Australian Critical Care (2009) **22**, 125—131

ELSEVIER

ACCCN
Australian College of Critical Care Nurses
www.elsevier.com/locate/aucc

The intra-aortic balloon pump in heart failure management: Implications for nursing practice

Peter A. Lewis BN RM MN.Ed PhD[a,*], **Darian A. Ward RN MSc**[b], **Mary D. Courtney RN PhD**[a]

[a] *Queensland University of Technology, Victoria Park Rd, Kelvin Grove, Brisbane, Queensland 4059, Australia*
[b] *Saint Andrews War Memorial Hospital, 457 Wickham Terrace, Brisbane 4001, Australia*

Received 5 November 2008; received in revised form 16 June 2009; accepted 18 June 2009

KEYWORDS
Heart decompensation;
Heart failure;
IABP;
Intra-aortic balloon pumping;
Counterpulsation;
Assisted circulation;
Weaning;
Cardiac output, low

Summary Management of acute heart failure is an important consideration in critical care. Mechanical support of the failing heart is crucial for improving health outcomes. The most common Australasian application of intra-aortic balloon counterpulsation (IABP) is in the setting of cardiogenic shock. High end users of IABP (>37/annum) demonstrate significantly lower mortality for cardiogenic shock managed with IABP ($p < 0.001$) in contrast to hospitals which employ limited IABP (<4/annum). This underscores the importance of proficiency in managing the patient receiving IABP support. Nurses play a crucial role in caring for patients with acute heart failure. This paper summarises care considerations for management of the IABP.

Introduction

Management of acute heart failure is an important consideration in critical care units. Following the initial application to practice in 1968, intra-aortic balloon counterpulsation (IABP) has become the most widely used mechanical support in the assistance of the failing heart. Australasian application of IABP is most predominant in the setting of cardiogenic shock.[1] Of interest, high end users of IABP (>37/annum) demonstrate significantly lower mortality for cardiogenic shock managed with IABP ($p < 0.001$) in contrast to hospitals which employ limited IABP (<4/annum). High volume facilities experience up to 150 fewer deaths per 1000 IABP recipients.[2] This marked reduction in mortality sug-

* Corresponding author. Tel.: +61 7 3138 3834; fax: +61 7 3138 3814.
E-mail addresses: p.lewis@qut.edu.au (P.A. Lewis), da.ward@qut.edu.au (D.A. Ward), m.courtney@qut.edu.au (M.D. Courtney).

1036-7314/$ — see front matter.
doi:10.1016/j.aucc.2009.06.005

gests IABP knowledge and modality proficiency to contribute toward improved IABP outcome.[3] Nurses play a crucial role in caring for people receiving IABP therapy. This paper describes the implications for nursing practice which result from IABP insertion, management and weaning from the device.

Nurses who care for patients managed with IABP require a knowledge of the mechanisms and actions of this therapeutic device. As well as addressing IABP physiology, benefits, potential complications and safety considerations, this paper discusses the importance of monitoring cardiac function and undertaking regular comprehensive patient assessment—core nursing responsibilities in the management of IABP. How assessment must be informed by an understanding of IABP complications and safety issues will be addressed, as will IABP timing and how this can maximise impaired cardiac function. Finally, discussion will describe patients ready to be weaned from IABP with consideration given to understanding weaning strategies and their implications for nursing practice.

Physiologic effects of intra-aortic balloon counterpulsation

The principal characteristic of acute heart failure is inadequate contractile force of the myocardium resulting in a failure to maintain adequate cardiac output.[4] This reduction in contractility is a product of inadequate myocardial oxygenation and increasing cardiac workload. The primary purpose of IABP is the support of the failing heart by simultaneously increasing myocardial oxygen supply and decreasing myocardial oxygen demand.[5] This is achieved by the positioning of an intra-aortic balloon (IAB) in the descending thoracic aorta. The IAB is located immediately inferior to the origin of the left subclavian artery and superior to the renal arteries and is attached to an external drive console which inflates and deflates the IAB in synchrony with cardiac contractions.[5] The IAB is inflated at the onset of diastole when blood ceases to eject from the heart. It displaces blood volume within the descending thoracic aorta. Proximal blood is returned to the heart to oxygenate the coronary arteries as well as being distributed through the branches in the aortic arch. Blood in the distal descending aorta is circulated systemically.[6] Balloon deflation is timed to occur immediately prior to the onset of systole before the heart commences ejection. Balloon deflation leaves the aorta partially empty thus reducing afterload, maximising left ventricular ejection fraction and reducing mitral regurgitation. By augmenting coronary artery and systemic perfusion pressures, IABP improves myocardial oxygen supply and decreases myocardial oxygen consumption by reducing cardiac workload.[5,7] Understanding these physiological effects enables the nurse to effectively manage patients treated with IABP with a specific focus on expected improvements in cardiac function.

Intra-aortic balloon counterpulsation timing

To optimise cardiac function in the setting of IABP inflation of the IAB must be synchronised with the cardiac cycle. Timing of IAB inflation and deflation is achieved by choosing a trigger which accurately predicts the open and closure of the aortic valve. The preferred trigger is the electrocardiogram (ECG) tracing. Other triggers such as aortic pressure or pacing spikes may be used if necessary.[8] The ECG is the favoured trigger as the R wave provides the most accurate reference point for signalling the onset of ventricular systole and the opening of the aortic valve.[5] Even in the context of irregular and paced rhythms the R wave will offer the clearest indication of the onset of systole. The importance of a reliable trigger for balloon inflation and deflation is crucial for optimised IABP.[8–10] Ideally ECG monitoring leads are attached directly to the IABP drive console. However, an option exists for the drive console to 'slave' the ECG trace from the cardiac monitor—as such, it is not unusual for a patient managed with IABP to have two sets of ECG leads.[8] Establishing and maintaining the quality of data from a trigger source is an important nursing responsibility.

To establish maximal IABP support careful monitoring of the aortic pressure waveform is critical. IAB inflation and deflation must be synchronous with the cardiac cycle. During systole (when blood is ejected from the left ventricle) the IAB should be deflated; during diastole (when there is no blood ejected from the left ventricle) the IAB should be inflated. The aortic pressure waveform represents systole and diastole. Systole occurs from the first point of positive pressure after the dicrotic notch (this immediately follows the lowest arterial pressure) to the highest arterial pressure and continues until the dicrotic notch (closure of the aortic valve). Diastole occurs from the advent of the dicrotic notch until the first point of positive pressure following this point. The IAB should be inflated on the dicrotic notch and deflated immediately prior to the first positive pressure following the dicrotic notch (Fig. 1). If IAB inflation and deflation is not