope administration, graphically, in order to identify trends. Baseline and serial ECGs are important in patients with ischaemic heart disease, to assess for ischemic changes associated with acute deterioration of the patient. Where available, transthoracic (TTE) or transoesophageal (TOE) echocardiography are useful in evaluation of the structure and function of the right and left ventricles and heart valves.

The use of goal-directed fluid therapy, guided by cardiac output monitoring is controversial but may be of benefit in early sepsis,[19] however many units lack the required equipment for this. The clinical response to fluid administration and, where available, central venous oxygen saturations ($ScvO_2$) may be employed to guide the use of fluids, inotropes and vasopressors (See Box 3).[19] The use of steroids should be reserved for refractory shock.[5]

Abdomen and nutrition

The abdomen should be fully examined at least daily, as it is a concealed source of infection and subsequent driver of inflammation in critical illness. The presence of any surgical drains should be noted and the trends of collection volumes noted to see if further surgery is required, or whether the drain can be removed. Abdominal pressure measurements may be required if abdominal compartment syndrome is suspected on examination. Where available the serum lactate provides a non-specific indicator of pathologies such as bowel ischaemia, that are difficult to detect clinically. Nasogastric (NG) tube placement should be confirmed on a daily basis by pH testing or chest Xray if being used for feeding. The NG tube should be removed as soon as it is no longer needed.

The patient's daily weights should be recorded as a basic nutritional assessment. The typical critical care patient's energy needs are approximately 25kcal per kg per day.[20] This may be doubled in severe sepsis, trauma and burns. Oral intake, NG feeding and any gastric residual volume should be used to calculate energy intake. If available, dietician support and the use of feeding guidelines,[21] will aid adequate calorie, protein, fat, essential amino-acid and mineral input. If NG feeding fails, consider the use of post-pyloric feeding via a tube inserted through the stomach into the proximal small bowel. The potential for re-feeding syndrome should be considered in patients with poor dietary input prior to their ICU admission.

Bowel output should be recorded, and diarrhoea noted and tested for infectious organisms such as *Clostridium difficile* that causes pseudomembranous colitis. Other causes of diarrhoea such as overflow, drugs, high-osmolar feed and intestinal ischaemia should be considered. Delayed gastric emptying is indicated by large aspirates from the NG tube. This is relatively common in critically ill patients and early administration of prokinetics, such as metoclopramide or low-dose erythromycin, is often required. Aperients may be required for constipation.

Early enteral nutrition, is recommended to prevent stress ulceration of the stomach[22] and to preserve mucosal integrity. Ranitidine or a proton pump inhibitor, such as omeprazole, should be given to ventilated patients who are not yet established on enteral feeding.[22,23] Parenteral nutrition (PN) should be reserved for those patients in whom enteral feeding is contraindicated or failing.[24]

Renal, fluids and electrolytes

The urine output should be charted every hour where appropriate. Most urinary catheters are colonised with bacteria, but these are usually not clinically significant. However, catheters should be removed if not

Box 2. *Abbreviated surviving sepsis care bundle.*

SURVIVING SEPSIS CARE BUNDLE (ABBREVIATED)[1]

Initial resuscitation (first 6hours)

1. *Begin resuscitation immediately if hypotensive or lactate > 4mmol.L^{-1}. Targets are:*
   a. CVP 8-12mmHg
   b. MAP ≥ 65mmHg - norepinephrine or dopamine are first-line vasopressors. Use epinephrine as second-line in norepinephrine/dopamine refractory shock. If possible use an arterial catheter to guide vasopressor infusions.
   c. Urine output ≥ 0.5ml.kg^{-1}.h^{-1}. Do not use low-dose dopamine infusions for renal protection.
   d. Central venous O_2 saturations ≥ 70% or mixed venous ≥ 65%.
   e. If venous saturation target missed:
      i. Consider further fluid,
      ii. Transfuse packed red cells to a haematocrit of ≥ 30% and/or,
      iii. Start dobutamine infusion 5-20mcg.kg^{-1}.h^{-1}. Do not increase cardiac index to supranormal levels.
2. *Ventilation*
   a. 6ml.kg^{-1} tidal volumes. Aim for plateau pressure ≤ 30cmH_2O.
   b. Permissive hypercapnia may be required to minimize plateau pressures, except in patients with intracranial hypertension.
3. *Diagnosis*
   a. Obtain appropriate cultures as long as this does not significantly delay antibiotic administration. Two or more blood cultures (one percutaneous culture and cultures from each vascular access device in place > 48hours).
   b. Perform imaging studies promptly to confirm and sample any source if safe to do so.
4. *Antibiotic Therapy*
   a. Begin broad-spectrum antibiotics with good penetration to presumed source and active against likely pathogens as soon as possible, but at least within 1 hour of recognizing sepsis or septic shock.
   b. Combination therapy should be considered for *Pseudomonas* infection or in neutropaenic patients, until culture susceptibilities are available.
   c. Stop antibiotic therapy if the cause is found to be non-infectious.
5. *Steroids*
   a. Hydrocortisone < 300mg per day in divided doses can be considered for fluid and vasopressor-refractory shock.

required or in patients who are anuric due to renal failure. The trends in renal function and electrolytes should be examined frequently and correlated with the patient's progress as a whole.

The patient's fluid administration should be reviewed and the daily and cumulative fluid balances noted. The use of crystalloid versus colloid fluid is still debated. The use of starch-based colloids does not improve survival and may cause renal impairment.[25,26] The SAFE study showed no benefit of albumin over saline in all ICU patients and subgroup analysis suggested albumin may reduce mortality in sepsis, but increase it in traumatic brain injury.[27]

Dialysis or renal replacement therapy (RRT) may be required in hyperkalaemia, fluid overload, uraemia, acidosis, or poisoning due to a filterable toxin. There is no difference between intermittent haemodialysis (IHD) or continuous veno-venous haemodiafiltration (CVVHD) in outcome, but CVVHD may be better tolerated in patients who are cardiovascularly unstable.[28] Thrombocytopaenia is a common complication of renal replacement therapy and is usually due to consumption by the extracorporeal circuit, but other causes such as heparin induced thrombocytopaenia (HIT) should be considered.

BLOOD TESTS

All of the patient's blood tests should be reviewed and trends noted - this is most easily viewed when plotted on a chart. Where available, ICU patients require daily measurement of renal function, electrolytes and haematology indices. Magnesium and calcium levels, clotting function and blood grouping for transfusion are frequently required. Low levels of magnesium (<0.7mmol.L^{-1}) and phosphate should be treated by intravenous supplementation.

A conservative transfusion strategy is usually recommended in 'stable' critically ill patients; aim for a haemoglobin level above 7g.dL^{-1},[29,30] although a higher haemoglobin concentration may be targeted in patients with ischaemic heart disease and septic shock.[19] Transfusion practice is greatly affected by local availability of donor blood and by the prevalence of diseases such as malaria within the population.

Where available, platelet transfusion is usually guided by consultation with a haematologist, but should always be considered when:

- the platelet count is <5 x10^{9}.L^{-1} regardless of bleeding,
- 5-30 x10^{9}.L^{-1} in active bleeding, or
- <50 x10^{9}.L^{-1} when surgery or invasive procedures are planned.

Some neurosurgery centres may aim for a platelet count of >100 x10^{9}.L^{-1} in cases of intracranial haemorrhage.

Blood glucose control has been controversial, with a major recent study demonstrating that tight glucose control worsens outcome.[31] Use an intravenous infusion of short-acting insulin or regular injections of subcutaneous insulin to keep blood sugar levels between 5 and 8mmol.L^{-1}.

MICROBIOLOGY

Sepsis can begin insidiously and may be difficult to recognise, but should be suspected if the patient is not progressing as expected. Many patients are relatively immunocompromised in response to their primary illness, and tend to develop secondary episodes of sepsis several days after admission. A thorough CNS, respiratory, cardiac and abdominal examination, looking for stigmata of infection, should be completed to identify the likely sources of infection. Management should follow the surviving sepsis bundle (see Box 2). Blood cultures and other microbiology samples should be taken and appropriate antibiotics administered within 1 hour.[1] Each hour that appropriate antibiotic administration is delayed increases mortality by 8%.[32]

Microbiology input should be sought and antibiotics tailored to local pathogens and their known sensitivities. Antibiotics should be reviewed on a daily basis and stopped after an appropriate response and duration.

RADIOLOGY

Current and past imaging should be reviewed as required. A competent person should check every diagnostic test and document the results, to ensure that relevant information is not missed and that patients do not undergo unnecessary harmful procedures involving exposure to Xrays. There is no evidence that routine daily chest radiography is superior to clinically indicated studies.

MEDICATIONS

Scrutinise the patient's medication chart on every ward round, stopping any unnecessary drugs and antibiotics. If the patient has impaired renal or hepatic function, special consideration should be made for the risks of each medication administered and the remaining medication should be dose-adjusted. Levels may be required for certain medications, such as digoxin and phenytoin. Each medication should be reviewed in light of the current diagnosis and issues affecting the patient, for example the presence of ACE inhibitors or non-steroidal anti-inflammatory drugs in acute kidney injury.

Ensure that, when appropriate, the patient's usual drugs are restarted (e.g. antihypertensive drugs after an episode of sepsis).

VASCULAR ACCESS

Routinely check any vascular access catheters for each patient. Your unit should have robust system for documenting the insertion date of each of these. If sepsis develops and no other source is evident, replace all venous and arterial catheters. There is no evidence to support routine replacement of venous catheters after a certain number of days, but suspicion of infection should increase the longer a cannula is in situ, particularly if there are local signs of infection (erythema, pus).

FASTHUG

The application of a final series of checks helps to ensure that all elements of good supportive care are in place. The FASTHUG assessment is one such system in common use (see Box 3).[33] This simple assessment covers many aspects of important ICU care, that are often neglected, but will reduce the incidence of ventilator associated pneumonia (VAP), deep vein thrombosis (DVT), stress ulcers and malnutrition.

Box 3. *FASTHUG mnemonic*[33]

FASTHUG

F **Feeding** - Ensure nutrition has been assessed and that the patient's nutrition needs are being met.

A **Analgesia** - Pain should be assessed and pain relief given for the patient's disease process and medical interventions (including as part of sedation strategy).

S **Sedation** - Sedation should be assessed and patients not over-sedated. Daily sedation breaks should be considered.

T **Thromboprophylaxis** - All patients should receive prophylactic dose subcutaneous low molecular weight heparin unless contraindicated. TED stockings or calf/foot pumps should be applied.

H **Head-up** - The head of the bed should be elevated to 30 - 45 degrees to reduce gastro-oesophageal reflux and nosocomial pneumonia in ventilated patients.

U **Ulcer prophylaxis** - Ranitidine should be prescribed for ventilated patients, not established on enteral feeding. Once enteral feeding is established, it should be discontinued.

G **Glucose control** - Aim to keep glucose levels ≤150mg.dL^{-1} (8mmol.L^{-1}) using a validated protocol.

DOCUMENTATION

Document all of your findings in a systematic way. Always clearly date and time your assessment of the patient. Make a clear *problem list*, followed by a *plan* for the day that relates to the problem list. It is useful to tick off the items on the plan as they are completed.

FAMILY/NEXT OF KIN

Ask who the immediate family are and whether they have had any discussion with members of the nursing or medical staff. Should someone speak to them today to keep them up-to-date with changes in the patient's condition? Document any discussions that you do have.

OTHER POINTS

- Discuss the resuscitation status of the patient and check that any decisions about the levels of care offered in the case of clinical deterioration have been documented.
- Ask the nurse looking after that patient whether they have any other issues that have not been resolved in your assessment.
- Ask any other members of the team whether they have anything else to add.
- Explain your main findings and plans to the patient, in as much detail as appropriate.

SUMMARY

This system will guide you to perform a comprehensive assessment of your patient. In ICU rigorous attention to detail can make the difference between survival and death. Combine clinical skills with knowledge of current evidence to reach a diagnosis and guide your management of each patient you encounter.

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