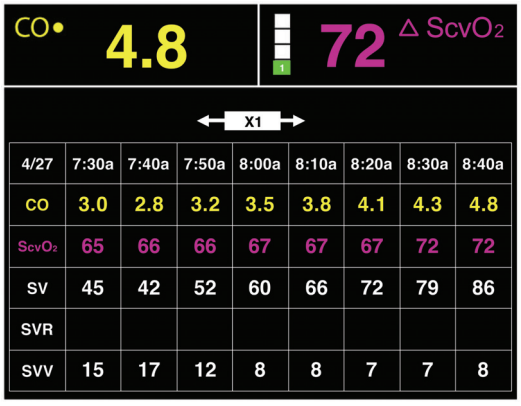
CASE STUDY

Minimally Invasive Monitoring Necrotizing Fasciitis

INTRODUCTION

The availability of a minimally invasive device that can be easily set up to monitor critically ill patients in an emergency situation is extremely valuable. In addition to monitoring basic hemodynamic parameters such as blood pressure and heart rate, such devices allow more sophisticated monitoring of other important cardiovascular parameters such as cardiac output, central venous oxygen saturation, stroke volume variation, and systemic vascular resistance.

Patient details:	66-year-old female, 168 cm, 99 kg, 2.15 m^2
Medical history:	Poorly controlled diabetes mellitus, not compliant with insulin therapy; rheumatoid arthritis on long-term steroid therapy



4/27	7:30a	7:40a	7:50a	8:00a	8:10a	8:20a	8:30a	8:40a
CO	3.0	2.8	3.2	3.5	3.8	4.1	4.3	4.8
ScvO2	65	66	66	67	67	67	72	72
SV	45	42	52	60	66	72	79	86
SVR								
SVV	15	17	12	8	8	7	7	8

Figure 1

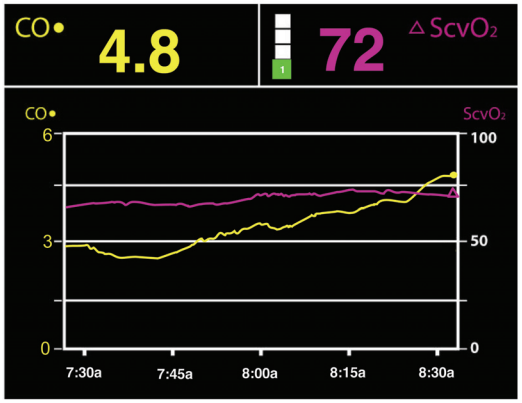


Figure 2

CASE NOTES

This patient presents with a four day history of pain and swelling in her right foot. On examination, she appeared lethargic with a temperature of 38.4ºC. Blood pressure (BP) was 100/55, heart rate (HR) 120/min and respiratory rate (RR) 22/min. Her right foot was edematous, indurated and tender with ascending inflammation involving her calf that was extending to her knee. A probable diagnosis of necrotizing fasciitis was made based on the history and clinical findings.

She arrived in the operating room for an emergency exploration and debridement of her right lower extremity. A fluid bolus of 500 ml Lactate Ringer's solution was administered prior to induction of anesthesia as the patient was hypotensive and tachycardic. A rapid sequence induction was performed using intravenous etomidate 2mg/kg and suxamethonium 1 mg/kg. The trachea was intubated and anesthesia was maintained with isoflurane in 2 L/min of oxygen and 1 L/min of nitrous oxide.

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When surgical incision was made on the foot, extensive necrosis extending proximally was found in the soft tissue and muscle. Thirty minutes into surgery, the patient's hemodynamic parameters deteriorated. BP decreased to 85/40. Electrocardiogram showed a HR of 136/min, sinus tachycardia with a 1-mm ST segment depression. Blood loss was approximately 300 ml. Despite repeated fluid challenge with colloids as well as 1 unit of packed red blood cells, the patient's vital signs remained unchanged.

A radial arterial line with a cardiac output sensor (Edwards FloTrac sensor, Edwards Lifesciences, Irvine, CA, USA) was inserted. A central venous catheter with a central venous oxygen saturation sensor (Edwards PreSep central venous oximetry catheter, Edwards Lifesciences, Irvine, CA, USA) was also placed. Initial readings revealed a cardiac output (CO) of 3.0 L/min (cardiac index of 1.4 L/min/m^2), stroke volume (SV) of 45 ml (stroke volume index of 21 ml/m^2) and stroke volume variation (SVV) of 15% (Figure 1). $ScvO_2$ was 65%. Additional colloid solution was administered to a total volume of 700 ml. SVV improved to 8% with slight elevations in CO to 3.5 L/min and SV to 60 ml. The Edwards Vigileo monitor also showed the calculated systemic vascular resistance to be low at 550 dyne-sec/cm^{-5} (systemic vascular resistance index, SVRI, of 256 dyne-sec/cm^{-5}/m^2) using the Vigileo monitor on-board derived calculator.

An intravenous infusion of norepinephrine was therefore started at 0.04 mcg/kg/min and titrated upwards according to the patient's hemodynamic parameters. CO improved and remained at about 4.8 L/min while vital signs began to normalize. BP was 110/68 and HR was 105/min. Surgery was completed in 1 hour. In view of patient's critical condition, she was kept intubated and ventilated and was transferred to the Intensive Care Unit for postoperative stabilization. Intravenous penicillin G, gentamicin and metronidazole were started pending bacterial culture and sensitivity testing from the wound and blood. Over the next 24 hours, the patient's status was optimized with a combination of antibiotics, fluid and vasopressors. CO increased to 5.1 L/min, $ScvO_2$ increased to 80% and SVR increased to 1300 dyne-sec/cm^{-5}. On the second postoperative day, the patient appeared to respond to the antibiotic therapy. She was gradually weaned off the ventilator as requirement for vasopressors declined. She was extubated on the third postoperative day. Group A hemolytic streptococcus and Staphylococcus aureus sensitive to penicillin was grown from both blood and tissue specimens. Patient was transferred to the stepdown unit the following day.

DISCUSSION

This case demonstrates the usefulness of a minimally invasive continuous CO monitor in a perioperative setting. In this example, the initial measurements of low CO, SV and large SVV were consistent with hypovolemia. Careful fluid resuscitation did not completely correct the hemodynamic changes as the hypotension was also contributed by the low SVR.

The FloTrac sensor was helpful in excluding cardiogenic and hypovolemic causes of shock. It was also useful for monitoring of systemic vascular resistance. An extremely low SVR shown by the monitor was consistent with septic shock. The clinical picture of septic shock was expected with necrotizing fasciitis. After adequate fluid loading, the correct intervention using intravenous norepinephrine infusion was therefore instituted to increase peripheral vascular resistance to treat hypotension. The continuous monitoring of $ScvO_2$ enables close tracking of the patient's progress and the adequacy of oxygen delivery against oxygen consumption.

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