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Incidence, prevention and treatment of pressure ulcers in intensive care patients: A longitudinal study

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Abstract

Background: Pressure ulcers are common in acute and long-term care. However, critically ill patients usually have multiple risk factors for pressure ulcers.

Objectives: The study was conducted to assess pressure ulcer incidence in intensive care patients, the factors related to pressure ulcer incidence and the course of pressure ulcers after the admission to an intensive care unit.

Design: A longitudinal design.

Setting: This study was carried out in cardiological and surgical intensive care of a general hospital and in a nephrological intensive care of a university hospital.

Participants: All patients admitted to intensive care wards during the period from April until October 2006 were invited to take a part in the study. One hundred and twenty-one patients were involved in the study. The inclusion criteria were adult intensive care patients, males and females, all diagnosis were included. The exclusion criterion was patients whose age less than 18 years.

Method: Each patient was assessed twice; first, upon admission and second upon discharge or death, or after 2 weeks if the patient was still in intensive care. The assessed data included pressure ulcer preventive measures, risk factors using Braden score, pressure ulcer characteristics and treatment. Additionally, incontinence supplies (urine/bowel) if used and the severity of illness using Acute Physiology and Chronic Health Evaluation (APACHE II score) were assessd.

Results: This study revealed a total incidence of 3.3% (4.5% in nephrological patients and 2.9% in surgical patients). Sixteen patients with a total of 21 pressure ulcers were admitted to the intensive care units. During the patients' stay at the intensive care units six pressure ulcers developed newly and five pressure ulcers healed. The mean of the APACHE II score of patients with new pressure ulcers (16.6) were higher than in patients without new pressure ulcers (11.5).

Conclusion: Pressure ulcer incidence is low in this study compared to other studies. Pressure ulcers can be healed in intensive care patients. Using some preventive measures such as foam and alternating air pressure mattresses may help to decrease pressure ulcer development. Hydrocolloid dressing may help to increase the healing rate of pressure ulcers.

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Keywords: Intensive care patients; Incidence; Pressure; Ulcer; Hydrocolloid; Skin care; Foam mattresses

What is already known about the topic?

- Pressure ulcer research is limited in intensive care settings.
- Incidence design gives more accurate insight about pressure ulcer magnitude in intensive care settings.

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- Pressure ulcer incidence in intensive care settings is high comparing to other health care settings.
- All intensive care patients at a risk for pressure ulcer.
- There is a limitation in using all pressure ulcer preventive measures in intensive care settings.
- Pressure ulcer can be healed in intensive care settings.
- Patient with new pressure ulcers had higher score regarding the severity of illness than patients without new pressure ulcers.
- Foam mattresses as a preventive device and hydrocolloid as a type of dressing may be having positive effect in preventing and increase healing rate of pressure ulcer in intensive care settings. Using plastic linen as incontinence material is associated with pressure ulcer development.

1. Introduction

Pressure ulcers are common in acute and long-term care. The treatment and prevention of pressure ulcers consume large quantities of resources in terms of disposable equipment and nursing time (Defloor and Grypdonck, 2005). Moreover, pressure ulcers have been described as one of the most costly and physically debilitating complications in the 20th century (Burdette-Taylor and Kass, 2002). Pressure ulcers are the third most expensive disorder after cancer and cardiovascular diseases (A Health Council of the Netherlands: Pressure Ulcers, 1999). In addition, about 57–60% of all pressure ulcers occur within hospitals (Thomas, 2001). Up to 13% of patients develop pressure sores while being treated in an intensive care (Hunt, 1993). However, critically ill patients usually have multiple risk factors for the development of pressure ulcers (Peerless et al., 1999). The development of pressure ulcers entails a substantial morbidity of the critically ill and debilitated patients (Eachempati et al., 2001). Patients in many intensive care units (ICUs) are sedated and ventilated and therefore unable to move or care for themselves. Movement is a natural defense to pressure, but this defence is lost during a critical illness due to conditions such as anaemia, renal impairment, shock or vascular failure (Lowery, 1995).

Urinary and faecal incontinence have been cited as risk factors for pressure ulcers, with faecal incontinence being the better predictor of pressure ulcer formation (Clever et al., 2002). Additionally, patients with fecal incontinence have more than 20 times the risk of pressure ulcers than continent patients. Incontinence increases risk by causing chemical irritation and creating an excessively moist environment. Excoriation and maceration can occur even after a brief episode of incontinence (Calianno, 2000). Therefore, measures focusing on the skin care of patients with incontinence are recommended to reduce the incidence of pressure ulcers on sacrum and ischium (Lowery, 1995). Also, there is often confusion between a pressure ulcer and a lesion caused by moisture which can be a result of incontinence of urine and/or bowel. Therefore, the differentiation between the two lesions is clinically important because prevention and treatment protocols differ largely. Wound characteristics such as causes, shape, depth, edges and color are helpful to differentiate between a pressure ulcer and a moisture lesion (Defloor et al., 2005). The following figures shows the difference between pressure ulcer lesion (see Fig. 1) and incontinence lesion (see Fig. 2).

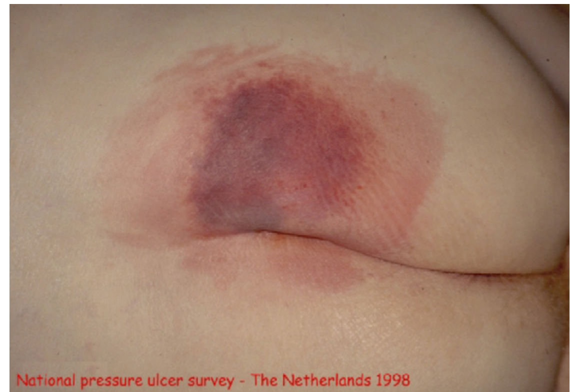

Fig. 1. Pressure ulcer lesion.

In order to determine the effect of risk factors or to evaluate the effectiveness of specific preventive intervention, incidence measurements are indicated (Halfens and Bours, 2002). Incidence has been defined as measuring the number of persons developing new pressure ulcers during a period of time (EPUAP, 2002). There are only few incidence studies concerning pressure ulcers in intensive care units in Germany, although it is a common problem in ICUs in various countries. In Texas, Fife et al. (2001) found a pressure ulcer incidence rate of 12.4% in neurological ICU. In Rotterdam, Weststrate et al. (1998) reported an incidence rate of 7.9% in surgical ICU. In Wales, Boyle and Green (2001) described a rate of 5.2% and in India, Wolverton et al. (2005) found a rate of 13.7% in general ICU. Moreover, the study of Brown (2003) revealed that 33.3% of ICU patients died 30 days after the onset of full thickness pressure ulcers and 73.3% had died after 1 year. However, incidence studies are more

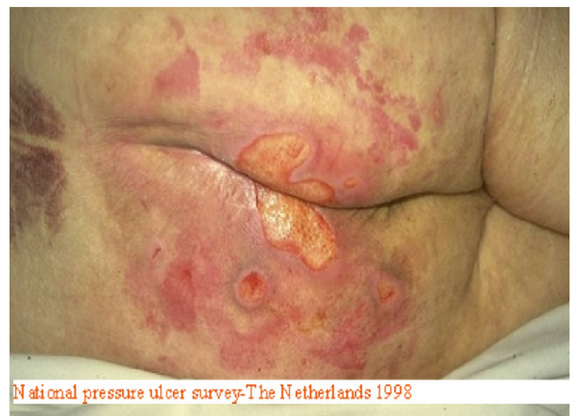

Fig. 2. Incontinence lesion.

suitable for giving insight concerning the factors related to the development of pressure ulcers in intensive care than prevalence studies. The magnitude of pressure ulcers in intensive care cannot be determined accurately by prevalence studies because patients are often admitted to ICU with existing pressure ulcers. Moreover, assessing the course of pressure ulcers after admission to ICU helps to trace whether pressure ulcers could be healed or whether they deteriorated to a higher grade.

1.1. Research questions

1. What is the incidence of pressure ulcers in intensive care patients?
2. Which factors (prevention, treatment or patient characteristics) are related to pressure ulcer incidence in intensive care patients?
3. What is the course of pressure ulcers following admission to an intensive care unit?

2. Materials and methods

2.1. Design

In a longitudinal study design each patient was assessed twice: upon admission (t1) and upon discharge or death or after 2 weeks if the patient was still in the ICU (t2).

2.1.1. Instruments

A questionnaire was developed containing questions regarding the patient demographics, pressure ulcer occurrence, grades, body sites of pressure ulcers, duration, origin, types of dressing and preventive measures. The grading system of the European Pressure Ulcer Advisory Panel (EPUAP) was used and stated as the following by Defloor and Schoonhoven (2004) (Table 1).

The reliability and clinical utility of EPUAP was tested, which revealed a kappa level of 0.308 with agreement of 85.7% (Pedley, 2004). Additionally, the inter-rater agreement and accuracy of response using the EPUAP and Stirling scale was tested and the consistency was highest for the EPUAP scale (61.9% of cases) in comparison to 30.2% for the Stirling scale (Russell and Reynolds, 2001) In addition, the Braden scale was used to assess the risk of developing pressure ulcers. The predictive validity of the Braden scale has been tested in more than one health care setting, which revealed that risk assessment with the Braden scale upon admission is highly predictive of pressure ulcer development in all settings (Bergstrom et al., 1998). Questions about supplies used for incontinent patients (bowel and urine) were included as well. Pressure ulcer lenses were used to identify nonblanchable erythema. With these lenses the extend was visible to which the erthema blanched when applying pressure.

The second instrument was the APACHE II (Acute Physiology and Chronic Health Evaluation) which is used to assess the severity of illness (Rao and Suhasini, 2003). APACHE II is one of the most frequently used instruments for outcome prediction in adult critically ill patients (Rao and Suhasini, 2003). The ability of APACHE II to predict hospital mortality was tested in 2795 patients from interdisciplinary intensive care units in a period of 3 years. It revealed a correct prediction of 84.3% and an area under the receiver operating characteristic (ROC) curve of 0.832 (Rainer et al., 2000).

2.2. Sample

Fig. 3 shows that 103 patients from two hospitals (53 from the university hospital and 50 from the general hospital) refused to participate in the study, while 121 patients (67 from the nephrological ICU of the university hospital and 54 from surgical and cardiological ICU of the general hospital) accepted to participate in the study.

The reason for non-response was the inability to read and sign the informed consent, some accepted to participate but refused to sign the consent. Moreover, relatives of comatose patients did not want their patients to participate in the study because they did not know whether their patient would accept or not.

2.3. Data collection

The researcher trained two assistants (ICU nurses), one in each hospital. The researcher clarified in detail with the assistants when and how the patients were to be assessed and

Table 1
Pressure ulcer classification according to European Pressure Ulcer Advisory Panel

PU[a] grade	Definition
Grade 1	Non-blanchable erythema of intact skin and is described as a discolouration of the skin, warmth, oedema, induration or hardness
Grade 2	Partial loss in the thickness of the skin involving epidermis, dermis, or both
Grade 3	Full loss in the thickness of the skin involving damage necrosis of subcutaneous tissue that may extend down to, but not through underlying fascia
Grade 4	Extensive destruction, tissue necrosis, or damage to muscle, bone or supporting structure with or without full loss in the thickness of the skin

[a] Pressure ulcer.

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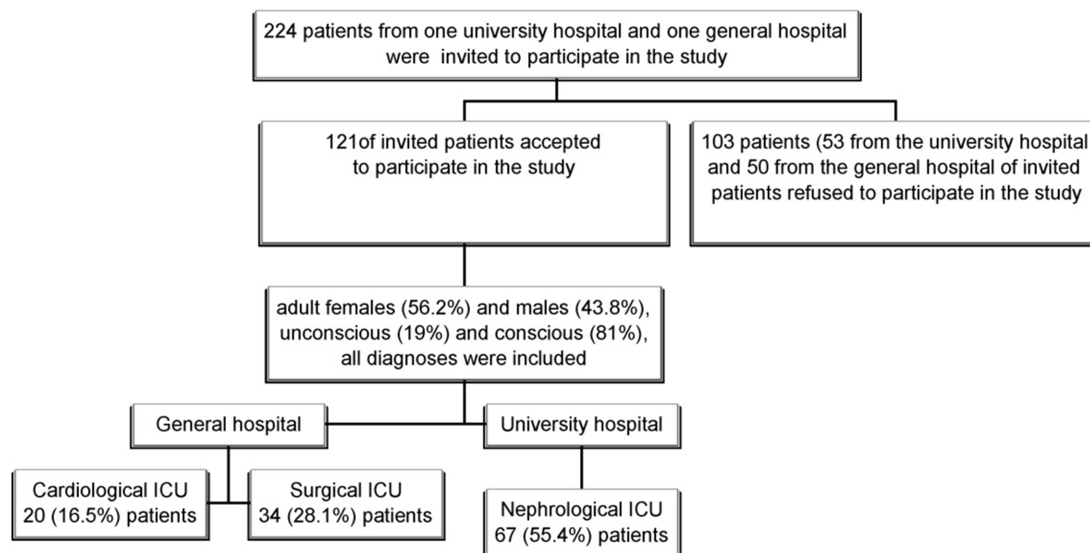

Fig. 3. Flowchart of sample distribution and characteristics.

how the research instruments were to be used. Additionally, pictures and definitions of each pressure ulcer grade and information on how to differentiate between pressure ulcer lesions and other lesions resulting from urine or bowel incontinence were given to each assistant (Defloor and Clark, 2005). Each nurse filled out the questionnaire for pressure ulcers immediately after patient assessment and the APACHE II score was also filled out by the same nurse using the patient's file. The summation of APACHE II scores at admission and at discharge was calculated. The mean of the summation was used to describe the difference between patients with and without pressure ulcers. The data were collected from April until October 2006.

2.4. Ethical consideration

Permission to conduct the study was obtained from the Berlin medical ethical committee. Prior to data collection, the informed consent was obtained from conscious patients, and assent was obtained from relatives of unconscious patients.

2.5. Data analysis

The data were analysed using the Statistical Package of Social Science (SPSS) version 13. The determined incidence was based on the EPUAP definition (EPUAP, 2002): incidence = (new pressure ulcer/patients at risk) $\times$ 100. The differences between the groups of patients with pressure ulcer and without pressure ulcer were described using patients numbers, percentage, mean and standard deviation regarding the factors gender, age, body mass index, Braden score, severity of illness (APACHE II score), length of stay, unconsciousness, urinary catheter at admission and patients with pressure ulcer at admission.

3. Results

The total sample of 121 patients consisted of 56.2% males and 43.8% females. Twenty-three (19%) patients of the sample were unconscious. The mean of the length of stay for all patients was 7 days (S.D. $\pm$8.6 days), while the length of stay for patients with new pressure ulcer was 9.5 days (S.D. $\pm$5.1 days). The results also revealed a total incidence of 3.3%, which was 4.5% for the nephrological patients and 2.9% for the surgical patients, while none of the cardiologic patients developed a pressure ulcer. Additionally, 16 patients had a pressure ulcer at admission. The highest pressure ulcer grade was grade 2.

3.1. Body sites of pressure ulcers and duration

The most common body sites of pressure ulcers among those patients who were admitted with an existing pressure ulcer were sacrum, heel and ischium. However, shoulder, sacrum, heel and ear were the favourite sites of newly developed pressure ulcers. The duration of 71.4% of existed pressure ulcers at the time of the admission to the ICU was unknown, while 19% had developed within 2 weeks. Additionally, 25% of new pressure ulcers had developed in patients who stayed less than 1 week in ICU, whereas 75% of them developed in patients who stayed more than 1 week and less than 2 weeks in ICU.

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Table 2
The course of pressure ulcers in ICU, *N* (%)

Grade	At admission	New PU	Healed	Healing progress	At discharge
Grade 1	6 (4)[a] (28.5%)	1 (1)[a] (16.6%)	3 (2)[a] (60%)	1 deteriorated to grade 2	3 (3)[a] (13.6%)
Grade 2	9 (8)[a] (42%)	4 (2)[a] (66.6%)	2 (2)[a] (40%)	No change	12 (8)[a] (54.5%)
Grade 3	6 (5)[a] (28.6%)	1 (1)[a] (16.6%)	–	1 deteriorated to grade 4	6 (5)[a] (27.3%)
Grade 4	–	–	–	No change	1 (1)[a] (4.5%)
Total	21 (16)[a] (100%)	6 (4)[a] (100%)	5 (4)[a] (100%)	–	22 (17)[a] (100%)

[a] Number of patients.

3.2. *The course of pressure ulcers after admission to an intensive care unit*

Table 2 shows that 16 patient with a total of 21 pressure ulcers were admitted to intensive care unit. Additionally, four persons developed six new pressure ulcers during their stay in the ICU, and five ulcers in four patients were healed during patients' stay in ICU. Moreover, one pressure ulcer grade 1 deteriorated to grade 2 and one pressure ulcer grade 3 deteriorated to grade 4. Furthermore, grade 2 was the highest pressure ulcer grade upon admission (9 ulcers) in eight patients, upon discharge (12 ulcers) in eight patients and two patients developed four new pressure ulcers grade 2. Table 2 shows a total of 16 patients having pressure ulcers at admission whereas adding the numbers in the collum would result in 17 patients having pressure ulcers at admission. However, one patient is listed twice because of having two ulcers (grades 2 and 3). Therefore the total patient score was adjusted to 16.

Table 3 shows that three of the healed pressure ulcers in two patients were grades 1 and 2 ulcers in two patients were grade 2. Moreover, all healed ulcers were those of females, whose age ranged from 63 to 83 years, and all patients were overweight (BMI $\geq$ 25). No change in the severity of the illness from the time of admission to the time of discharge was found, except in one patient.

3.3. *Prevention*

This study revealed that foam mattresses were used for 43%, standard mattresses for 23% and alternating air pressure mattresses were used for 33% of the patients. One patient had a low air-loss bed. Heel and elbow protectors and synthetic sheep skin were not used at all during this study. The most frequently applied preventive nursing care measures were skin inspection with 89.3%, mobilisation with 79.3% and massage with 40.5%. Avoiding insufficient nutritional and fluid intake was a measure used for 21.5 % of the ICU patients. The results overlap to a certain extent because some nursing measures were combined.

3.4. *Treatment*

Table 4 shows that no dressing was used for most patients who suffered from pressure ulcers, whereas hydrocolloid was the dressing most commonly used for patients who had a pressure ulcers.

3.5. *Incontinence supplies*

Eighty-six patients (71.1%) had a urinary catheter and 45 (37.2%) patients had plastic linen. Urine collectors were used for 14 (11.6%) patients. Other incontinence supplies were rarely used and ranged from 0.95% to 6%. All patients who developed a new pressure ulcer were catheterised and three of them had plastic linen.

Table 5 shows some differences between patients with new pressure ulcers and patients without pressure ulcers regarding gender, age, Braden score, severity of illness, length of stay, unconsciousness and catheterization at admission. Furthermore, there are also some obvious differences between patients with pressure ulcers at admission and patients without pressure ulcers regarding gender, age, over weight, Braden score <14, and urinary catheterization at admission.

Table 3
Characteristics of patients with healed pressure ulcers

No. of ulcers	Gender	Ward	BMI	Age	Braden	Grade	Site	Dressing	Length of stay	APACHE II upon admission	APACHE II upon discharge
1	Female	Cardiology	39.1	80	19	1	Sacrum	None	3	8	8
	Female	Nephrology	33.1	73	14	2	Sacrum	Hydrocolloid	13	15	15
	Female	Nephrology	34.2	63	8	2	Elbow	Hydrocolloid	14	24	9
2	Female	Nephrology	26.9	83	13	1	Sacrum and heel	None	9	18	17

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Table 4
The types of pressure ulcer dressing regarding pressure ulcer grades N (%)

	None	Hydrocolloid	Alginate	Hydro polymer	Alginate and hydro polymer	Others	Total
Grade 1	8	–	–	–	–	2	10
Grade 2	–	8	–	1	–	2	11
Grade 3	4	–	1	–	1	–	6
Grade 4	–	–	–	–	–	–	–
Total	12	8	1	1	1	4	27[a]

[a] Total number of pressure ulcers existing at admission (21) with newly developed pressure ulcers (6).

Table 5
Patients that never developed pressure ulcers versus patients who developed pressure ulcers after admission

Factor	− PU, N = 101	+ New PU, N = 4	+ PU at admission, N = 16
Male, N (%)	59 (58.4%)	3 (75%)	6 (37.5%)
Female, N (%)	42 (41.6%)	1 (25%)	10 (62.5%)
Age[a]	64.7 (15.3)	68.5 (20.2)	73 (11.7)
Under weight (BMI < 18.5)	1 (.9%)	0 (%)	1 (6.3%)
Ideal weight (BMI 18.5–24.9)	40 (39.6%)	3 (75%)	5 (31.3%)
Over weight (BMI > 25)	57 (56.4%)	1 (25%)	10 (62.3%)
Braden score <14	32 (31.7%)	1 (25%)	9 (56.3%)
Braden score from 14 to 18	42 (41.6%)	3 (75)	6 (37.5%)
Braden score >18	27 (26.7%)	0 (0%)	1 (6.3%)
Severity of illness at admission (APACHE II score)[a]	10.8 (6.9)	16.6 (7.6)	13.3 (4.8)
Length of stay[a]	6.9 (9.2)	9.5 (5.1)	7.3 (4.8)
Unconsciousness, N (%)	18 (17.8%)	1 (25%)	4 (25%)
Urinary catheter at admission, N (%)	70 (69.3%)	4 (100%)	12 (75%)
Pressure ulcer at admission, N (%)	–	0 (%)	16 (100%)

[a] Mean and standard deviation.

4. Discussion

4.1. Incidence

The results of this study reveal a lower pressure ulcer incidence compared to other studies. The highest incidence was found in the nephrological speciality, while no pressure ulcers developed in the cardiologic speciality. This study result can be explained by the short period that patients stay in an intensive care unit. Additionally, the structures of the hospitals participating in this study did not include the recovery and intermediate wards. Therefore, all surgery patients were admitted to the ICU, even though they only stayed there for a short period of time (2–3 days). Moreover, some patients had not been actually critically ill for an admission to the ICU or may have only needed a transfer to an intermediate ward. This may explain why the mean of APACHE II score (14.6) in this study was lower than other studies, however in more than one other study in ICU it was 18 and higher (Theaker et al., 2005; Arabi et al., 2002). Moreover, the sample size of this study was not large enough to gain an accurate insight into the pressure ulcer frequency in intensive care settings. This decreases the ability to compare it to other studies and/or to generalise the results. Additionally, the incidence of pressure ulcers in this study is very low, therefore; the results regarding the influencing factors have to be interpreted carefully. Another factor influencing the results was the difficulty to get informed consent from conscious patients and assent for unconscious patients. This is supported by a study conducted by Harvey et al. (2006) on 498 intensive care patients regarding the identification of the proportion of critically ill patients able to consent to participate in a randomised controlled trial and the assessment as to what extent the patients' consent and relatives' consent are required to obtain the permission of the ethical committee. It was established that only 13 (2.6%) patients were able to give their informed consent independently, which leads to the conclusion that only a very small proportion of patients was able to give consent before conducting the study.

4.2. Body sites of pressure ulcers

The sacrum, heel and ischium were the most common body sites of pressure ulcers in this study. The result is supported by a study of Carlson et al. (1999) who found out that the most common body sites of pressure ulcers were sacrum, coccyx and heel. Additionally, the study by Calianno (2000) confirmed that heel ulcers are the second most frequent ulcers related to pressure. The interpretation of these results led to the conclusion that sacrum and heel were the most common body sites of pressure ulcers in

intensive care patients. Otherwise the shoulder and ear were found as sites of pressure ulcer in this study. This result has not been confirmed yet by other studies and could be considered in further research.

4.3. Prevention

Foam mattresses and alternating air pressure mattresses were the preventive devices most frequently applied to patients in this study. In this respect, a RCT study revealed that a foam alternative to the standard hospital mattress can reduce the incidence of pressure ulcers in at-risk patients (Russell et al., 2003). Moreover Reddy et al. (2006) reviewed 48 randomised controlled trials investigating the role of support surfaces in preventing pressure ulcers in different health care settings (acute care, long-term care, operating room and intensive care). Seven of them were conducted in ICU setting. Two trials investigated the effect of low air loss mattress. The first one compared low air loss mattresses versus alternating air pressure mattresses, Theaker et al. (2005), and the second one compared low air loss mattresses versus standard ICU beds (Inman et al., 1993). Both of the trials revealed a reduction in pressure ulcer incidence with applying low air loss mattresses and alternating air pressure mattresses without significant difference between both of them. However, this study was not able to confirm theses results due to some factors like the small sample size and lack of randomisation.

This study also revealed that massage was used as a preventive measure for 40.5% of the ICU patients, although national and international guidelines for the prevention of pressure ulcers describe massage as not being useful for pressure ulcer prevention (EPUAP, 1998; National Pressure Ulcer Advisory Panel, 1992; Dutch CBO-guidelines and Toetsing C.B.v.d.I., 2002). Avoiding insufficient nutritional and fluid intake applied just for 21.5% of the ICU patient. In this respect the study by Hengstermann et al. (2007) found that the percentage of malnourished pressure ulcer patients (39.5%) was more than twice the percentage of non-pressure ulcer patients with malnutrition (16.6%). Moreover, the body mass index in (42.9%) of patients with pressure ulcers was <20 in the same study. Based on these results avoiding insufficient nutrition might be considered as a measure for pressure ulcer prevention.

4.4. Treatment

No dressing was used for most of the patients in this study during treatment for pressure ulcer. The most frequently applied dressing was the hydrocolloid dressing. Additionally, a study of Chang et al. (1998) comparing the performance of hydrocolloid dressings and saline gauze dressing in the treatment of pressure ulcers grade 2 and more revealed that patients treated with the hydrocolloid dressing experienced a reduction of an average of 34% in their baseline surface area measurement compared to patients treated with gauze dressing where it increased by an average of 9%. A RCT study also revealed that hydrocolloid was more effective in the complete healing of pressure ulcers than simple dressing and phenytoin (Hollisaz et al., 2004). This can be explained by the performance of hydrocolloid, which not only improves healing but also reduces bacterial colonization and ensures autodebridement of the ulcer. In addition, Barr et al. (1995) established that a combination of hydrocolloid and alginate dressing on full thickness pressure ulcers led to a significant increase in the granulation tissue/epithelium and to a decrease regarding the amount of devitalized tissue. These results could not be confirmed by the result of this study due to the small number of patients treated with a dressing for their pressure ulcers.

4.5. Related factors

This study revealed some differences between groups of patients with pressure ulcers and without pressure ulcers. In this study, three patients with new pressure ulcers were males; three patients had a Braden score between 14 and 18. Also, there is a little difference between both groups regarding length of stay, while all patients with new pressure ulcers were catheterised. This may lead us to think about the relationship between urinary catheterization and the development pressure ulcers. Moreover, only one unconscious patient developed a new pressure ulcer while the other unconscious patients did not develop pressure ulcers, whereas the study by Boyle and Green (2001) revealed that coma/unresponsiveness and paralysis were significantly associated with pressure ulcer development. Additionally, Reed et al. (2003) found that confusion is significantly related to pressure ulcer development. This study also revealed that plastic linen was used for 75% of patients with new pressure ulcers. With regard to this, Jeter and Lutz (1996) stated that plastic linen should never be placed under a patient because it holds back the moisture, thus irritating the skin surface. Therefore, the application of plastic linen could be associated with pressure ulcer development. Moreover, this study revealed that patients with new pressure ulcers had APACHE II score higher than patients without new pressure ulcer. In this respect Theaker et al. (2005) found out, that there was no significant relationship between pressure ulcer development and the APACHE II score or the length of stay among 323 intensive care patients. The study of Wolverton et al. (2005) on 422 intensive care patients showed that 55% of pressure ulcers developed within 2 weeks upon admission as this study also showed. Furthermore, it should be taken into consideration that the group of patients with new pressure ulcers is too small for comparing them to the group without new pressure ulcers which limits the generalization of factors related to developing new pressure ulcers.

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4.6. The course of pressure ulcers

The results of this study revealed that five pressure ulcers were healed after patients' admission to intensive care units of which three ulcers were grade 1. This may be explained by the fact that patients being admitted to ICU often have multiple diagnoses that require frequent general assessment and more care, which might also help in curing and preventing other health problems such as pressure ulcers. Furthermore, pressure ulcers grade 1 is difficult to measure reliably and can be healed within 1 day (EPUAP, 2002). It may be also due to the use of some preventive measures such as mobilisation and skin inspection which were applied to most of the patients in this study.

5. Study limitations

One of the limitations of this study was the decreasing number of patient admissions during the period of the data collection. A lot of patients were also too weak to read and sign the informed consent or even did not want to sign it at all. In the event of unconsciousness the patients' assent was obtained. However, some relatives did not wish their patients to participate in the study, because they claimed that they did not know if the patients accepted a participation or not.

6. Conclusion

This study suggests that pressure ulcers can be healed in intensive care patients. Further observation and frequent assessment may help to reduce pressure ulcer incidence. Some preventive measures, such as foam mattresses and alternating air pressure mattresses, probably have a positive effect on preventing pressure ulcers among intensive care patients as well. However, the use of some incontinence supplies like plastic linen can be associated with pressure ulcer development. Hydrocolloid dressing may be helpful in increasing the healing rate. More research is required to establish those factors that are definitely related to pressure ulcer incidence in intensive care patients. The body sites of pressure ulcers, though, are comparable in more than one study on intensive care patients.

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Conflict of interest

None.

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