Crisis management during anaesthesia: sepsis

J A Myburgh, M J Chapman, S M Szekely, G A Osborne*


**ORIGINAL ARTICLE**

Sepsis has been defined as the systemic response to infection. Prompt and effective resuscitation, rational prescription of antibiotics and where appropriate, surgical debridement and drainage are the essentials in the treatment of severe infections. Anaesthesia with concurrent sepsis is risky, and involves consideration of possible organ dysfunctions—respiratory, cardiovascular, renal, and haematological—as well as ensuring that appropriate antibiotics are given after taking the necessary microbiological specimens. Because prompt attention needs to be paid to so many body systems, the place for a structured approach during anaesthesia for a septic patient was assessed.

**Background:** Anaesthesia with concurrent sepsis is risky, and involves consideration of possible organ dysfunctions—including respiratory, cardiovascular, renal, and haematological—as well as ensuring that appropriate antibiotics are given after taking the necessary microbiological specimens. Because prompt attention needs to be paid to so many body systems, the place for a structured approach during anaesthesia for a septic patient was assessed.

**Objectives:** To examine the role of a previously described core algorithm “COVER ABCD–A SWIFT CHECK”, supplemented by a specific sub-algorithm for sepsis, in the management of sepsis occurring in association with anaesthesia.

**Methods:** The potential performance of this structured approach for each of the relevant incidents among the first 4000 reported to the Australian Incident Monitoring Study (AIMS) was compared with the actual management as reported by the anaesthetists involved.

**Results:** Sepsis was identified as the primary problem in 13 of the first 4000 reports (<1%) to AIMS. The incidents reported generally occurred in sick patients; 70% were ASA status III or worse. The COVER ABCD algorithm provided a diagnosis and corrective manoeuvre in only 15% (2/13) of reported incidents, and the sepsis sub-algorithm provided adequate therapeutic strategies in a further 38% (5/13) of the incidents. Eight cases required the use of additional sub-algorithms for desaturation (30%), cardiac arrest (15%), hypotension (8%), and aspiration (8%).

**Conclusion:** Sepsis involves a serious physiological stress upon multiple organ systems. The use of a structured approach involving a core algorithm and additional sub-algorithms as required provides a series of checklists that can successfully deal with the complex multiple and interrelating problems that these patients present.

**METHODS**

Of the first 4000 incidents reported to AIMS, those that made reference to sepsis were extracted and analysed for relevance, presenting features, type of surgery, cause, management, and outcome. The COVER ABCD–A SWIFT CHECK algorithm, as presented elsewhere in this set of articles, was applied to each relevant report to determine the stages at which the problem might have been diagnosed and to confirm that activating the COVER portion would have led to appropriate initial steps being taken.

As sepsis was not adequately dealt with by this algorithm, a specific sub-algorithm was developed for these problems (see fig 1), and its putative effectiveness was tested against the reports. How this was done is described elsewhere in this set of articles. The potential value of this structured approach...
that is, the application of COVER ABCD–A SWIFT CHECK to
diagnosis and initial management of this problem,
followed by the application of the sub-algorithm for sepsis
was assessed in the light of the AIMS reports by comparing
its potential effectiveness for each incident with that of the
actual management, as recorded in each report.

RESULTS
There were 36 reports that contained the word “sepsis”. Of
these, 13 were associated with specific sepsis related events
and were analysed for this study. The remaining 23 reports
related to other incidents in which sepsis did not play a
significant role. Physical (ASA) status is shown in table 1.

Presenting features are shown in table 2, and features of
the procedure and patient in table 3.

In summary, the incidents reported generally occurred in
very sick patients; 69% were ASA status III or worse (table 1).
Diabetic, immunocompromised, and intensive care patients
undergoing procedures for urological, biliary, or cutaneous
infections were represented. Cardiorespiratory compromise
presenting as desaturation (77%), hypovolaemia (46%), and
hypotension (30%) were the most common presentations
(table 2). These incidents occurred most frequently at
intubation (37%), following extubation, or in the immediate
postoperative period (67%). Premature extubation requiring
reintubation for respiratory failure was common (62%) and
of these patients, the majority (75%) required postoperative
ventilation in the intensive care unit. Volume resuscitation
was used in 46%, and inotropic support in 40%.

The COVER ABCD algorithm and the sepsis sub-algorithm
were sufficient for adequate management in just over half of
the patients; however, eight cases required additional sub-


diagonal lines

DISCUSSION
This study analysed incidents from 4000 AIMS reports where
sepsis or infection related incidents were identified during

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Classification according the American Society of Anesthesiologists (ASA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASA status</td>
<td>Definition</td>
</tr>
<tr>
<td>I</td>
<td>Healthy patient</td>
</tr>
<tr>
<td>II</td>
<td>Mild systemic disease</td>
</tr>
<tr>
<td>III</td>
<td>Moderate systemic disease</td>
</tr>
<tr>
<td>IV</td>
<td>Severe systemic disease</td>
</tr>
<tr>
<td>V</td>
<td>Moribund patient</td>
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</tbody>
</table>

*38% (5/13) patients were emergencies.

SEPSIS

SIGN (1)*
Confusion/tachypnoea
Hypotension or tachycardia
Unexplained desaturation or hypercarbia
Sporadic fever and rigors, or hyperthermia
Unexplained metabolic acidosis
Oliguria
Elevated creatinine
Thrombocytopaenia
Evidence of disseminated intravascular coagulopathy
Postoperative respiratory failure
Failure to reverse

EMERGENCY MANAGEMENT (2)
Complete COVER ABCD–A SWIFT CHECK
Call for help
100% oxygen
Bolus of crystalloid or colloid 10 ml/kg IV
Consider placing an arterial line
Consider an adrenaline infusion
Adrenaline: for easy adult doses, see (4) on page 71**
Titrate to achieve a mean blood pressure > 70 mmHg

Further management (3)
Consider placing a central venous line
Aim for a CVP of > 8 mmHg
Take samples for microscopy and culture of:
- Blood, urine
- Any other fluids (e.g. bile, pus, ascites, CSF)
Record any prior antibiotics
Give appropriate empirical antibiotics (seek advice if unsure)
Check haematology, coagulation status, biochemistry, blood gases
Place a urinary catheter

* Numbers in brackets refer to Notes in the right hand panel.
** Page references refer to Crisis Management Manual12.

FURTHER CARE
Continue vigorous fluid resuscitation throughout
Continue the adrenaline infusion
If there is continuing instability → ICU

(1) Cardiorespiratory compromise presenting as desaturation – 77%,
hypovolaemia – 46%, and hypotension – 30% were the
commonest presentations.
Postoperative respiratory failure was common – 62% of reported
incidents: 31% requiring re-intubation.
(2) Sepsis was generally reported in high risk patients:
70% were ASA III or above
Diabetics
Intensive Care patients
Immunocompromised patients
Instrumental urological procedures
Instrumental enteric and biliary procedures
Orthopaedic infections
(3) Active infection/sepsis:
- Urological sepsis
- Gynaecological sepsis
- Biliary sepsis
- Pancreatitis
- Abscesses
- Cellulitis/fascitis

These notes comprise a reverse side of a page of the Crisis Management Manual12.
anaesthesia. Sepsis is the systemic response to infection and represents a continuum of illness severity from minor constitutional signs (fever, tachycardia, leucocytosis) to septic shock and multiple organ failure. The duration of this response is variable and may persist into the postoperative period. Initially, it represents an endogenous mediator driven response to increase the patient’s capacity to meet the metabolic demands imposed by the septic insult. This may manifest as an increase in cardiorespiratory drive in order to increase oxygen delivery. In the normal individual, this endogenous response is well tolerated. Associated cardiorespiratory comorbidities and reduced immunocompetence by diseases such as diabetes, malignancy, or by drugs may reduce the capacity of the patient to meet these increased metabolic demands. Certain infections such as gram negative or gram positive septicemia may induce an overwhelming endogenous response that exhausts the reserve of the patient. These patients should be transferred to the ICU. Seventy five per cent required postoperative ventilation and patient features and management.

The limited data from this study confirm that septic patients undergoing anaesthesia for procedures directed at the underlying septic problem are vulnerable to hypoxia and hypotension during the perioperative period. It is vital to eliminate any causes of desaturation or hypotension that are unrelated to the underlying septic problem. These are diagnosed and corrected by the COVER ABCD algorithm, and, if necessary, the desaturation, hypotension, and any other relevant sub-algorithms. When the cause of desaturation or hypotension remains obscure, sepsis or SIRS should be considered to be the mechanism. A “sepsis” sub-algorithm for anaesthesia (fig 1) is proposed in these circumstances. Unexpected desaturation during intubation and hypotension following induction of anaesthesia are manifestations of increased metabolic demands and hypovolaemia that are hallmarks of sepsis. The majority of reports pertained to incidents that occurred in the immediate postoperative period, where premature extubation and postoperative cardiorespiratory failure might have exposed the limited reserve of the patient. These patients should be transferred to an intensive care unit for postoperative ventilation and management.

In the control of sepsis, the use of a structured approach involving a core algorithm and any necessary sub-algorithm provides a series of checklists in what otherwise can become an overwhelmingly complex set of problems. This also ensures that an additional, unrelated problem is not compromising the patient.

### Key messages

- Sepsis was identified as the primary problem in 13 of the first 4000 incidents reported toAIMS.
- Seventy per cent of the patients were graded ASA III or worse; one patient was moribund.
- The commonest performed procedures were urological, enteric, biliary, and cutaneous/orthopaedic.
- Thirty eight per cent of the patients were diabetic. Eight per cent were immunosuppressed.
- Commonest presenting incidents in the series were: desaturation (77%); postoperative respiratory failure (62%); hypovolaemia (46%); hypotension (31%).
- Seventy five per cent required postoperative ventilation in the ICU. Volume replacement was used in 46% and inotropes in 40%.
- The COVER ABCD core algorithm and the sepsis sub-algorithm were adequate for the management of just over half the patients. However additional sub-algorithms were required for eight cases, namely desaturation (30%), hypotension (18%), cardiac arrest (15%), and aspiration (8%).

### ACKNOWLEDGEMENTS

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REFERENCES

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