International Journal of Nursing Studies 72 (2017) 53–59

Contents lists available at ScienceDirect

International Journal of Nursing Studies

journal homepage: www.elsevier.com/locate/ijns

Pressure mapping to prevent pressure ulcers in a hospital setting: A pragmatic randomised controlled trial

Lena Gunningberg*, Inga-Maj Sedin, Sara Andersson, Ronnie Pingel

Department of Public Health and Caring Sciences, Caring Sciences, Uppsala University Hospital, Uppsala University, Uppsala, Sweden

ARTICLE INFO

Keywords:
Hospital
Prevention
Pressure mapping
Pressure ulcer
RCT

ABSTRACT

Background: Pressure ulcers cause suffering to patients and costs to society. Reducing pressure at the interface between the patient's body and the support surface is a valid clinical intervention for reducing the risk of pressure ulcers. However, studies have shown that knowledge of how to reduce pressure and shear and to prevent pressure ulcers is lacking.

Objective: To evaluate the effect of a pressure mapping system on pressure ulcer prevalence and incidence in a hospital setting.

Design: Pragmatic randomised controlled trial.

Setting: A geriatric/internal medical ward with 26 beds in a Swedish university hospital.

Participants: 190 patients were recruited (intervention: n = 91; control: n = 99) over a period of 9 months. Patients were eligible if they were over 50 years old, admitted to the ward between Sunday 4 pm and Friday 4 pm, and expected to stay in the ward ≥3 days.

Intervention: The continuous bedside pressure mapping system displays the patient's pressure points in real-time colour imagery showing how pressure is distributed at the body–mat interface. The system gives immediate feedback to staff about the patient's pressure points, facilitating preventive interventions related to repositioning. It was used from admittance to discharge from the ward (or 14 days at most). Both intervention and control groups received standard pressure ulcer prevention care.

Results: No significant difference in the prevalence and incidence of pressure ulcers was shown between intervention and control groups. The prevalence of pressure ulcers in the intervention group was 24.2% on day 1 and 28.2% on day 14. In the control group the corresponding numbers were 18.2% and 23.8%. Seven of 69 patients (10.1%) in the intervention group and seven of 81 patients (8.6%) in the control group who had no pressure ulcers on admission developed category 1 and category 2 ulcers during their hospital stay. The incidence rate ratio between the intervention and control groups was 1.13 (95% CI: 0.34–3.79).

Conclusions: This study failed to demonstrate a beneficial effect of a pressure mapping system on pressure ulcer prevalence and incidence. However, the study could have increased staff awareness and focus on pressure ulcer prevention, thus affecting the prevalence and incidence of pressure ulcers in a positive way in both study groups. It is important to further investigate the experience of the multidisciplinary team and the patients regarding their use of the pressure mapping system, as well as strengths and weaknesses of the system.

What is already known about the topic?

- Pressure ulcers cause suffering for the individual patient, as well as cost to society.
- Pressure relief through repositioning and the use of pressure-reducing mattresses, chair cushions, and heel cushions are the mainstay of preventive interventions.
- Knowledge about reducing the amount of pressure and implementing preventive interventions is lacking.

What this paper adds

- A continuous pressure mapping system can provide staff with visual real-time feedback of pressure points and increase their commitment to preventive interventions.
- Uncertainty remains as to whether a pressure mapping system can reduce pressure ulcer prevalence and incidence in a regular hospital ward.
- Staff awareness and focus on pressure ulcer prevention could have a

* Corresponding author.
E-mail addresses: lena.gunningberg@pubcare.uu.se (L. Gunningberg), Inga-maj.sedin@akademiska.se (I.-M. Sedin), Sara.b.andersson@akademiska.se (S. Andersson), Ronnie.pingel@pubcare.uu.se (R. Pingel).

http://dx.doi.org/10.1016/j.ijnurstu.2017.04.007
Received 22 December 2016; Received in revised form 5 March 2017; Accepted 17 April 2017

positive effect on pressure ulcer prevalence and incidence.

1. Introduction

Pressure ulcers (PUs) cause suffering to patients (Gorecki et al., 2009) and costs to society (Demarré et al., 2015). The prevalence of PUs is used as a quality indicator worldwide and studies from hospital settings in different countries report prevalences from 0% to 46% (National Pressure Ulcer Advisory Panel [NPUAP], European Pressure Ulcer Advisory Panel, and Pan-Pacific Pressure Injury Alliance, 2014). Evidence-based international guidelines (NPUAP, 2014) were recently revised and are available to clinicians. A systematic review of 26 implementation studies suggests that key issues for success in PU prevention were the simplification and standardisation of PU-specific interventions and documentation, the involvement of multidisciplinary teams and leadership, designated skin champions, ongoing staff education, and sustained audit and feedback (Sullivan and Schoelles, 2013).

In 2007, a national patient safety initiative was launched by the Swedish Association of Local Authorities and Regions (SALAR). Preventing PUs is a prioritised area and Swedish national prevalence studies have been conducted annually since 2011. National goals are set, public reporting and benchmarking are available, and evidence-based guidelines have been disseminated free of charge to hospitals and nursing homes. Furthermore, a performance-based remuneration model was provided by the government to inspire hospitals to participate in the patient safety work in 2011–2015. Despite great effort on the national level to encourage the prevention of PUs, their prevalence remains high. In Swedish hospitals, the prevalence was 16.6% in 2011 and 13.4% in 2016 (Gunningberg et al., 2013a; SALAR, 2016).

Pressure relief through repositioning and the use of pressure-reducing mattresses, chair cushions, and heel cushions, for example, are the mainstay of preventive interventions (NPUAP, 2014; McInnes et al., 2015). International guidelines (NPUAP, 2014) do not recommend a specific time interval for repositioning. Instead, repositioning frequency should be individually determined with attention to the patient's tissue tolerance, level of activity and mobility, general medical condition, overall treatment objectives, skin condition, and comfort. The most common locations for PUs are the sacrum and heels (Bredesen et al., 2015; Gunningberg et al., 2013a). Reducing the pressure at the interface between the patient's body and the support surface is a valid clinical intervention for reducing the risk of pressure ulcer development (NPUAP, 2014). However, studies have revealed that both knowledge of how to reduce pressure and shear (Beeckman et al., 2011; Gunningberg et al., 2013b) and preventive interventions (repositioning and pressure-reducing equipment) are still lacking (Bredesen et al., 2015; Bååth et al., 2014).

1.1. Continuous pressure mapping systems

There are several commercially available pressure mapping systems that can measure interface pressure in different positions and on various types of pressure-redistribution surfaces (Bush et al., 2015; Lippoldt et al., 2014; Yoshikawa et al., 2015). Continuous pressure mapping can provide nursing staff with real-time feedback on pressure points in those at risk for PU and allow PU prevention to be individualised. The utility of such a pressure mapping system has been investigated in a clinical training centre at one Swedish university hospital (Gunningberg and Carli, 2016; Gunningberg et al., 2016). Regardless of nursing category (registered, assistant, or student nurse), nurses achieved lower interface pressure for volunteer patients when using feedback from the monitor than without such feedback. The system was also well appreciated by the nurses; therefore, a pressure mapping system with visual, real-time feedback could be an effective pedagogic tool for increasing hospital nursing staff's commitment to PU preventive interventions. Behrendt et al. (2014), found that a continuous pressure mapping system significantly reduced the incidence of PUs in an intensive care unit (ICU) in the United States. Yet other studies on the effects of pressure mapping on PUs are lacking.

The main aim of the current study was to evaluate the effect of a pressure mapping system on PU prevalence and incidence in a hospital setting. A secondary aim was to describe nurses' preventive actions, interface pressures, and patients' comfort in bed.

2. Method

2.1. Design

A pragmatic randomised controlled trial design was used (Zwarenstein et al., 2008) (www.clinicaltrial.com, NCT02474979).

2.2. Outcomes

Primary outcomes were pressure ulcer prevalence and incidence, category 1–4 (NPUAP, 2014). Secondary outcomes were preventive actions, interface pressure, and patients' comfort in bed.

2.3. Setting

The study was conducted in a 26-bed geriatric/internal medical ward in a Swedish university hospital, where most of the patients are over 65 years old, have multiple illnesses, and need rehabilitation. The regular staff consisted of registered nurses (n = 20), assistant nurses (n = 23), physical therapists (n = 3), occupational therapist (n = 2), and senior physicians (n = 2). Staff communications between shifts were handled through the multidisciplinary electronic health record, short (5–10 min) workplace meetings on weekday mornings, daily ward rounds, and multidisciplinary team rounds three times a week. Standard PU prevention in the study ward included risk assessment according to the Modified Norton scale (Ek et al., 2009) skin inspection, pressure reduction (support surfaces, heel protection, turning schedule, sliding sheets), and nutrition screening. The ward also used pressure-reducing foam mattresses (Optimal5zon) in all beds and five additional alternating pressure air mattresses (Auto Logic Auto Firm 110).

2.4. Sample

Patients were considered eligible for inclusion if they were over 50 years of age, admitted to the ward between Sunday 4 pm and Friday 4 pm, and expected to stay in the ward for at least three days. Patients who were discharged before data collection on day 3 or who were in the end-of-life phase were excluded.

A priori sample size calculation was undertaken based on the following information. A prevalence study including 14 Belgian hospitals revealed a PU prevalence of 22.8% in geriatric wards (Beeckman et al., 2011). Previous prevalence studies in the study ward showed a high prevalence of around 45%. In discussions with the nurse manager, the goal was that the intervention should result in a 20-percentage point decrease in PU prevalence. To have 80% power to detect such a decrease using a two-sided two-sample proportions test at the 5% significance level, 89 patients per study group were needed. New patients were included until there were a sufficient number of patients in both groups on day 3.

2.5. Randomisation, concealment, and blinding

Two study nurses and co-authors (S.A., I.-M.S.) were responsible for the inclusion of patients, their allocation to intervention and control groups, and the data collection. They were clinical nurse specialists in the care of the elderly, had long working experience in the geriatric department at the hospital, and were highly competent in risk assessment and PU classification. Before the start of the study they conducted the e-learning programme PUCLAS (Beeckman et al., 2008) about the