Intensive and Critical Care Nursing xxx (2017) xxx–xxx

Contents lists available at ScienceDirect

Intensive and Critical Care Nursing

journal homepage: www.elsevier.com/iccn

Review

Protective isolation precautions for the prevention of nosocomial colonization and infection in burn patients: A systematic review and meta-analysis☆

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ARTICLE INFO

Article history:
Received 29 July 2016
Received in revised form 13 March 2017
Accepted 18 March 2017

Keywords:
Protective isolation precautions
Prevention
Nosocomial
Infection
Colonization
Burn patient
Systematic review
Meta-analysis

ABSTRACT

Objectives: To assess the impact of protective isolation precautions on nosocomial colonization and infection rates in burn patients.
Research methodology: A systematic review and meta-analysis were performed of studies identified through Pubmed and Web of Science. Only articles in English were considered. The Downs and Black tool was used to evaluate their methodological quality. Random-effects meta-analysis obtained pooled risk ratios (RRs) and 95% confidence intervals (CIs) of nosocomial colonization and infection rates.
Results: Five eligible before-after studies were identified, encompassing a total of 3033 patients (1192 in the experimental group; 1841 in the control group). Varying protective isolation precautions were investigated, resulting in high clinical heterogeneity. Quality assessment revealed overall poor methodological quality. Protective isolation significantly reduces combined colonization and infection rates compared to baseline care (RR 0.52, 95% CI 0.40–0.69; $P < 0.0001$). Subgroup analyses indicated significant reductions in both nosocomial colonization (RR 0.65, 95% CI 0.51–0.83; $P = 0.02$) and infection rates (RR 0.53, 95% CI 0.49–0.58; $P < 0.0001$).
Conclusions: Protective isolation precautions appear to decrease the risk of colonization and infection in burn patients. Because of the absence of higher quality study designs, clinical heterogeneity and the small number of studies involved, these results must be interpreted cautiously.

Contents

☆ Presented in part: 27th Annual Congress of the European Society of Intensive Care Medicine, Barcelona, Spain, 27 September-1 October 2014.
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http://dx.doi.org/10.1016/j.iccn.2017.03.005
0964-3397/

Introduction

Severe burn injury is associated with significant morbidity and mortality (Brusselaers et al., 2010c). Determinants of death include a large total burned surface area (TBSA), substantial full-thickness burns, difficultly healing wounds, late transfer to a burn center, older age, the presence of an inhalation injury, inadequate fluid resuscitation and organ failure such as acute kidney injury (Herndon, 2012; Belgian outcome in burn injury study group, 2009; Alp et al., 2012; Brusselaers et al., 2005; Brusselaers et al., 2012; Paratz et al., 2014; Brusselaers et al., 2010a) Besides the loss of skin function, burn injury provokes an inflammatory response leading to a state of immunologic dysfunction. As a consequence, burn patients are at high risk of infection (Herndon, 2012; Çakir, 2004). Despite advances in burn care, infection still remains a major cause of morbidity and mortality in burn patients (Saffle, 1998; Sheridan, 2003; Muller et al., 2001; Brusselaers et al., 2012; Brusselaers et al., 2010b). The most relevant risk factors for burn wound colonization or infection include the extent of the burn wound (TBSA in%) and prolonged duration of hospitalization (Mayhall, 2003; Lowbury and Fox, 1954; Wormald, 1970; Thomsen, 1970). Patients with more than 40% TBSA burns require specific and specialized care as up to 75% of all burn-related deaths were associated with infectious complications (Alp et al., 2012). As such, the importance of a solid infection prevention and control program seems obvious (Greenfield and McManus, 1997).

Specific infection prevention measures include antiseptic ointments for wound care, selective digestive decontamination and early surgical wound excision and closure (Mayhall, 2003). Additionally general protective isolation precautions, as defined by the Center for Disease Control and Prevention (CDC), are widely implemented in modern burn care to prevent transmission of microorganisms (Mayhall, 2003; Garner and Simmons, 1983). These precautions include strict hand hygiene and glove use, the use of masks, gowns and sterile gloves during wound care and single patient isolation rooms (Alp et al., 2012; Haynes and Hench, 1965; Church et al., 2006; Mayhall, 2003). The use of isolation rooms is labour intensive and expensive, while these techniques are only based on a scarce number of scientific studies for evaluating their effectiveness.

We performed a systematic review and meta-analysis postulating that protective isolation precaution reduces the occurrence of nosocomial colonization and infection in burn patients compared with an absence of these precautions.

Methods

The meta-analysis and systematic review were written following the template from the online Cochrane Handbook of Systematic Reviews of Interventions. Additionally the PRISMA statement (Liberati et al., 2009) consisting of a 27-item checklist was used for reporting the items preferred for the systematic review and meta-analysis.

Search strategy

The research question was first specified and clearly defined on the basis of the "PICO" question (Patient/Population: Burn patients, Intervention/Indicator: Protective isolation, Control/Comparator: None/standard of care, Outcome: Rates of post-intervention nosocomial colonization and/or infection) (Schardt et al., 2007). MeSH terms were consulted in the MeSH database to find relevant keyword combinations for the identification of eligible studies in the databases Pubmed and Web of Science. The algorithm used was: "(isolation) AND (infection) AND (burn OR burns OR thermal injury) AND (prevention OR control)". Databases were regularly investigated starting in November 2012; a final check for relevant publications was conducted in October 2013. Only English-language articles were considered without restriction in year of publication. Reference lists of potentially eligible studies were manually explored; but gave no additional articles.

Study selection

The meta-analysis inclusion- and exclusion criteria are displayed in Table 1. Eligible study designs included before-after, interrupted time series, controlled before-after studies and randomized controlled trials (RCTs) to assess the effect of protective isolation of burn patients on rates of nosocomial colonization and or infection. The population consisted of burn patients with all levels of percentage TBSA. No distinctions were made based on gender, age, length of stay, ethnicity and cause of the burns. Reviews, studies on general preventive interventions (sterile gloves, masks, gowns...) but not including strict isolation, and studies investigating air environmental decontamination systems were excluded. Also studies conducted in general intensive care units in which sporadically burn victims are admitted were excluded because of the possible bias mixing specialized centers with general intensive care units. The primary outcome measures were pre- and post-intervention colonization and/or infection incidence expressed in number of affected patients per total number of admitted patients or, alternatively, colonization and/or infection rates in intervention and control groups in randomized studies. Hospital acquired infections (HAIs) needed to be expressed according to the CDC infection criteria for burn patients. (Garner et al., 1988) Search results in Pubmed and Web of Science were screened by title and abstract. An independent reader screened and re-evaluated the selected studies to check the correctness of interpretation. Articles were assessed for eligibility by their full-text and after mutual consideration between authors.

Quality assessment

Criteria for the assessment of internal and external validity of the five studies included in the meta-analysis were investigated by the checklist of Downs and Black (Downs and Black, 1998) which consists of 27 questions that evaluate the reporting, external validity, internal validity and power of studies.

Data extraction

Extracted data included author and year of publication, settings and study populations, study designs and period, the general preventive interventions and protective isolation precautions in the baseline and intervention period and the number of colonized and/or infected patients per total number of admitted patients. Results were stratified into pre- and post-intervention groups to facilitate analysis. Authors were not contacted for additional information.

Please cite this article in press as: Raes, K., et al., Protective isolation precautions for the prevention of nosocomial colonization and infection in burn patients: A systematic review and meta-analysis. Intensive Crit Care Nurs (2017), http://dx.doi.org/10.1016/j.iccn.2017.03.005