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A prospective pilot study evaluating the 'cardiac decompensation score' in the setting of intraaortic balloon counterpulsation

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Summary The study objective was to determine whether the 'cardiac decompensation score' could identify cardiac decompensation in a patient with existing cardiac compromise managed with intraaortic balloon counterpulsation (IABP). A one-group, posttest-only design was utilised to collect observations in 2003 from IABP recipients treated in the intensive care unit of a 450 bed Australian, government funded, public, cardiothoracic, tertiary referral hospital. Twenty-three consecutive IABP recipients were enrolled, four of whom died in ICU (17.4%). All non-survivors exhibited primarily rising scores over the observation period ($p < 0.001$) and had final scores of 25 or higher. In contrast, the maximum score obtained by a survivor at any time was 15. Regardless of survival, scores for the 23 participants were generally decreasing immediately following therapy escalation ($p = 0.016$). Further reflecting these changes in patient support, there was also a trend for scores to move from rising to falling at such treatment escalations ($p = 0.024$). This pilot study indicates the 'cardiac decompensation score' to accurately represent changes in heart function specific to an individual patient. Use of the score in conjunction with IABP may lead to earlier identification of changes occurring in a patient's cardiac function and thus facilitate improved IABP outcomes.

Introduction

Withdrawal of intraaortic balloon counterpulsation (IABP) support, while progressive, is reliant on the degree of cardiac recovery. Presently, thorough knowledge, continual assessment and prompt intervention are essential in determining the best patient response during IABP weaning. While this should never change, design of a score that measures a

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patient's individual cardiac function would seem an appropriate step to assist in the management of IABP minimisation and withdrawal. Importantly, a score determining cardiac decompensation would be beneficial regardless of the manner of IABP support withdrawal adopted by the clinician. As research specific to IABP weaning faces numerous difficulties, provision of evidence to assist weaning may lie in the measurement of cardiac function. The authors of this paper designed a 'cardiac decompensation score' with the purpose of accurately representing cardiac decompensation specific to a patient's individual cardiac function.

Following its initial application to practice in 1968, IABP has become the most widely used mechanical support in the assistance of a failing heart (Christenson et al., 2002). Though extensive research has been undertaken in this field over the past four decades very little study has directly examined the withdrawal of IABP support. O'Malley (2000) examined the haemodynamic effects of two patterns of IABP weaning and while her overall results were not statistically significant, they did suggest volume weaning to generate a more positive haemodynamic outcome for the patient. Through critical analysis and synthesis of numerous IABP papers, Lewis and Courtney (2006) also suggest volume reduction to appear the most effective weaning method; they also found frequency weaning to appear problematic. Australasian IABP practice meanwhile, indicates frequency reduction to demonstrate the better weaning outcome (Lewis et al., 2006). Discussion regarding both volume and frequency reduction weaning as well as combinations of both methods can be found in numerous papers with all demonstrating apparent success (Bavin and Self, 1991; Bolooki, 1998; Christenson and Schmuziger, 1999; Kantrowitz et al., 1993; Krau, 1999; Vitale, 1999). No empiric justification, however, can be found for any IABP weaning processes as all methods appear based around past practice, clinician preference and support withdrawal alternatives available on the IABP drive console. Given this, a score able to measure a patient's cardiac function would seem an appropriate step to assist in the management of IABP weaning and could be applied in any acute care setting internationally. The aim of this study was to clinically test the 'cardiac decompensation score' and determine its sensitivity. To meet this aim this study set out to answer the research question ''Can the 'cardiac decompensation score' accurately identify deterioration of cardiac function in a patient who is already cardiac compromised?''

Methods

To examine the clinical efficacy of the cardiac decompensation score a quasi-experimental, one-group posttest-only design was utilised. After obtaining the approval of both the hospital and university ethics committees, 23 patients managed consecutively with IABP consented to be enrolled in the study. Data were collected in Brisbane, Australia at The Prince Charles Hospital — a 450 bed metropolitan, government funded public, cardiothoracic tertiary referral teaching hospital. The study did not require any change in patient treatment — observations only were collected over the course of IABP and were compared against fluctuations in therapy to determine a patient's cardiac function. Observations were collected on all patients for the duration of IABP therapy and were used to determine the patient's cardiac decompensation score. To ensure blinding, doctors regulating patient treatments did not have access to the score; all scores were generated by the nurse caring for the patient.

Instrument

In attempting to predict IABP mortality following cardiac surgery, a retrospective Australian study undertaken at the Austin Hospital in Melbourne examined a number of clinical variables (Davies et al., 2001). They found statistically significant predictors of mortality and failure to wean from IABP to include lactate, base deficit, mean arterial pressure, development of acute renal failure and urine output. A recent survey of Australasian IABP management identified physiological criteria of importance prior to IABP weaning to include heart rate, blood pressure and to a moderate extent gas exchange (Lewis et al., 2006). While the Davies study strongly suggests the inclusion of lactate levels, renal function and metabolic measures in the cardiac decompensation score, Australasian IABP weaning practice (Lewis) identifies heart rate, blood pressure and lung function as worthy of inclusion. Despite score incorporation of these clinical variables, the extent of physiological changes manifested by impaired cardiac function remains extensive and require further consideration. Owing to an absence of evidence and lack of clinical studies, other possible aspects for score inclusion warranted selection based upon clinical experience and physiological knowledge of cardiac function and homeostatic mechanisms. Homeostatic response heralds an initial decline in cardiac function and consequent bodily compensation. In addition to Davies' lactate levels, peripheral perfusion was identified for score inclusion. Clinical experience also saw the addition of two delayed determinates of a failing heart, electrocardiograph (ECG) and mentation. Owing to its impact upon blood pressure, fluid replacement was also included (as most IABP recipients at the study centre are nil by mouth, fluid replacement is required; this parameter was consequently weighted less than others).

Following generation of cardiac decompensation score clinical indicators the authors sought consultation with an expert panel. Chosen for relevant clinical experience and expert knowledge the panel consisted intensivists, cardiac surgeons and cardiac intensive care nurses. While all 10 selected score components were preserved some component parameters were refined. Prior to data collection, the score was tested on a purposive sample of 10 nurses varying in age, gender and clinical experience. Inter-rater reliability was high (Fleiss' kappa, $\kappa = 0.91$) while participant score generation demonstrated ease and speed.

Regardless of the underlying pathology, treatment of severe cardiac dysfunction requires institution and escalation of multiple supportive therapies until the patient condition can be stabilised. Following successful patient stabilisation, the decision to minimise any supportive therapy indicates the optimum cardiac function which can be expected for the patient under their current clinical