

ORIGINAL ARTICLE

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Pressure sores: epidemiology, medico-legal implications and forensic argumentation concerning causality

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Abstract The aim of the present investigation was to identify the frequency and grading of pressure sores in a large series of unselected consecutive deceased subjects before cremation and to discuss aspects of the forensic argumentation concerning causality. A total of 10222 corpses were examined prospectively over a 1-year-period (1998) for the occurrence, localization and grading of pressure sores. Epidemiological aspects (e.g. age, sex, underlying and contributing causes of death, place of death etc.) were taken from the death certificate. The mean prevalence of pressure sores was 11.2% (87.1% isolated sores; predominant localization of advanced grades on the sacrum in 69.6%). There was a positive correlation between the prevalence of sores and advanced age resulting in a clear female predominance in the age group of 80 years and over because of differences in life expectancy. A significant correlation was found between the prevalence of pressure sores and certain underlying diseases, e.g. trauma, senile dementia, neurological diseases, apoplexy and marasmus. Pressure sores of all grades were more frequently found in the deceased when a senior citizen's or nursing home was given on the death certificate as the domicile in the last period of life. The forensic argumentation for the causal relationship of a pressure sore as the focus of fatal infectious complications or septicemia has to be based on the results of clinical expertises and forensic investigations (evaluation of the institutional documentation of the patient's course, autopsy findings, histology, immunohistochemistry). The vast majority of physicians seem to pay only little attention to the potentially fatal outcome of pressure sores and fatalities associated with this condition are clearly underreported. From the point of view of social medicine, the prevalence of pressure sores in a defined population can be seen as a parameter for the quality of nursing and medical care. In bringing these fatalities to light, the field of legal medicine con-

tributes to a general quality control of standards of nursing and medical care.

Key words Pressure sore · Epidemiology · External examination · Cremation · Malpractice · Negligence · Iatrogenic injury · Septicemia · Geriatrics

Introduction

Pressure sores are a serious medical problem most commonly encountered in geriatric patients institutionalized in senior citizen's homes, nursing homes and hospitals and associated with increased patient morbidity and mortality [1, 2, 3, 21, 39,41]. It is widely accepted that pressure sores can be successfully prevented by the early use of risk assessment scores, modification of intrinsic and extrinsic risk factors for the patient, consistent monitoring and the appropriate utilization of various prophylactic procedures [2, 16, 20, 21, 26, 27, 30] and that pre-existing sores can be treated effectively by conservative or surgical intervention [2, 21, 28, 30]. Therefore, from the medico-legal point of view, the occurrence of a pressure sore in a resident of a senior citizen's home or nursing home as well as in a hospitalized patient can be considered as a nursing injury. In particular cases, an iatrogenic origin must also be considered [22, 31, 45]. Fatalities due to infectious complications and septicemia in the course of pressure sores seem to be underdiagnosed and underreported, a fact ascribable to the major difficulty of physicians to differentiate between a cause of death attributable to an underlying disease process and the fatal outcome of pressure sore-associated complications.

The purpose of a second external investigation before cremation in Germany is to re-examine the body of a deceased for signs of an unnatural manner of death in the light of the death certificate, when the manner of death has been certified as natural [11, 12, 13]. When a pressure sore is found during this examination, the question of the manner of death (e.g. unnatural death due to septicemia as a consequence of the pressure sore) may arise; if the deceased

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was in need of nursing or medical care before, the forensic investigator may be also confronted with questions concerning negligence or malpractice.

A few medico-legal publications have focused on this problem [22, 31] but no actual data on the prevalence of pressure sores in a large series of unselected cases of post-mortem investigation are available.

It was the purpose of the present study to identify the actual number of pressure sores in a large series of unselected corpses and to reflect the medico-legal implications associated with the subject.

Material and methods

In a prospective study 10222 corpses were investigated within the scope of an external examination before cremation over a 1-year-period (1st January 1998–31st December 1998). The bodies were examined by forensic pathologists from the Institute of Legal Medicine at the crematory of Öjendorf, Hamburg, Germany. The post-mortem period ranged from 5 to 31 days. Approximately 6% of the bodies in the study showed signs of advanced putrefaction but the examination for sores was generally not affected by putrefaction and autolysis. The occurrence, localization and grading of pressure sores was documented on a standardized form. The grading of the pressure sores was classified according to Shea (modified) [38] as follows:

- Grade 1 – Non-blanchable reddening of skin
- Grade 2 – Dermal ulceration not exposing subcutaneous fatty tissue
- Grade 3 – Ulceration reaching subcutaneous tissue
- Grade 4 – No anatomical limit, facultative osteomyelitis and dislocation of adjacent joints

Corpses with multiple sores were classified by the highest score. Furthermore, data on the deceased's age, sex, underlying or associated diseases and place of death (e.g. private home, senior citizen's home, nursing home or hospital) were taken from the death certificate and critically evaluated.

Results

Prevalence and grading of pressure sores

The investigation revealed pressure sores in 1145 of the corpses examined, corresponding to a mean prevalence of pressure sores of 11.2%. Grades 1 and 2 were the most frequently reported whereby 6.1% of all the deceased had a pressure sore of grade 1, 3% had a sore of grade 2, 1.1% had a sore of grade 3 and a grade 4 pressure sore was found in 0.9%.

Localisation of pressure sores

Among the advanced grades 3 and 4, single sores were found in 87.1% and were localized on the sacrum in 69.6%. In addition, in cases with multiple sores the sacrum was the most frequent position (10.9%). Isolated sores were found on the trochanter in 9.6%. The most frequent combination of localization of multiple sores were trochanter and sacrum (4%), hip and sacrum (3.2%) and thoracic spinal column and sacrum (2.4%).

Association of pressure sores with age and sex distribution

There was a clear association between the prevalence of pressure sores and age. In the group aged 70 years or under, grade 1 pressure sores were found in less than 4% and the group aged 90 years or over showed grade 1 pressure sores in approximately 10%. The highest prevalence of sores of the advanced grades 3 and 4 was found in the age group 90 years or over (4%) and 73% of all grades 3 and 4 sores were found in the age group 80 years or over.

There was a female predominance and 3% of all females examined showed grade 4 sores compared to males with 1.1%.

Underlying and contributing causes of death

A highly significant correlation was found between the prevalence of pressure sores and trauma, senile dementia, neurological diseases, apoplexy and marasmus ($P < 0.01$). There was no significant correlation for the association of pressure sores with cardiovascular diseases, lung diseases or an underlying diabetes.

Place of death

Pressure sores of all grades were more frequently found in deceased who died in senior citizen's or nursing homes than in any other category of the place of death; e.g. grade 4 sores were found in 36.2% when the place of death was a senior citizen's or nursing home (private home: 23.4%, hospital: 17%; in 23.4% the place of death could not be reconstructed).

Of all fatalities with sores, 41.3% had lived in institutions for aged people, whereas only 24% of the deceased in the study group had lived in such institutions (only included in this part of the analysis are those cases where the place of death could be reconstructed).

Fatalities with grade 3 and 4 pressure sores were found at a frequency ranging between 0% and 20% in senior citizen's or nursing homes.

Discussion

In this prospective study the mean prevalence of pressure sores in a series of 10222 corpses examined before cremation was 11.2%. In larger clinical series the reported prevalence was obviously lower than in our study. Barrois et al. [6] investigated 12 050 patients and found a pressure sore prevalence of 5.2%, Barbenel et al. [5] reported a prevalence of 8.8% in a survey of a total of 10751 hospital in-patients and out-patients visited by nurses, but the patients concerned in both clinical studies must be regarded as selected. Lignitz and Mattig reported a prevalence of 1.3% in their retrospective autopsy study over an 11-year-period [31].

With an extended life expectancy and an increasing number of geriatric patients, senior citizen's homes, nursing homes and hospitals play an important role as domiciles in the last period of life for immobilized and bed-ridden patients. For questions of nursing or medical malpractice and negligence it is of interest to know in which residences pressure sores develop more frequently, but the last domicile of life taken from the death certificate in the current study does of course not imply that the lesion has developed in the domicile where death occurred.

Patient groups at risk of developing pressure sores are patients aged 70 years and over, immobilized and paraplegic patients, trauma patients and patients being underweight [4, 5, 30, 39, 44]. Additional well-recognized intrinsic and extrinsic risk factors which predispose the development of pressure sores are fecal and urinary incontinence, altered consciousness, impaired nutritional intake, dehydration, hypoalbuminemia, hypoxemia and the presence of moisture and constant pressure on skin areas at risk [2, 3, 4, 9, 32, 36, 39]. In this context it is important to recognize that the influence of these factors varies from patient to patient. Furthermore potential iatrogenic immunodeficiency following the use of glucocorticosteroids or immunosuppressive drugs with consecutive bacterial infection of the sore has to be borne in mind.

Once more our study has identified the well-known risk factors especially for the advanced grades of pressure sores. Moreover, long lasting agonal periods have the potential of an additional effect on the development of pressure sores. With respect to this increased risk, it has to be expected that pressure sores are overrepresented in deceased persons. This fact has to be taken into consideration when comparing our data with clinical or population studies.

The striking difference concerning the frequency of pressure sores in residents from different institutions of nursing does not unequivocally lead to the conclusion of a different standard of nursing. A careful interpretation of these data is necessary because there was no detailed information concerning the distribution of residents or pa-

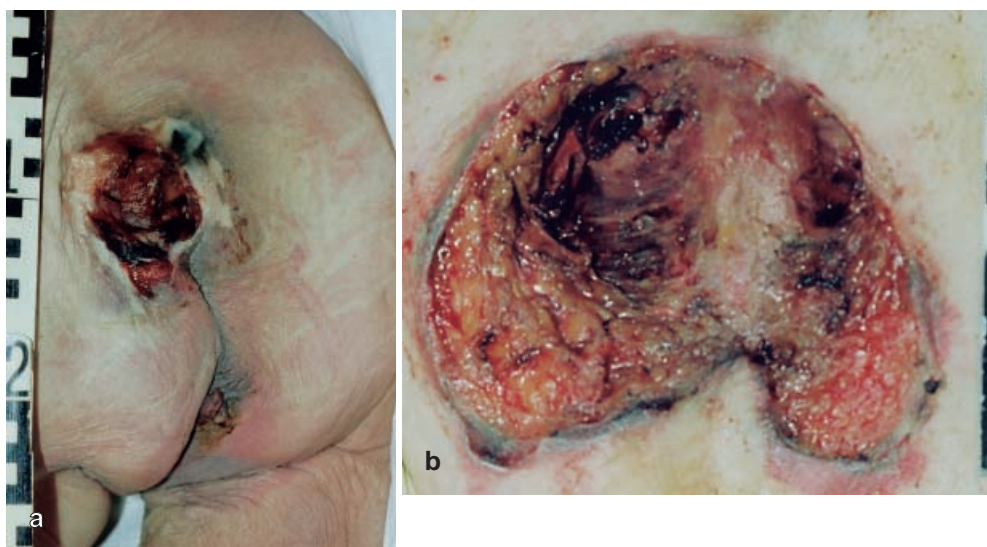
tients at high risk inside particular institutions and on the individual case histories. Only secondary investigations inside these institutions can answer whether these striking differences are caused by a different distribution of risk factors or differences in the quality of nursing. Pressure sore risk calculators, facilitating and standardizing the process of risk assessment, have assumed a cardinal role in the prevention and management of pressure sores [7, 8, 15, 20]. The most widely used are the Norton scale [33] and the Braden scale [10].

The colonization of persistent open pressure sores with microorganisms is associated with infectious complications such as bacteremia, osteomyelitis and septicemia [2, 14, 21, 38, 40] and septicemia related to pressure sores is associated with a mortality rate of up to 50% [14, 29]. Based on macromorphological autopsy findings, the diagnosis of fatal septicemia is often unconvincing and after a postmortem period of a few days, blood cultures are uninformative as they are contaminated due to putrefaction processes. However, histological and immunohistochemical investigations are of considerable value not only to identify the focus of septicemia and to verify inflammatory tissue changes [35, 42, 43], but also to demonstrate vitality of skin wounds and skeletal muscle alterations [17, 18, 19, 23, 24, 25, 34, 37]. These investigations are useful not only in identifying a pressure sore as the place of entry of bacteremia, but also as the focus of septicemia and can be evidential in drawing etiopathogenetic conclusions concerning the causal relationship between death and septicemia. Figures 1, 2 and 3 show different macromorphological and histological aspects of pressure sores.

For the forensic examiner evaluating a questioned case of pressure sore formation under aspects of alleged negligence or medical malpractice, it is of interest to know:

1. Where, when, and under what circumstances did the pressure sore develop?
2. Was a pressure sore risk calculator used on admission of the patient?

Fig. 1 Macromorphological appearance of **a** grade 3 and **b** grade 4 pressure sores (according to the modified classification by Shea) on the sacrum. Scale 1 cm



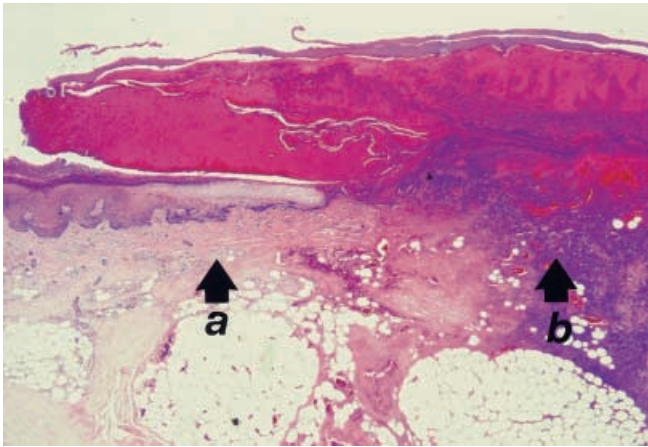


Fig. 2 Chronic pressure sore covered by a crust, showing epidermal atrophy with preserved architecture of the dermis (*arrow, a*), full-thickness destruction of skin with coagulation necrosis and chronic inflammatory changes (*arrow, b*). Hematoxylin-eosin $\times 40$

3. What intrinsic and extrinsic patient risk factors were identified?
4. Was the prevention management adequately adjusted to the identified risk factors?
5. Was the patient consistently monitored and were skin changes in skin areas at risk registered?
6. If the formation of a pressure sore was noted, was treatment subsequently undertaken?
7. Was the institutional documentation sufficient and are there enough data for a conclusive argumentation?

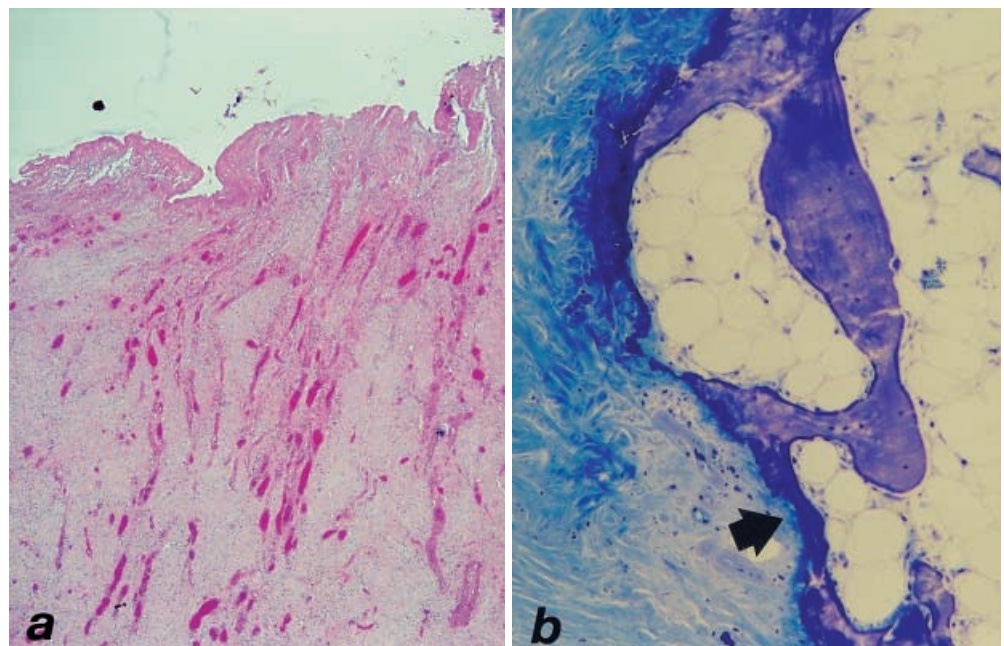
With respect to the forensic argumentation regarding causality, the causal relationship of a pressure sore as the origin of fatal infectious complications or septicemia has to be clearly demonstrated based on the results of clinical experience and the forensic investigation. Septicemia as a

consequence of pressure sore formation may be regarded as an unnatural cause of death when the possibility of neglectful care can be considered. The responsibility for the development of the sore has to be allocated by the legal authorities. If both aspects can be considered positive, the court of justice has to decide upon the assignment of guilt. The responsibility for assigning legal responsibility as opposed to causation varies from country to country. In Germany, the Supreme Federal Court has commented on the formation of pressure sores under aspects of the liability in civil law in two decisions [22, 45].

As a consequence of the results of our study, it has to be emphasized that there is a considerable variation in the ability of physicians responsible for the content and correctness of death certificates to recognize that pressure sores are a relevant cause of (unnatural) death especially in geriatric patients. In contrast to their actual duty to point to existing pressure sores on the death certificate, the vast majority of physicians seem to pay only very little attention to the potential fatal course of pressure sores. When these cases are not detected by the forensic investigator, e.g. within the scope of an external examination before cremation, no further investigations are usually carried out. According to our experience derived from this study, the reported number of fatalities due to infectious complications of pressure sores is likely to be an underestimate of the true frequency.

Apart from aspects of clinical forensic medicine, the investigation and elucidation of pressure sore-associated fatalities is also noteworthy from the point of view of social medicine. In bringing such fatalities to light, the field of legal medicine contributes to quality control of the nursing and medical care of (geriatric) in-patients and ambulatory patients. The prevalence of pressure sores in a defined population can be seen as a parameter for the quality and standards of nursing and medical care.

Fig. 3 a Healing pressure sore showing granulation tissue with multiple vertically orientated new blood vessel formations, edema and fibroblast proliferation. Hematoxylin-eosin $\times 40$. **b** pressure sore-related alteration of sacral bone showing fibrosis of the periostium, thinning of the corticalis (*arrow*) and mild inflammatory changes. Toluidine blue $\times 60$



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