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REVIEW

Does the use of a pulmonary artery catheter make a difference during or after cardiac surgery?

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Pulmonary artery catheters (PACs) were introduced in 1970. Since then, their use has steadily increased. However, there have been questions raised regarding their efficacy for multiple clinical scenarios. The purpose of this systematic review was to determine the safety and effectiveness of routine use of PACs post cardiac surgery on mortality, complications, days in intensive care unit, days in hospital, and costs in patients undergoing cardiac surgery, or patients who end up in an intensive care unit.

Methods Medline, All EBM, Embase and Cumulative Index to Nursing and Allied Health Literature (CINAHL) databases were searched using predetermined search terms. Google, British Medical Journal (BMJ) Best Practice, and the National Institute for Clinical Excellence (NICE) were also searched. All searches were from 2012 to current to update a previous review from 2013. Studies were included if they involved adult cardiac surgery patients, or intensive care unit (ICU) patients requiring haemodynamic monitoring. All other surgical patients were excluded.

Results Six articles were included in this review. Of the six articles, five were randomised or observational studies, and one was an expert recommendation. For all cardiac surgery patients and patients having coronary artery bypass grafting, there was no difference in mortality. There was an increase in mortality in high-risk cardiac surgery patients, who had a PAC. For patients following coronary artery bypass grafting, there was no difference in ICU length of stay (LOS) but for patients following cardiac surgery total length of hospital stay >30 days was greater in patients with a PAC. For patients following coronary artery bypass grafting, in-hospital costs for the entire hospitalisation were higher in patients with a PAC and, there was no difference in complications between PAC and a central venous catheter use. Overall, PACs were not a predictor of worse outcomes.

Conclusion This review revealed that PAC use was associated with a poorer outcome in a small subset of cardiac surgical patients but in the majority of patients PAC use made no difference to outcome. Further studies are required to confirm the true safety and efficacy of PAC use in cardiac surgery.

Keywords Swan Ganz catheter • Adult • Bypass • Graft • Intensive care

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Introduction

The pulmonary artery catheter (PAC) was introduced in 1970 by HJ Swan and W Ganz to manage haemodynamic perturbances in real-time [1]. PACs provide information on multiple key variables, intracardiac and intrathoracic vascular pressures, and hence preload, cardiac output, and mixed venous oxygen saturation [2]. As a result, the insertion of PACs have been used to guide therapy and to potentially reduce morbidity and mortality rates in critically ill patients [3], and are often standard practice for coronary artery bypass graft (CABG) or cardiac valvular surgery [4]. Selective use of the PACs for high risk cases in some public institutions may exist, the use of a PAC is near universal in the private sector.

However, PACs have been criticised in the past owing to the lack of evidence for their use in multiple clinical scenarios [5], particularly given their invasiveness. As a result, it has been suggested that the lack of evidence supporting improved outcomes, as well as the decreased familiarity and training in PAC use, have triggered the search for less invasive haemodynamic monitoring methods. As a result, many new imaging modalities and minimally invasive haemodynamic monitoring methods have surfaced [6].

Following the reservations regarding the efficacy of PACs a systematic review was conducted in 2013 [7] exploring the effectiveness of PACs on mortality, length of stay (LOS) in intensive care unit (ICU) and hospital, and cost of care in adult intensive care patients. As a result, this review will explore published evidence since that review with the view to update the current information on the use of PAC in cardiac surgery and ICU patients.

The purpose of this systematic review was to understand what evidence is available for the safety and effectiveness of routine use of a PAC during or post cardiac surgery. In order to respond to this question, our objectives were: 1) To systematically search the published and grey literature base for evidence of safety and effectiveness for PAC use versus no-PAC use in cardiac surgery and ICU patients; and 2) To synthesise and summarise the recent evidence identified in order to guide clinical practice based on mortality rates, complications, days in intensive care unit, days in hospital, and cost.

Material and Methods

Search Strategy

Medline, All EBM, Embase and Cumulative Index to Nursing and Allied Health Literature (CINAHL) databases were searched using search terms from a previous review that was being updated [7] (Table 1). In addition, Google and the websites for British Medical Journal Best Practice (BMJ Best Practice), and The National Institute for Health and Care Excellence (NICE) were also searched in April and May 2017. Search terms were replicated from the previous review [7] and specific dates are provided in Tables 2 and 3.

Table 1 Database Search Terms.

Search terms in Medline*
1 Exp Catheterization-Swan-Ganz/
2 Exp Heart-Catheterization/
3 pulmonary art?ery catheter*.ti,ab.
4 (pulmonary arter* adj5 (flotation or cathet*)).mp.
5 (right?heart and catheter*).mp.
6 swan?ganz*.ti,ab.
7 OR 1-6
8 exp Critical care/
9 exp Intensive-Care-Units/
10 critical care unit*.mp.
11 ((intensiv* or critical or post?an?esthesia) adj5 care unit).mp.
12 high dependency unit*.mp.
13 critical care.ti,ab.
14 Exp thoracic surgery/
15 exp Operating Rooms/
16 OR 8-15
17 7 AND 16
18 limit 17 to (english language and humans and yr = ''2012 – Current'')

*Similar terms were used in other databases.

Table 2 Database search dates.

Information sources	Date of search
All EBM (Ovid)	27/04/2017
Medline (Ovid)	27/04/2017
Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations, Ovid MEDLINE(R) and Ovid OLDMEDLINE(R) 1950 to Present	
EMBASE (Ovid)	27/04/2017
CINAHL	03/05/2017

Document Selection

Titles and abstracts identified in each database were exported to EndNote X7 (Thompson, Reuters, Carlsbad, California, USA). Papers identified were screened using inclusion and exclusion criteria established *a priori* (Table 4). Results from items earlier than 2012 were excluded as this was where the searching concluded in the previous review. Titles and abstracts were initially screened, then full text articles were obtained for studies that needed to be further explored. Searches conducted of the Medline, All EBM, Embase and CINAHL databases were performed and results screened by one author (MG). Searches of Google, BMJ Best Practice and

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