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Postoperative Pressure Injury after Epidural Analgesia; a Scoping Review

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Abstract: Objective: To identify how postoperative pressure injury (PI) after epidural analgesia had been researched to identify the existing gaps, then to summarize the existing literature, particularly focusing on the rate of occurrence, clinical presentation and risk factors. **Design:** Scoping review. **Data sources:** MEDLINE, CINHAL, Academic Search Complete, and SCOPUS up to September 2018. **Study selection:** All published articles that discussed PI following postoperative epidural analgesia regardless of study design, or language. **Data extraction:** Studies were assessed on article characteristics (author, year of publication, article type, language, and study location); methodology (study design, study objectives, and number of participants); participants' characteristics (age, gender, and type, and duration of surgery); anesthesia and epidural analgesia characteristics (anesthesia type, epidural analgesia medications and rate, and level of epidural insertion); and PI description (percentage of occurrence, site, preventive measures, and treatment). **Results:** From 225 studies, 19 were included for analysis. Unfortunately, most of the articles found were descriptive in addition to short litters. In fact, the methodological limitations resulted in great variation in the reported occurrence rate, being present in anywhere between 0% and 23% of cases. Many of the reported cases were among healthy, young, and low risk patients. Preventive measures reported frequently including the application of PI prevention protocol, and increase patients and staff awareness. Studies discussed factors thought to be related to PI development. However, characteristics of anesthesia and epidural analgesia were the predominant factors. Those characteristics included neuroaxial versus general anesthesia, lumbar versus thoracic epidural insertion, in addition to motor and sensory block. **Conclusions:** The published work is insufficient to describe the full picture of postoperative PI following epidural analgesia. In addition, the association of PI with epidural analgesia has not yet been confirmed due to the lack of robust methodology. Further well-designed studies are recommended to bridge literature gap.
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Strengths and limitations of this study

1. This is the first review collected data about postoperative pressure injury after epidural analgesia.
2. The large proportion of letters and case studies could have led to a bias and negatively affect the quality of our results.
3. Quality evaluation was not performed because of the limited number of good published studies.

Introduction

Epidural analgesia represents a major advancement in postoperative pain control, as it significantly reduces postoperative pain, decreases opioid requirement, and improves patient satisfaction.[1-3] However, epidural analgesia has been known to result in frequent complications, including hypotension, motor block, urinary retention, and pruritus.[3] Pressure ulcers are an infrequent but well-recognized complication associated with postoperative epidural analgesia.[3] This can be disappointing for patients who, after having a pain-free postoperative period as a result of epidural analgesia, end up with pressure ulcers and the associated pain.[4] The National Pressure Ulcer Advisory Panel (NPUAP) uses the term 'pressure injury' (PI) instead of 'pressure sores' or 'ulcers' because pressure damage can happen while the skin remains intact.[5] PI is a localized change in the skin and/or underlying tissues as a result of an increase in the local pressure, with or without shear, usually over a bony prominence, to the degree sufficient to impair its blood supply.[6,7]

In 2006, PI prevalence in five European countries reached 18.1% across 25 hospitals.[8] PIs put an extra financial burden on the healthcare system, with the estimated cost reaching between $9.1 and $11.6 billion every year in the United States.[9] It was ranked second among the most common claims after wrongful death, as more than 17,000 claims per year were related to PI.[9] PI is more common among high-risk populations, especially elderly people and those with spinal injuries.[6] Others who are particularly at risk for PI include those with a serious illness; neurological problems such as cerebrovascular accident; and impaired mobility, including that related to surgical procedures, impaired nutrition or obesity.[6] Favorably, PI is preventable in most cases.[6] Effective in-hospital preventive measures include risk assessment; skin care; nutritional assessment and support; repositioning and mobilization; and education for both patients and their families.[7]

Despite the presence of sporadic studies discussing PI in relation to epidural analgesia, this complication seems to be understudied in the literature. It was considered to be a rare and unusual complication.[10] No previous review has been found in this regard. We conducted a scoping review to systematically map the research done in this area, thereby to identify existing gaps in knowledge. The following research questions were formulated: How postoperative PI after epidural analgesia had been researched? And what is known from the literature about this problem particularly as it pertains to the rate of occurrence, clinical presentation and risk factors?.

Methods

This manuscript adheres to The PRISMA Extension for Scoping Reviews (PRISMA-ScR) Checklist.[11] We conducted this scoping review following the five steps proposed by Arksey and O'Malley.[12] These steps include the following:

1. Identifying the research question

We conducted a scoping review to systematically map the research done in this area, thereby to identify existing gaps in knowledge. The following research questions were formulated: How postoperative PI after epidural analgesia had been researched? And what is known from the literature about this problem particularly as it pertains to the rate of occurrence, clinical presentation and risk factors?

2. Identifying the relevant studies

We conducted a systematic search to find eligible articles that discussed the problem of PI complicating postoperative epidural analgesia. The search strategies were developed by the research team with an experienced librarian then refined several times through team discussion. The final search strategy for MEDLINE can be found in Supplemental data file 1. The databases that were included in the search: MEDLINE, CINHAL, Academic Search Complete, and SCOPUS up to September 2018. No limitations were applied due to the paucity of citations about this topic. The references of the relevant articles were also searched manually.

3. Study selection

The titles and, if not conclusive, abstracts of the retrieved articles were screened independently by both authors. The full texts of the potentially relevant articles were obtained for full-text review. The inclusion criterion was that the texts should be published articles that discussed PI following postoperative epidural analgesia regardless of study design, date of publication or language. The exclusion criterion was when the abstract and/or full text of the article was not accessible. We set wide selection criteria because of the limited number of studies on this topic, also because our primary objective is to map the previous literature work concerning this problem.

The literature search identified 225 articles, and this list was shortened to 171 after the removal of duplicates. Of the 171 articles, 147 did not match the inclusion criteria after the screening the article titles and/or abstracts by two reviewers (HHW and RSA). Two articles were excluded due to inaccessibility of abstracts or full texts.[13,14] The full texts of 21 articles were reviewed by both authors independently. Three more articles were excluded after full-text review (Fig 1). A hand search of the 18 relevant papers added one more article.[15] As such, in total, 19 articles were included for analysis. Disagreements about study eligibility throughout the selection process were resolved by discussion between both authors.

4. Charting the data

Data were charted from the 19 selected articles using NVivo 12 software. Both reviewers participated in developing the data charting forms. The forms were piloted on 5–10 articles by the review team. The pilot result was discussed between the review team, modified, then the modified form was piloted again till the final form reached. The final chart form included the following main columns: article characteristics (author, year of publication, article type, language and study location); methodology (study design, study objectives and number of participants); participants' characteristics (age, gender, type of surgery and duration of surgery); anesthesia and epidural analgesia characteristics (anesthesia type, epidural analgesia medications and rate, level of epidural insertion and duration of epidural analgesia); and PI description (percentage of occurrence, site, preventive measures, treatment and outcome). HHW charted the data from the selected studies. Then, the charted data were checked for accuracy and completeness by the other reviewer (RSA).

5. Collating, summarizing, and reporting the data

In this step, we first conducted a quantitative analysis using an Excel spreadsheet to analyze the articles' characteristics; participants' characteristics; methodology; anesthesia and epidural analgesia characteristics; and PI description. Quantitative analysis included calculating the frequency, percentage and the range of these variables. Then, we conducted a qualitative analysis related to the study objectives, preventive measures, and treatment.

In fact, the type of selected articles affected the amount of the available data and reporting options. As many of them were case reports—and some were actually letters—the reported data were extremely variable and some points were mentioned in different ways among the articles or were mentioned in only in few studies. For example staging of PI was either not reported, or reported using variable staging systems. We used Microsoft Excel 2010 for the quantitative analysis and graphs, and NVivo version 12 for the qualitative analysis.

Patient and Public Involvement

The development of the research questions and outcome measures was triggered by two cases of postepidural injury after epidural analgesia for cesarean section. The cases are prepared to be published as a case report. The patients asked us about what is already known in the literature about this problem and if there were similar cases. We searched literature but did not find an answer. We conducted the review after that and updated our patients about the results. Their questions encourage us to do our study as a scoping review but they were not involved in the conduction of the study.

Results

Methodology

As shown in the flow diagram of the article selection process (Fig 1), of the 171 identified articles, 19 articles were included in the analysis. All were published in English except one, which was published in German.[16] Supplementary Table 1 shows the characteristics of the included articles. The dates of publication ranged from 1985 to 2013. Sixteen of them (84%) were older than ten years (i.e., published before 2008). Six of these studies were conducted in the UK,[10,17-21] three in Australia,[15,22,23] and two in Japan[24,25]; the remaining were in Ireland,[26] Taiwan,[27] Austria,[28] Belgium,[29] the Netherlands,[30] Germany,[16] and the USA.[31] Concerning the article types, 12 were original research articles (63%), and 7 were letters (37%). One of the letters to the editor discussed opinion and did not include patients' data.[32] Two studies reported the occurrence of PI as one of the complications of epidural analgesia and not as the primary objective.[16,26]

Regarding study design, the most common study design was case reports, of which there were nine (47%). These case reports also include short papers, as letters in which very brief documentation of the case was written. However, there were also five prospective cohort, single group studies (26%) and four retrospective cohort reviews (21%). The sample size varied widely, from one patient (as in case reports) to 2807 patients.

Anesthesia and epidural analgesia characteristics

The type of anesthesia used during the operations was not documented in some articles. Generally, neuraxial anesthesia was most commonly used among those who documented. Edwards and colleagues noticed that heel pressure ulcers following a hip or a knee replacement developed exclusively in patients who underwent central neuraxial blockade or peripheral nerve block, while none of the patients with general anesthetic alone were affected.[10] Likewise, it had been found that PI did not develop after combined general anesthesia and high central epidural anesthesia (cervical/upper thoracic), even after long operations; rather, lower central epidural anesthesia was associated with the development of PI.[25] Yet, many other authors did observe postoperative epidural analgesia PI in patients who underwent general anaesthesia.[20-22,24,30]

Roche and colleagues documented an association between PI and lumbar insertion of the epidural catheter, but this association was not statistically significant.[15] In the same direction, Sellers adopted low thoracic instead of lumbar epidural insertion to reduce PI occurrence.[18] In contrary, PI has been reported with epidural thoracic insertion as well.[19] Duncan and colleagues reported that most cases of PI occurred with thoracic epidural insertion.[17]

The duration of epidural analgesia ranged from 12 hours to 6 days postoperatively. Medications used for epidural analgesia was mostly bupivacaine, used in seven studies (37%), either alone or mixed with other medications[16,18,20,21,25,28-31]; ribovacaine, used in three studies (15%)[20,23]; levobupivacaine, used in one[26]; and Naropin, also used in one.[22] The remaining articles did not clarify the medications used.[10,15,19,24,27,28] The most commonly used medication in combination with local anesthetics was fentanyl; others included nicomorphin, diamorphin, epinephrine, sufentanail, and clonidine.

Sellers claimed that changing epidural infusion from 0.25% bupivacaine to a combination of bupivacaine 0.1% and fentanyl 2 mg/ml resulted in a reduction of PI occurrence due to patients' ability to move their legs with the later regimen, despite being numb.[18] He added that a rate of 6 $ml.h^{-1}$ continuous infusion with a bolus of 6 ml maintained foot and heel sensation.[18] In contrast, Smet and colleagues thought that the combination of bupivacaine with other drugs

in the analgesic mixture may explain the occurrence of PI.[29] The combination used by Smet included sufentanil, clonidine, and epinephrine. Wiedermann and colleagues had a zero prevalence rate of PI when used epidural analgesia with 0.0625% bupivacaine mixed with fentanyl and adrenaline at a continuous infusion of 6–8 $ml.h^{-1}$, aiming to obtain sufficient analgesia without motor or profound sensory block and to limit motor block to the immediate postoperative period.[28] In addition, their patients do not leave the post-anesthesia care unit until after resolution of motor block, especially after combined spinal-epidural anaesthesia.[28]

The rate of PI occurrence and clinical presentation

The total number of patients affected by postoperative epidural PI in all studies together was about 69 patients; 18 (26%) of them being case-reported. Some papers mentioned the percentage of occurrence of PI without specifying the sample size. The prevalence or incidence reported varied widely, from 0% to 23%. The reported age of the participants ranged from 19 to 64 years. Three studies included both men and women.[17,22,26] Five articles did not specify the participants' gender.[10,15,16,19,28] A total of 25 women were studied in 9 articles,[18,20-22,24,25,29-31] and a total of 7 men were studied in 3 articles.[22,23,27]

Fig 2 shows the types of surgical operations performed within the study population. The most common surgeries studied were gynecological, followed by orthopedic surgeries. The duration of surgery for those affected by PI varied from 50 minutes to 5 hours, while the time interval between the surgical operation and the diagnosis of PI also varied greatly in the literature, ranging from 12 hours to 3 weeks. Duncan reported that in most of the studied cases, PI was reported after hospital discharge by the community or stoma nurses.[19]

Concerning the site of PI, the heel was reported in 12 (63%) out of the 19 articles. Heel injuries were reported as unilateral,[10,18,29] left,[21,23] right,[20] or both heels,[30,31] and occasionally, it was not specified which heel was affected.[10,17,19,22] The second most common site was the sacrum,[23-25] while others included the right buttock[23] and coccyx.[29] Surprisingly, Cherng and colleagues reported a case of a linear pressure sore with a ruptured blister underneath the line of the epidural catheter, along the midline of the back.[27] Some studies did not specify the site or documented it as a decubitus ulcer.[15,16,26]

Regarding the staging of PI, Edwards and colleagues used the European Pressure Ulcer Advisory Panel (EPUAP) staging system, which includes four stages.[10,24] None of the patients developed a stage 3 PI; even those with stage 4 had progressed from stage 2 directly to stage 4.[10,23] However, some authors adopted different classification systems to determine PI stage.[17,22]

A number of preventive measures against PI were discussed in the literature, Table 1 summarizes these measures. Some authors stated that the reported cases of postoperative PI did not receive preventive nursing care (for example, they were not nursed on pressure relieving mattresses and were not turned regularly).[20,21] However, PI developed despite changing a patient's position every two hours.[24] A prevalence of 13.8% was reported among surgical patients who received standard care of two-hourly repositioning, risk assessment, and heel protection.[22] Most of the retrieved articles stressed the importance of nursing care that includes both awareness and the application of pressure-relief techniques as preventive measures against postoperative PI.[10,21,30,32]

Table 1. Preventive Measures Against Pressure Injury After Epidural Analgesia

Risk assessment
Apply PI[a] prevention protocols.[10,17,20,21,23,29,31]
Assess PI[a] routinely as a part of patient monitoring.[10,17,20,21,23,29,31]
Avoid hypotension.[20]
Skin care
Encourage examination of postoperative patients' heels by anesthetists and their acute pain teams because nurses commonly miss reporting this issue.[19]
Secure epidural catheter along the paramedian or lateral chest line instead of the midline of the back.[27]
Repositioning and mobilization
Apply the pressure-relieving techniques such as pressure reduction mattresses.[10,20,21,23,30]
Use the heel protection devices and select them appropriately for each patient.[10,20,30]
Encourage the patients to change their position especially to lift their legs regularly.[19,27]
Encourage early supervised ambulation with EA[b].[26]
Minimize the duration of action of the motor and sensory to the least effective by adjusting the type and dose of the anesthetic agent, and by considering lower thoracic instead of lumbar epidural placement.[10,18,20,26]
Turn the patient regularly and especially those with a sensory/motor block and treat them as paraplegic patients.[10,20,21,30]
Awareness raising
Raise patients and staff awareness about PI[a] as a complication of EA[b].[10,19,20,23,29,32]

[a]PI, pressure injury; [b]EA, epidural analgesia

PI was treated in different ways in the literature. The following methods were documented: dry dressing with subsequent incision,[31] dressing with povidone-iodine solution,[27] film or hydrocolloid dressings,[10] ointments containing disinfectant and anti-decubitus ulcer drugs,[25] vacuum-assisted closure (VAC) dressing[23] and the injection of betamethasone sodium phosphate locally.[21] Moreover, some methods used to prevent further damage included pressure relief through leg elevation, the use of heel pads or a low air loss mattress overlay.[10,23,29,30] In cases of blister formation, both the method of removing the roof of the blister[30] and the method of leaving the blister intact while using a protective dressing[23] were reported. Stage 4 PIs were treated by surgical management in the form of the debridement of necrotic tissues.[10,23]

Most of the studies that followed up with participants documented that PIs healed uneventfully. However, the periods of recovery were variable, from as short as two days[27] to as long as nine months[20] (which occurred in a case where the patient was a heavy smoker, had lymphoedema in both legs and developed severe pressure necrosis of both heels). Totally 4 cases of stage 4 PI had been reported, all needed surgical care.[10,20,22,23] All were in heels but one affected the sacral area in a patient with vascular insufficiency and eventually healed after three months.[23] Interestingly, two of stage 4 PI developed despite having taken preventive measures such as risk assessment, repositioning and heel protection.[22]

Risk factors

Regarding surgical procedures, PI was found to be more common after obstetrics/gynecology surgeries, but this difference was not statistically significant.[15] It has been found that the number of patients with PI after knee replacement surgery was greater than those with PI after a hip replacement.[10] This was explained by the postoperative leg position, as for those who had a knee replacement their legs were in direct contact with the bed sheet and mattress.

Heel damage was significantly associated with the postoperative use of heel pads, which are designed for operating theatres.[22] The postoperative use of thrombo-embolus deterrent stockings (TEDS), especially when worn continuously, was associated with PI.[22]

Concerning patients' risk category, Shah[20] and others[20,29,30] studied low-risk patients. PI was found in patients who did not have significant predisposing factors; whose surgeries were not prolonged, who had no excessive hypotension and for whom silicon jelly pads were used to relieve pressure during surgery.[20,29] Other studies included patients with known risk factors, including vascular patients,[22,23] patients with a constitutional predisposition,[25] patients with perioperative hypotension,[17,22] patients with high PI risk assessment scores,[17] patients who were smokers,[22] patients with multiple disease burdens[22] and elderly patients.[31] PI occurred in female patients more often than it did in male patients.[22]

Motor and sensory block was the most prominent risk factor identified in the literature. Pither and colleagues[31] reported a case of bilateral heel ulcers with dense motor block. Punt[30] and others[23] reported motor block in their patients, although some of the patients were able to move their legs in the first postoperative night. Roche and colleagues found a statistically significant association between postoperative PI development and dense motor block.[15]

In addition, Edwards and colleagues reported heel pressure ulcer development on the side of the nerve block in 66% of the sample.[10] Similarly, Shah reported three cases, of which one had a unilateral motor and sensory block and developed a heel ulcer on that side.[20] Takahashi and colleagues noticed that, 18 hours after surgery, the anesthetic effect of epidural analgesia continued below the L2 level, which was thought to be a possible predisposing factor.[24] Duff and colleagues found that lumbar epidural analgesia was associated with lower limb motor block when compared to thoracic epidural insertion, being found in 43% of patients with lumbar versus 7.2% with thoracic epidural placement.[26] In contrast, postoperative PI also developed after epidural analgesia in patients without dense motor blocks who were able to move their legs.[16,19]

Discussion

PI following postoperative epidural analgesia has not been studied adequately. The number of publications is generally limited. Our review showed that the studied cases were limited to 10 countries distributed in Europe (11 articles), the Western Pacific (6 articles), and the Americas (1 article). This is probably related to the differences in research publication trends between different countries, and it does not necessarily indicate the absence of this complication in other world regions. The countries for which the reports were available are ranked among the top 35 publishing countries in the medical field.[33] In addition, all the publications were from high-income economies, where the quality of health care is expected to be high.

Out of the 19 selected studies, nine were case reports which are known to have substantial methodological limitations.[34] In addition, case reports are prone to biases and the results cannot be generalized, so they are still ranked low on the

evidence hierarchy.[34] In the same vein, some of our case reports were published within a letter which is too short to provide the details of those cases. Most importantly, the association of epidural analgesia with PI has not been confirmed by any interventional study with a sound methodology. With regard to the date of publication, most of the articles were more than ten years old. The health system and the quality of health care have undergone substantial changes in recent years, so the published work might not reflect the current or recent situation. Additionally, PI preventive care has become more widely adopted and has reduced the occurrence of PI, as evident in data from the US which showed a clear 50% drop in facility-acquired PI prevalence from 2006 to 2015.[35] However, the data include PI of all causes, and there is no clear indication of whether there was a drop in the occurrence of PI after epidural analgesia as well.

PI associated with postoperative epidural analgesia is a significant problem and is not as rare a complication as it was thought to be before. Its occurrence rate reached as high as 23%, according to Duncan's study published in 2001.[19] This figure is very high when compared with the occurrence of all-cause PI. For example, a UK study done in 2000 reported the incidence of PI to be 4–10% among patients admitted to a district general hospital.[36] The occurrence rate was high in two articles within this review (above 20%) i.e. within the range of PI prevalence reported in patients with spinal injuries, which is between 20% and 30% at 1 to 5 years after injury.[37]

There is a wide variation in PI prevalence, and this could be attributed to the differences in definitions and data collection methods. It is known that PI can be easily missed, especially in the early stages. Additionally, the time interval between epidural analgesia and PI development could be many days after discharge from the hospital, so these cases are also frequently missed.[10] Histologic studies by Witkowski and Parish revealed some interesting findings concerning PI development.[38] They found that early signs of pressure damage occur in the upper dermis [38] while the epidermis remains intact because it has the ability to tolerate prolonged hypoxia before showing signs of pressure damage.[38] This could explain why PI could be noticed days or weeks after epidural analgesia.

The studies which reported a high prevalence rate did include minor injuries, i.e. stage 1, and were prospective in nature; the patients were regularly examined to check for early signs of PI before they complained. Similarly, studies performed at hospitals where a PI risk assessment protocol was applied were able to detect minor pressure changes as well. In contrast, studies that reported low rates were mostly retrospective in nature and relied on hospital records.[15] Given these findings, a sound methodology and well-defined outcome measures were recommended when studying PI prevalence.[39]

With regard to its gender-related prevalence, more women than men were reported to have PI. Female gender has been found to be associated with pressure ulcer development.[40] Another reason could be that the most common surgeries studied were gynecological ones.

With regard to the features of PI, heels were the predominant site. Heels are particularly vulnerable to PI due to its structural features, that is, bony prominence over a small area with a paucity of soft tissue padding.[10] Interestingly, postoperative epidural analgesia-related PI can reach stage 4, which is severe enough to require surgical management. This observation emphasizes the importance of risk assessment and early detection of PI to avoid this serious complication.

Although most cases of PI healed up within a short time, few cases had long recovery period reached up to 9 months. This is longer than the period of recovery for the surgical wound itself; which is the primary cause of epidural analgesia administration. Additionally, the pain caused by PI and the discomfort caused by the possible need for frequent dressing and tissue debridement could be difficult for a patient who received epidural analgesia just to have a pain-free postoperative period. Therefore, patients should be informed about this possible complication and their consent should be obtained before procedures that carry the risk of PI.[16]

Neuraxial anesthesia was the most common anesthesia procedure reported. Neuraxial anesthesia induces a paraplegia-like state, with sensory loss and perhaps a variable degree of inhibition of spontaneous patient movement.[41,42] In tissues with normal sensation, pressure, and compression lead to a feeling of discomfort. This leads to the urge to move or generally change tissue position, even when the person is asleep.[42] This could also explain why PI has a higher incidence with lumbar than with thoracic epidural administration. Nonetheless, the results were incontinent so it is worth to confirm the association by further study.

Regarding epidural medications, the epidural administration of a local anesthetic can cause peripheral vasodilation and hypotension. This may cause local shunting at the pressure points and local skin ischemia, which are associated with a predisposition towards PI.[30,43]

PI has been reported to develop when bupivacaine is used alone or with other medications. The bupivacaine concentration and infusion rate could be one of the determining factors. None of the PI

occurrences reported in the current review occurred with a bupivacaine concentration of 0.0625%. A study on labor epidural analgesia supported this finding as there were no reports of pressure sores in any of the parturient when bupivacaine was used at a concentration of 0.0625%.[44] Similarly, Wiedermann and colleagues confirmed that no PI developed in 608 postoperative patients who received epidural analgesia for various major operations with administration of 0.0625% bupivacaine, fentanyl, and adrenaline as a continuous infusion at a slow rate of 6–8 $ml.h^{-1}$. It is possible that controlling both the administration rate and bupivacaine concentration can help in maintaining motor and sensory function and thereby prevent PI.[28]

Several other factors were considered to predispose patients to post-epidural PI. Unfortunately, the results were erratic due to methodological limitations and failed to prove the association. Post-epidural PI, unlike PI of other causes, has been noted in young, healthy, low-risk persons. Further, factors such as hypotension and prolonged surgeries were not common in the studied population.

Although PI is a known complication of epidural analgesia, the use of this excellent postoperative analgesia method should not be completely avoided.[10,32] The advantages of epidural analgesia include early mobilization, less narcotic use, and easier nursing care,[10,16,32] so it would be worthwhile to put in some effort to prevent this avoidable complication.

Conclusions

The development of postoperative PI following epidural analgesia is not as rare complication as has been previously thought. Unfortunately, most of the articles found were descriptive with many short litters. The published work is therefore insufficient to describe the full picture of postoperative PI following epidural analgesia such as determining the rate of prevalence or proving the association of post-epidural analgesia with PI. Many of the reported cases were among healthy, young, and low-risk patients. Preventive measures reported frequently including the application of PI prevention protocol, and increase patients and staff awareness. Studies discussed several factors thought to be related to PI development. However, the results were largely inconsistent but the characteristics of anesthesia and epidural analgesia were the predominant reported factors. Those characteristics included neuraxial versus general anesthesia, lumbar versus thoracic epidural insertion, rate, and concentration of epidural medication in addition to motor and sensory block. Further well-designed studies are recommended to bridge the literature gap.

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Contributorship

Name: Hana Hasan Webair, MBBS, MS.

Contribution: This author helped in electronic search, study selection, analysis, and interpretation, manuscript writing, and critical review of manuscript drafts.

Attestation: Hana Hasan Webair approved the final manuscript.

Name: Raed Sayed Ahmed, MBCh, FRCSC, FACOG, MScCH

Contribution: This author helped in study design, electronic search, study selection, analysis, interpretation, and critical review of manuscript drafts.

Attestation: Raed Sayed Ahmed approved the final manuscript.

Figure Legends (Figures are not shown)

Figure 1: Flow diagram of studies selection for scoping review about postoperative pressure injury following epidural analgesia.

Figure 2: Frequency distribution of surgical operations in the included studies about pressure injury after postoperative epidural analgesia.

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