

Noninvasive Clinical Monitor for Early Detection of Shock

Kenneth A. Schenkman, Lorilee S. L. Arakaki, Wayne A. Ciesielski,
David J. Carlborn and Eileen M. Bulger
University of Washington, Harborview Medical Center and
Seattle Children's Hospital, Seattle, WA

Shock is a major medical problem

Shock is a life-threatening medical condition. During shock, insufficient oxygen reaches the body tissues, and organs begin to shut down.

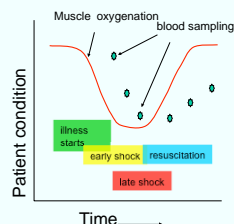
- High mortality rate.
- Current diagnosis and treatment rely on in-dwelling catheters and blood testing, which are highly invasive and expensive.
- There is no monitor currently available for detecting shock in its earliest and most reversible stages.

Our approach

This project is to develop a noninvasive monitor for shock. This monitor will serve as an early warning to clinicians that shock may be developing.

- Uses safe, white light.
- Probe attaches to the hand.
- Analyzes absorption of light in hand muscle.
- Measures oxygen within muscle.
- Can give real-time information.

Fig. 1. Muscle oxygenation monitoring has the advantage of yielding continuous and timely clinical information. Blood sampling is not continuous, and values may lag changes in clinical state.



Supported by The Washington State Life Science Discovery Fund, with additional funding from The University of Washington Center for Commercialization, The Medic One Foundation, and The W. H. Coulter Foundation. Thanks also to Dana M. Fisk, Kellie L. Sheehan, and Karin M. Asplund, for assistance with patient enrollment and data collection.

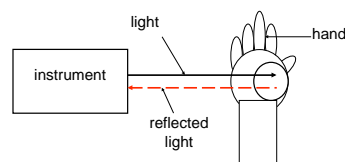


Fig. 2. White light illuminates the muscle tissue and back-scattered light is collected by the detector. Information contained with the optical spectra are analyzed to measure muscle oxygenation.

Significance:

Early identification of shock has been shown to decrease mortality and lower hospital costs. Shock is expensive to treat and has a high mortality rate.

- 750,000 cases of shock per year.
- Mortality can be as high as 40%.
- \$10 Billion spent in US for septic shock alone.
- \$17 Billion to treat all forms of shock.



Fig. 3. Prototype shock monitor in the Emergency Department at Harborview Medical Center measuring muscle oxygenation in a trauma patient

Progress to date

We have enrolled 27 patients who sustained a traumatic injury and were admitted to the ED at Harborview. 11 were also followed during their ICU hospital course.

- Muscle oxygenation on admission to the ED is significantly lower compared with healthy control subjects.
- Patients requiring mechanical ventilation have lower muscle oxygenation than those not on a ventilator.
- Muscle oxygenation tracks with clinical status.

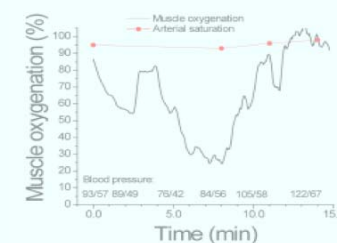


Fig. 4. Muscle oxygenation changes with clinical status. In this patient, muscle oxygenation dropped with lower blood pressure and improved promptly with treatment.

Future plans

With data from this study we aim to attract further funding to develop a compact, clinically useful noninvasive monitor. We envision this will be used in ambulances, emergency departments, intensive care units and operating rooms. This monitor will aid in early diagnosis of shock, resulting in improved survival and lower medical costs.