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Air Medical Journal

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Original Research

Management of Septic Shock in the Remote Prehospital Setting

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A B S T R A C T

This study aims to assess the management of septic shock by air medical retrieval teams in the remote setting. A retrospective observational study was performed over 36 months. Sixty-seven adult patients who met the criteria for septic shock were included. Respiratory sepsis was the working diagnosis for 53% of patients; this was confirmed on intensive care unit (ICU) discharge in 39% of patients. Intravenous antibiotics and oxygen were delivered in over 90% of patients. Central and arterial line insertions were performed in 48% and 40% of patients, respectively, and 79% of patients were catheterized. Thirty-three percent of patients required intubation, and 80% of patients received an initial crystalloid fluid bolus of 20 mL/kg. Vasopressors were started in 89% of patients. Upon reaching definitive care, 91% of patients were admitted to a high-dependency or ICU setting, with a median length of ICU stay of 4 days and a 30-day mortality of 13%. Of those admitted to the ICU, intubation was required in 48%, new renal support in 20%, and blood pressure support in 84% of patients, respectively. Septic shock was recognized early and managed aggressively by remote retrieval teams, which may have contributed to the low mortality rate observed. Crown Copyright © 2016 Published by Elsevier Inc. on behalf of Air Medical Journal Associates. All rights reserved.

The Top End is a geographical region encompassing the northernmost section of Australia's Northern Territory (NT). It covers an area of 400,000 km² with a population of around 160,000.¹ Care Flight NT provides the air medical retrieval service in the Top End. Care Flight retrieves approximately 5,000 patients a year to Royal Darwin Hospital (RDH), the major referral hospital in the NT. Most referrals are from remote clinics and 2 smaller rural hospitals. Referrals include a high proportion of indigenous patients who are critically unwell and encompass a wide disease spectrum including trauma, sepsis, and psychiatric illness.

Indigenous Australians account for 27% of the catchment population, and 30% live in remote locations. Generally, indigenous people account for 2% of the Australian population.² Their increased morbidity and decreased life expectancy in comparison with nonindigenous Australians have been well-documented. Indigenous people face many barriers to health care and often present late in the disease course.³

Septic shock is a life-threatening condition worldwide, with a high associated mortality. The incidence of sepsis in the Top End of Australia's NT is higher than in more temperate parts of Australia.³ The incidence in the indigenous population is far

greater (4.7 vs. 1.3 per 1,000 population per year) than in the general population.³

Septic shock is a time-critical illness similar to polytrauma or myocardial infarction. Early recognition and prompt management of septic patients have been shown to improve patient outcomes.⁴ This observational study aims to assess the recognition and management of septic shock in the remote retrieval setting.

Methods

A retrospective observational study was performed over 3 years from January 2011 to January 2014. Inclusion criteria were adult retrieval patients who met diagnostic criteria for septic shock. Septic shock is defined as severe sepsis with refractory hypotension (systolic blood pressure < 90 mm Hg or mean arterial pressure [MAP] < 65 mm Hg) despite adequate fluid resuscitation. Severe sepsis is defined as sepsis-induced tissue hypoperfusion or organ dysfunction with a generalized inflammatory response thought secondary to infection.⁴ Exclusion criteria included patients < 18 years old and undifferentiated or other forms of shock.

Two trained health professionals used standardized criteria for data collection. Electronic records were analyzed and cross-referenced with the patients' paper records. All patient records within the data collection period were examined for evidence of septic shock. Patients' electronic hospital records were examined to assess outcomes after admission to the referral hospital. Data

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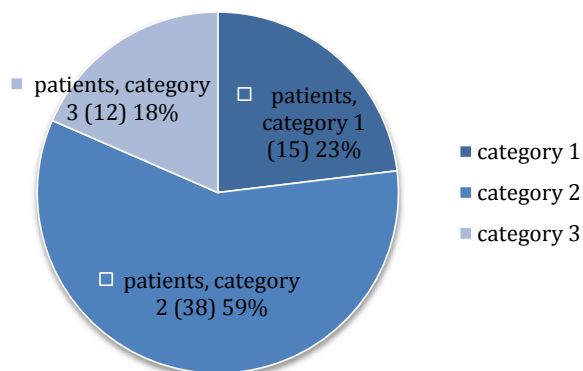


Figure 1. The percentage of patients retrieved by triage category.

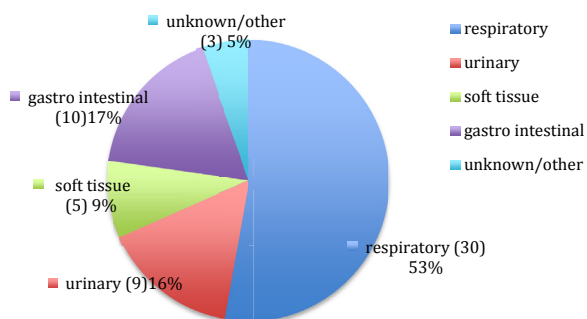


Figure 2. The provisional source of sepsis.

collection included age, sex, referral site, triage category, duration of retrieval, flight crew composition, observations on referral, lactate, and suspected source of infection. Prehospital treatment and interventions recorded included blood cultures, intravenous antibiotics, initial fluid bolus, inotrope and/or vasopressor support, central line placement, urine output measurement, invasive blood pressure monitoring, and intubation. Data collection after hospital admission included intensive care unit (ICU) admission and length of stay (LOS), organ support on ICU, correct antibiotic use in accordance with local policy, confirmed sources of infection, and 30-day mortality. Ethics approval was granted through the Menzies School of Health Research.

Results

Sixty-seven patients were identified as having septic shock; of these, 23 (34%) were male, and the median age was 48.5 years. Ninety-four percent of the population were indigenous. Job retrieval times ranged from 90 minutes to 12 hours, with a median time of approximately 6 hours. Both a doctor and nurse retrieved 88% of patients, and 12% were retrieved solely by a nurse. The majority of transfers were done using fixed wing aircraft; a small number of transfers used rotor wing aircraft. The most common referral sites were the 2 smaller district hospitals, with approximately 50% of referrals received. The following triage system was used for patient retrieval depending on urgency, and this was the responsibility of the Care Flight consultant on duty: category 1, urgent (depart base within 30 minutes); category 2, semiurgent (depart within 2 hours), and category 3, nonurgent (depart within 6 hours). Most patients were triaged as category 2 (59%) as shown in Figure 1.

A serum lactate was documented on referral in 31 of 67 (46%) patients. Thirteen of 31 (42%) patients had a serum lactate > 4 mmol/L. A provisional diagnosis and source of sepsis were documented by the retrieval team (Fig. 2). Fifty-three percent of

Table 1
Interventions Performed by Care Flight Retrieval Team

Intervention	Yes, n (%)	No, n (%)	Total Number of Patients	Excluded (No Documentation)
Oxygen delivery	65 (97)	2 (3)	67	—
Arterial line	26 (40)	39 (60)	65	2
Central line	32 (48)	34 (52)	66	1
Catheterization	53 (79)	14 (21)	67	—
Hourly urine output documented	17 (26)	50 (83)	67	—
Blood cultures	22 (34)	42 (66)	64	3
Intravenous antibiotics	65 (99)	1 (1)	67	1
Initial fluid bolus (20 mL/kg)	39 (80)	10 (20)	67	18
Intubation (by clinic or CF)	22 (33)	45 (67)	67	—

Table 2
Fluid Volume Delivered After Fluid Bolus

Volume (mL)	None	< 1,000	1,001-1,999	2,000-2,999	3,000-3,999
Total patients (40)	7 (17%)	15 (38%)	7 (17%)	8 (20%)	3 (8%)

patients were documented as having a respiratory source of sepsis followed by gastrointestinal (17%) and urinary tract (16%) sources.

Prehospital interventions performed by the retrieval team are shown in Table 1. Oxygen was delivered in 97% of patients; the remainder maintained oxygen saturations > 95% on air. Less than 50% of patients had either a central or arterial line inserted. However, the majority of cases required vasopressor or inotropic support to maintain a systolic blood pressure of more than 90 mm Hg. Fifty-three (79%) patients were catheterized in the retrieval setting, and urine output was documented in 17 (26%) patients; 9 patients (14%) had a documented urine output > 0.5 mL/kg/h during retrieval. Blood cultures were documented in 22 (34%) patients. The Care Flight retrieval physician was responsible for the timely delivery of intravenous antibiotics (IVABs), and these were given upon referral to Care Flight in 99% of the cases. Twenty-two (33%) patients required intubation for respiratory support before reaching definitive care. Of these, 15 (22%) were intubated by Care Flight, and 7 (10%) were intubated in the referring clinic before retrieval.

Fluid resuscitation by weight was available for 49 patients; the median volume for fluid resuscitation was 3 L. An initial crystalloid bolus of 20 mL/kg, in accordance with Survive Sepsis Campaign guidelines, was given to 39 (80%) patients. Ten (20%) patients did not receive an adequate crystalloid bolus. A crystalloid bolus > 1 L was given in 58 (89%) patients. Seven patients (11%) received < 1 L, and, of these, 3 did not have the fluid volume recorded, and 4 received minimal fluid because of end-stage renal failure and concerns about hypervolaemia. Two patients were excluded because fluid was not documented.

Seven patients (17%) had an adequate initial fluid bolus in clinic and required no further fluid resuscitation before arrival at RDH (Table 2). Thirty-eight percent of patients required < 1 L fluid bolus by the retrieval team, 17% received 1 to 2 L, and 20% received 2 to 3 L fluid, respectively. Eight percent of patients required 3 to 4 L fluid resuscitation.

Forty-eight percent of patients had a central line insertion, and inotropes/vasopressors were instituted in 59 (89%) patients. (Five patients had no vasopressors, and 3 had no documentation.) These were administered peripherally if central access was not practical or available before reaching definitive care. Central venous pressure was not routinely documented in the retrieval setting. Most patients (40%) received metaraminol via a peripheral line as the first-line vasopressor followed by noradrenaline (21%) centrally and adrenaline (12%) centrally or peripherally. Fourteen percent of patients received metaraminol plus adrenaline or noradrenaline.

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