D15

The use of high fidelity simulators to facilitate teaching of the diagnosis and treatment of circulatory shock

A.T. Lovell

University Department of Anaesthesia, University of Bristol, Bristol, UK

This demonstration will illustrate the use of a high fidelity simulator in the teaching of the applied cardiovascular pathophysiolgy of shock. Traditional teaching of the recognition and management of circulatory shock is commonly performed either in a lecture or seminar format. Although this is a clinical problem in applied circulatory pathophysiology, the concept of a clinical demonstration of the differential diagnosis and management of circulatory shock has hitherto generally been considered as impractical. These patients are critically ill, and usually present a times incompatible with undergraduate teaching. The clinical burden of these patients is considerable, in the United States just under a million patients a year require hospitalization for acute heart failure[1], with a 5 year mortality of 50%[2].

The ultimate function of the cardiovascular system is to deliver an adequate supply of oxygen and nutrients to tissues and remove the consequent waste products. However, the system is complex, with multiple regulatory control mechanisms such as the baroreflex for example. Because of the ease of its measurement, maintenance of arterial blood pressure is frequently seen as an indication of adequacy of circulatory function. This misconception[3] has arisen because of the absence of a readily available, non-invasive, measure of cardiac output. In disease states there are multiple causes that can lead to failure of the cardiovascular system. Frequently these disease states are grouped into broad pathophysiological categories such as hypovolaemic, distributive and cardiogenic shock. The underlying pathophysiology of these different categories can be diametrically opposed, leading to widely different clinical approaches to treatment. The inappropriate application of a treatment strategy for hypovolaemic shock to cardiogenic shock might lead to a fatal patient outcome. Understanding the underlying pathophysiology enables the evaluation of the treatment plan in terms of whether it is likely to reverse the pathophysiological processes, and therefore optimises patient care.

The underlying pathophysiology in many forms of shock has been very well known for more than twenty years. In clinical medicine the ability to recognise these different disease processes is critically important; the treatments used are generally directed at reversing the pathophysiological abnormalities. In critical care it has long been recognised that there are substantial differences in the physiological values in survivors and non survivors[4], and early optimization of the circulation can under certain circumstances lead to an improvement in survival[5].

The use of a high fidelity human simulator has many attractions, not least that the students can expand their knowledge base by observing the effects of different treatments on a given patient. The ability to wind the clock back if a treatment is unsuccessful; following a discussion of the pathophysiology the student can then explore their new knowledge, something that would be impossible, and unethical with a real patient; with a simulated patient these issues do not apply. In order to facilitate learning, the simulator can be programmed to simulate patients with pure forms of shock, rather that the hybrid forms that may present in an ever aging population.

American Heart Association (2000). 2001 Heart and Stroke Statistical Update. Dallas.

Fonarow GC (2001).Rev Cardiovasc Med **2(Suppl 2)**,S7-S12.

Wo CC et al. (1993).Crit Care Med **21**,218-23.

Shoemaker WC et al. (1993).Crit Care Med **21**,1876-1889.

Kern JW & Shoemaker WC (2002).Crit Care Med **30**,1686-92.

Where applicable, the experiments described here conform with Physiological Society ethical requirements.

D16

Integration of a high fidelity Human Patient Simulator with existing physiology practical classes

J.R. Harris[1], E. Lloyd[1] and A.T. Lovell[2]

[1]Physiology, University of Bristol, Bristol, UK and [2]Anaesthesia, University of Bristol, Bristol, UK

The demonstration will outline some of the ways that Human Patient Simulators (or manikins) will be used to enhance our existing physiology practical teaching. The latter is currently based largely on undergraduates recording their own physiological responses (e.g. blood pressure, ECG, static and dynamic lung volumes, alveolar gas composition, urine output) in situations that are well within their physiological limits.

The manikin, on the other hand, can be programmed to simulate a wide range of physiological and pathophysiological processes and responses. These include: temperature changes; breathing (including the automatic and physiologically appropriate physical exchange of oxygen and carbon dioxide); cardiovascular parameters (for example electrocardiogram, cardiac output, systemic and pulmonary arterial pressure, central venous pressure); and respiratory parameters (for example arterial oxygen saturation and the partial pressures of oxygen & carbon dioxide in alveolar air and arterial blood).

It can be used to model physiological responses to extreme environments, intense exercise and ageing as well as a wide range of pathophysiology including haemorrhage, shock and disease processes. All these scenarios can be used to reinforce and enhance understanding of basic physiological processes but cannot be imposed on students!

Where applicable, the experiments described here conform with Physiological Society ethical requirements.