Efficacy of continuous epidural block with epidural electrical stimulation compared to conventional continuous epidural block for acute herpes zoster management: A retrospective study

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Abstract

Background Continuous epidural block is commonly used in clinical settings and reduces the likelihood of transition to postherpetic neuralgia via pain control. The purpose of the present study was to compare the efficacies of conventional continuous epidural block and continuous epidural block involving electric stimulation-guided localization of the catheter to areas with neurological damage, in the treatment of herpes zoster pain and prevention of postherpetic neuralgia.

Methods We analyzed the medical records of 114 patients in the present study. The patients were divided into two groups: esopocan (conventional continuous epidural block) and epistim (continuous epidural block with epidural electric stimulation). In the esopocan group, the position of the epidural catheter was confirmed using contrast medium alone, whereas in the epistim group, the site of herpes zoster infection was identified through electric stimulation using the guidewire in the catheter. Clinical efficacy was assessed using a numerical rating scale (pain score) up to 6 months after the procedures. We compared the percentage of patients who showed complete remission (pain score less than 2 and no further medication) in each group. We also investigated whether the patients required additional interventional treatment due to insufficient pain control during the 6 month follow-up period after each procedure.

Results After adjusting for confounding variables, the pain score was significantly lower in the epistim group than in the esopocan group for 6 months after the procedure. The adjusted odds ratio of patients included in the complete remission category was 1.9 times higher in the epistim group than the esopocan group (95% confidence interval: 0.81-4.44, P = 0.14). The adjusted odds ratio for other interventions within 6 months after the procedure was 3.62 times higher in the esopocan group than the epistim group (95% confidence interval: 1.17-11.19, P = 0.03).

Conclusion Epidural drug administration to specific spinal segments using electrical stimulation catheters may be more helpful than conventional continuous epidural block in improving pain and preventing postherpetic neuralgia in acute herpes zoster.

Background

Herpes zoster or shingles is caused by reactivation of latent varicella zoster virus (VZV) that remains in the dorsal root ganglia after the initial infection. It causes irritation along the nerve distribution,

abnormal sensitization of nociceptive receptors, and induces hyperactivity of the central nerve [1]. The frequency of reactivation increases, particularly in elderly patients and patients with inhibited virus-specific cellular immunity [2, 3]. The acute phase of herpes zoster is mainly defined as the period within 30 days of the onset of rash [4]. Postherpetic neuralgia (PHN) is the most common complication of herpes zoster and can occur if the patient is not properly treated during the acute phase or in elderly patients, despite proper treatment, due to the weakened immune system [5]. PHN is a neuropathic condition, is associated with severe refractory pain, and is considered to lower the quality of life. Among patients with herpes zoster, 70% of those over 50 years of age complained of pain 1 month following the disappearance of skin rash, whereas 50% of patients aged 70 years or older experienced pain 1 year following the disappearance of rash [6, 7]. Patients at risk of developing PHN may, therefore, require aggressive treatment using appropriate drug therapies.

Epidural, sympathetic, and paravertebral blocks are considered active treatments for acute episodes of herpes zoster. In acute herpes zoster, continuous epidural block is commonly used in clinical settings and is reported to reduce the likelihood of transition to PHN via pain control [8-10]. For the conventional continuous epidural block, the location of the epidural catheter is confirmed by injecting a contrast agent at the suspected epidural level, which is identified based on the site of rash or pain.

To improve the efficacy of the continuous epidural nerve block, it is important that the drug is administered precisely at the epidural level of the herpes zoster infection [11, 12], which is dependent on the proximity of the catheter to the affected nerve site. For this purpose, continuous epidural block is performed using epidural electrical stimulation to confirm whether the electrical stimulation accurately reaches the site of herpes zoster infection. The present retrospective study was designed to evaluate the efficacy of the continuous epidural block using epidural electrical stimulation in controlling acute herpes zoster pain and preventing PHN, compared to conventional epidural block.

Methods

Study design

Our retrospective observational study adhered to the STROBE checklist (S1 checklist) and was approved by the institutional review board of our hospital (No: 2019GR0073, March 11, 2019).

The medical records of patients who underwent continuous epidural block for herpes zoster pain from June 2010 to October 2017 were collected. Among these, only medical records of patients who received continuous epidural block within 30 days of rash onset were included. The patients were divided into two groups depending on the type of epidural catheter used for continuous epidural block: the esopocan group, which used general epidural catheters; and the epistim group, which used

electrical stimulation epidural catheters. Patients had to meet the following criteria to be included in the present study: older than 50 years of age with a numeric rating scale (NRS) score of 4 or greater; only received standard drug therapy including antiviral agents until the administration of continuous epidural block; and underwent a follow-up for a period of 6 months after continuous epidural block. The following criteria were used for exclusion: patients with insufficient medical records; patients who received other drugs, such as opioids, with epidural catheters; patients with immunosuppressed status; patients in whom the catheter was not maintained for more than 10 days after continuous epidural block; patients who did not receive standard medication, such as antiviral agents, until the procedure; and patients who discontinued the prescribed standard medication (gabapentin or pregabalin and analgesics) because of adverse effects. Additionally, patients who had undergone other interventional procedures due to the exacerbation of herpes zoster pain within 6 months of continuous epidural block were excluded, and the rates of the requirement of interventional procedures were analyzed separately.

Procedure

Continuous epidural block - esopocan group

Patients were placed in the prone position, and aseptic dressing was applied to the procedure site. An 18-gauge Tuohy needle was inserted into the inter-laminar space three levels below the target level under the guidance of fluoroscopic imaging. The loss of resistance (LOR) technique was used to verify whether the Tuohy needle was placed in the epidural space. After confirming the epidural space, a 20-gauge epidural catheter (Perifix® Soft Tip epidural anesthesia catheter; B. Braun, Melsungen, Germany) was inserted through the Tuohy needle and the diffusion of the contrast agent was checked to ensure the catheter was placed in the proper position (Figure 1). When the epidural catheters were confirmed to be placed at the epidural levels identified based on the site of pain and rash, 0.187% ropivacaine and 1 mg dexamethasone (8 mL total) were administered via the epidural catheter.

Continuous epidural block - epistim group

Similar to the esopocan group, after the epidural space was identified using the LOR technique, a 20-gauge epidural catheter (EpiStim™, length: 800 mm; Sewoon Medical Co., Ltd., Seoul, Korea) that can be confirmed radiographically was placed at the target level through the Tuohy needle (Figure 2). This epidural catheter has a built-in conductive guidewire (Nitinol; length: 1100 mm) with 800 mm inside the catheter and 300 mm exposed for connection to an electric nerve stimulator. The cathode of the electric nerve stimulator (Life-Tech EZstim, Stafford, TX, USA) was connected to the exposed guidewire and the anode was attached to an electrode on the patient’s calf. A 0-5 mA electrical stimulation was then delivered through the guidewire, which was removed from the epidural catheter following confirmation that the stimulus was reaching the herpes zoster affected

area. The position of the tip of the epidural catheter was confirmed using a contrast agent under a fluoroscope, and then, 0.187% ropivacaine and 1 mg of dexamethasone (8 mL total) were administered via the epidural catheter.

In both groups, the epidural catheter was fixed by subcutaneous tunneling to decrease the risk of infection and catheter migration. The inserted catheter was maintained in its position for a minimum of 10 days and was removed after 2 weeks. While patients were undergoing catheterization as inpatients and outpatients, a physician performed daily dressings and observed the procedure site.

After initial drug injection, patients of both groups were administered a continuous epidural infusion (275 mL) of 0.11-15% ropivacaine at a rate of 4 mL/h using a portable balloon infusion device (AutoFuser pump; ACE Medical Co., Ltd., Seoul, Korea). Ropivacaine concentrations were adjusted according to the degree of pain relief or side effects. Additionally, anticonvulsants (pregabalin or gabapentin) and analgesics were administered to patients in both groups. Anticonvulsants were prescribed by adjusting the drug dose according to age and renal function, and were tapered according to symptoms. Oxycodone was administered as an analgesic starting with the minimum dose that has been reported to be effective for PHN [13].

Data collection

Data on age, sex, dermatome involved, and days from the onset of rash to continuous epidural block as well as history of hypertension, diabetes, liver disease, kidney disease, and asthma were collected. Pain was assessed as a pain score using an 11-point verbal NRS (0, no pain; 10, unbearable pain). Pain score data were collected from the patients' medical records at different time points: immediately before the procedure (baseline pain score) and immediately, 14 days, and 1, 3, and 6 months after the procedure. Complete remission was defined as a pain score of less than 2 with no further medication required. The number of patients included in this category during the 6-month follow-up period was also recorded. Finally, we also investigated whether other interventional treatments were executed because of insufficient pain control during the 6 month follow-up period after each procedure.

Outcome measures

We compared the baseline pain scores of both groups and assessed whether they were significantly reduced during the 6 month post-procedure period. To compare analgesic effects, we compared the pain scores of the two groups at baseline, immediately after, 14 days after, and 1, 3, and 6 months after the procedure following correcting for various variables. We also compared the percentage of patients who achieved complete remission in each group. The proportion of patients requiring additional nerve block due to inadequate pain control after each procedure was also compared.

Statistical analysis

Demographic data were subjected to the Kolmogorov-Smirnov test to assess the normality of the distribution. Normally distributed datasets were compared between the groups using an independent t-test, and non-normally distributed datasets were compared using the Mann-Whitney U test. The Bonferroni post-hoc test was used to determine whether the pain score was significantly reduced at each time point after the procedure compared to baseline in each group. After correcting for various confounding variables (e.g., age, sex, site of herpes zoster infection, and history of hypertension, diabetes mellitus, asthma, hepatic disease, and kidney disease), we analyzed the differences in pain scores between the groups using a covariance analysis. A logistic regression analysis was used to compare the percentages patients who achieved complete remission within 6 months of the procedure and to compare the percentages of patients who underwent other interventional procedures between the two groups. Data are presented as mean ± standard deviation or median [interquartile range]. Data were analyzed using Statistical Package for the Social Sciences software (version 17.0; IBM, Chicago, IL, USA). All statistical tests were two tailed, and the threshold for statistical significance was set at $P < 0.05$.

Results

We reviewed 209 patient records. Nine patients missed the follow-up appointment or had inadequate medical records for the 6 months following the procedure. Twenty-five patients underwent other interventional procedures within the 6 months of continuous epidural block. In one patient, the catheter could not be maintained for more than 10 days due to the side effects associated with continuous epidural block. Two patients did not receive antiviral drugs at the beginning of the herpes zoster episode. During the 6-month follow-up period, two patients reported other pain-causing diseases. The medical records of these patients were excluded from the final analysis. Additionally, eight patients stopped using anticonvulsants and analgesics due to drug-associated side effects after the procedure, and 48 patients received other drugs, such as opioids, via the epidural catheter. To prevent drug-induced bias, these patients were also excluded from the final analysis. Finally, the medical records of 114 patients were analyzed; 57 patients were assigned to the esopocan group and 57 patients to the epistim group (Figure 3).

There were no significant differences in baseline demographics between the groups (Table 1, located at end of manuscript). Bonferroni post-hoc tests revealed that the pain scores at each time point after the procedure were significantly lower than those at baseline in both groups (Table 2).

Table 2. Comparison with baseline pain score at each time point

Group		Esopocan group		Epistim group	
Period A	Period B	Average difference (a−b)	*P*-value	Average difference (a−b)	*P* val
Baseline pain score*	(1)	3.97	$P < 0.001$	4.25	$P < 0.$
	(2)	4.62	$P < 0.001$	5.51	$P < 0.$
	(3)	4.47	$P < 0.001$	5.21	$P < 0.$
	(4)	4.88	$P < 0.001$	5.65	$P < 0.$
	(5)	5.25	$P < 0.001$	5.88	$P < 0.$

*: Pain score on an 11-point (0–10) numerical rating scale, (1): Pain score immediately after epidural procedure; (2): Pain score 14 days after epidural procedure; (3): Pain score 1 month after epidural procedure; (4): Pain score 3 months after epidural procedure; (5): Pain score 6 months after epidural procedure. Data were analyzed using the Bonferroni post-hoc test. A *P* value < 0.01 was considered statistically significant.

When the post-procedure pain scores were compared between the two groups, after correcting for confounding variables, no significant differences were observed immediately after the procedure; however, there were significant differences in the post-procedure pain scores between the two groups after the 14th day up to the sixth month (Table 3).

Table 3. Comparison of pain scores between groups after correction for the disturbance variables

	Acute HZ (≤ 30 days) Esopocan group (n = 57)	Acute HZ (≤ 30 days) Epistim group (n = 57)	*P* valu
Baseline pain score	7.4 ± 1.5	7.2 ± 1.5	*P* = 0.
Pain score* immediately after epidural procedure	3.5 ± 2.0	2.9 ± 1.8	*P* = 0.
Pain score* 14 days after epidural procedure	2.8 ± 1.9	1.7 ± 0.8	*P* = 0.0
Pain score* 1 month after epidural procedure	3.0 ± 2.1	1.9 ± 1.1	*P* = 0.
Pain score* 3 months after epidural procedure	2.6 ± 1.8	1.5 ± 1.2	*P* = 0.0
Pain score* 6 months after epidural procedure	2.2 ± 1.8	1.3 ± 1.1	*P* = 0.

HZ: herpes zoster, *: Pain score on an 11-point (0–10) numerical rating scale

Data are represented as adjusted mean ± standard deviation. Data were analyzed for the difference in pain scores between the groups using covariance analysis. Adjustments were made for age, sex, time from rash to epidural procedure, location of herpes zoster, hypertension, diabetes mellitus, asthma, hepatic disease, and kidney disease.

The difference between post-procedure pain scores of the two groups was analyzed at each level. With regard to the cervical and thoracic levels, the results were similar to those of the whole analysis; however, there was no significant difference between the two groups in the lumbar area, which was an affected site for a small number of patients (Table 4, see end of manuscript).

The proportion of patients showing complete remission was 1.90 times higher in the epistim group than in the esopocan group (Table 5).

Table 5. Comparison of complete remission during the 6 month follow-up period after each procedure

	Esopocan Group	Epistim Group	Adjusted OR (95% CI) Reference: esopocan group	*P* valu
Acute HZ (≤3 0 days)	29/57 [51% (38, 63%)]	41/57 [72% (59, 82%)]	1.90 (0.81–4.44)	*P* = 0.

HZ: herpes zoster, OR: odds ratio, CI: confidence interval.

Complete remission is defined as a pain score of less than 2 with no further medication. Data are represented as number [% (95% confidence interval)]. Data were analyzed by logistic regression analysis. Adjustments were made for age, sex, location of herpes zoster, days from the onset of rash to procedure, hypertension history, diabetes mellitus history, asthma history, hepatic disease history, kidney disease history, and baseline pain score.

The proportion of patients who underwent other interventional procedures due to insufficient pain control was 3.62 times higher in the esopocan group than in the epistim group within 6 months after continuous epidural block (Table 6).

Table 6. Comparison of procedures performed due to insufficient pain control during the 6 month follow-up period

	Esopocan Group	Epistim Group	Adjusted OR (95% CI) Reference: epistim group	*P* valu
Acute HZ (≤30 days)	20/77 [26% (17, 37%)]	5/62 [8% (3, 18%)]	3.62 (1.17–11.19)	*P* = 0.

HZ: herpes zoster, OR: odds ratio, CI: confidence interval

Data are represented as number [% (95% confidence interval)]. Data were analyzed by logistic regression analysis. Adjustments were made for age, sex, location of herpes zoster, days from the onset of rash to procedure, hypertension history, diabetes mellitus history, asthma history, hepatic disease history, kidney disease history, and baseline pain score.

Discussion

The purpose of the present study was to evaluate if a procedure that confirms the site of herpes zoster infection using epidural electric stimulation is more effective in reducing pain and preventing PHN than a procedure that identifies the location using epidural catheters and contrast agents alone.

In the present study, pain scores of the patients in both groups were significantly lower over the 6 month follow-up period than the baseline pain scores. From 14 days to 6 months after the procedure (follow-up period), pain scores were significantly lower in the epistim group than in the esopocan group. The rate of complete remission of herpes zoster up to 6 months after the procedure was 1.9 times higher in the epistim group than in the esopocan group. This suggests that administering the drug after confirming the correct VZV-containing dorsal root ganglion using epidural

electrical stimulation may be more effective in treating herpes zoster than the conventional continuous epidural block. The proportion of patients who received other epidural blocks because of the lack of pain control within the 6 months following the procedure was approximately one third lower in the epistim group than in the esopocan group.

There was also a difference in the drug injection site of the epidural catheter tip between the two groups. Reportedly, closed-tip, multi-orifice catheters are more effective for sensory blocks than open-tip, end-hole catheters; however, in the epistim group, where open-tip, end-hole catheters was used, a greater pain reduction was demonstrated than in the esopocan group, where closed-tip multi-orifice catheters were used [14, 15]. These results suggest that continuous epidural block, which uses electrical stimulation to confirm the location of herpes zoster, is more effective in achieving pain relief than the conventional continuous epidural block. EpiStim™ epidural catheters have a bent tip and a flexible guidewire as well as use electrical stimulation to identify the affected area, which increases the maneuverability of the catheter and makes it easier to position the catheter at the target site [12]. These features yielded significant differences in our results between the esopocan and epistim groups.

In the present study, there was no significant difference in pain reduction immediately after the procedure between the two groups. This is likely due to the spread of the 8 mL of drug epidurally administered during the procedure. After administration, it is likely that the drug spread to adjacent dermatomes. Therefore, even if the epidural catheter was not precisely at the affected site, the drug may have still spread to the site of the herpes zoster infection; however, this would occur only with a single epidural block. When the drug was administered continuously at the rate of 4 mL/h via a portable infusion pump, the spread of the drug decreased considerably. Therefore, precise administration of the drug to the correct site would have been possible only if the catheter was positioned in close proximity to the site of herpes zoster infection. We determined that the reason for the difference in pain scores 14 days and 1, 3, and 6 months after the procedures was likely because if the catheter was correctly located in the target region, it would relieve pain despite the effects of the continuous administration of the drug having worn off.

Due to the complexity of the pathophysiological mechanisms that contribute to the progression of acute herpes zoster to PHN, various strategies have been proposed for its prevention, including vaccinations and use of antiviral agents, anticonvulsants, and corticosteroids; however, according to a recent systematic review and meta-analysis, the efficacy of these treatments in preventing PHN is limited [16-21]. For the treatment of acute herpes zoster and PHN prevention, we focused on the nerve damage caused by VZV. Reactivated VZV in the dorsal root ganglion, which manifests as herpes zoster, subsequently diffuses to the affected dermatome producing an inflammatory response and inducing nerve damage. Severe initial nerve damage or inability to regain

normal function after the loss of nerve function can lead to PHN [22]. Therefore, proactive treatment before nerve injury is induced can help prevent PHN. According to an additional recent meta-analysis, continuous epidural block in acute herpes zoster is effective in preventing PHN [9]. The rationale behind applying epidural blockade to control acute herpes zoster pain and to prevent PHN is that the discontinued delivery of an invasive afferent stimulus to the central nervous system and improved flow of blood to the subjects' nerve tissue will minimize neural damage and reduce sensitization. In addition, it is possible that local anesthetics, along with the anti-inflammatory effects of corticosteroids, could be important in areas corresponding to the affected nerves [23]. Epidural administration of steroids not only inhibits inflammation but also reduces deafferentation by decreasing any neural ischemia resulting from inflammatory swelling [21]. Local anesthetics administered epidurally control pain and interfere with sensitization by blocking sympathetic nerves; however, to maximize the effects of epidural steroids and local anesthetics on the affected site, it is important to administer the drug precisely to the site of nerve injury [24]. We, therefore, performed epidural electrical stimulation to accurately identify the site sustaining the nerve injury caused by herpes zoster. This method allows for more accurate catheter placement than the conventional method, in which the diffusion image of a contrast agent is used to confirm the catheter's location.

In the present study, the patients who could not maintain the inserted continuous epidural catheter for more than 10 days were excluded from the analysis because, according to a previous study, a single epidural block may be effective in controlling herpes zoster pain, but it has limited efficacy in the prevention of PHN [25, 26].

All the patients included in the present study underwent continuous epidural block and simultaneously took anticonvulsants and analgesics. To avoid bias due to drug treatments, patients who discontinued the drug due to side effects from other treatments, and patients who were administered drugs other than local anesthetics and steroids via the epidural catheter, such as opioids, were excluded from the analysis.

The complete remission rate in the present study was 51% in the esopocan group and 72% in the epistim group. Reportedly, the greater the severity of acute herpes zoster pain, the greater is the likelihood of its progression to PHN [5, 27]. In our clinic, invasive treatments, such as continuous epidural blocks, are not performed for less severe cases of herpes zoster (pain score, < 4). All the participants of the present study, therefore, had pain scores of 4 or higher (mean 7.5 ± 1.5, 7.1 ± 1.4), which could have been one of the reasons for the lower rates of complete remission. Additionally, the definition we adopted for complete remission (pain score of ≤ 2; no further medication prescribed) is possibly another reason, because other studies have defined a pain-free state with a NRS score of less than 3 or without mentioning withdrawal of medication [8, 25].

Epidural hematoma, infection, and abscess are the complications that make continuous

epidural catheterization difficult; however, no epidural infections were reported after continuous epidural block in the present study. This is likely due to the involvement of well-trained physicians (who performed dressings daily) and well-educated patients and caregivers. The incidence of epidural hematoma is known to be low and was not observed in the present study; however, after the procedure, one patient experienced severe urinary retention, which was resolved after the epidural catheter was removed [1].

Limitations

First, this was a retrospective study; therefore, there may be an influence of unmeasured confounding variables; however, to control for potential disturbance factors, we conducted a covariance analysis with the baseline demographics and underlying disease of the patients as covariates. Additionally, only the patients who took both anticonvulsants and analgesics along with continuous epidural block were included in this study to ensure consistent drug use across the sample.

Second, our research data were derived from electronic medical records, which may have led to an underestimation of the actual incidence of side effects. In the present study, continuous epidural block was stopped in only one patient because of adverse effects; however, side effects such as dysuria and motor weakness may not have been added to the medical record when the epidural block was maintained because of low symptom severity.

Third, we excluded patients who were treated with other interventional procedures within the 6 month period. This can cause a selection bias in this study; however, had we included patients who had received other interventions in the above analysis, there would have been uncertainty as to whether the patients' symptoms improved because they received continuous epidural block for the first time or because they used other interventions. Therefore, we excluded patients who received other interventions when calculating complete remission and 6 month pain scores and analyzed the ratios separately.

Conclusions

Continuous epidural catheterization combined with standard drug therapy in patients with acute herpes zoster may be effective in preventing herpes zoster pain and PHN. Furthermore, using electrical stimulation to identify the specific epidural location affected by herpes zoster infection and administering the drug via an epidural catheter enables continuous drug administration to the correct site of neurological damage. A well-planned prospective study comparing methods for preventing herpes zoster pain and PHN is required to validate the results of the present study.

Declarations

List of abbreviations

VZV: varicella zoster virus

PHN: postherpetic neuralgia

NRS: numeric rating scale

Ethics approval and consent to participate:

The present study was conducted after approval by the Korea University Institutional Review Board Committee (IRB No: 2019GR0073; March 11, 2019).

Consent for publication:

Not applicable.

Availability of data and material:

The data analyzed during the current study are available from the corresponding author upon reasonable request.

Competing interests:

The authors declare that they have no conflicts of interest.

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Author’s Contributions:

All authors had full access to all the data and take responsibility for the integrity of the data and accuracy of the data analysis. CHL and SSC designed the experiments. All authors were involved in recruiting patients and performed the experiments. CHL managed the literature searches and summaries of previous related work and wrote the first draft of the manuscript. CHL and SSC provided revision of intellectual content and final approval of the manuscript.

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Tables

Table 1. Baseline characteristics of the patients

	Acute HZ (≤ 30 days) Esopocan group (n = 57)	Acute HZ (≤ 30 days) Epistim group (n = 57)	*P* value
Age (years)	67.0 ± 10.3	66.2 ± 11.7	*P* = 0.72
Sex (M/F)	25/32	16/41	*P* = 0.12
Site of HZ infection	C: 14 T: 36 L: 7	C: 13 T: 33 L: 11	*P* = 0.52
HTN	26 [46% (33, 58%)]	21 [37% (26, 50%)]	*P* = 0.45
DM	11 [19% (11, 31%)]	16 [28% (18, 41%)]	*P* = 0.38
Asthma	3 [5% (2, 14%)]	1 [2% (0, 9%)]	*P* = 0.62
Hepatic disease	5 [9% (4, 19%)]	3 [5% (2, 14%)]	*P* = 0.72
Kidney disease	2 [4% (1, 12%)]	3 [5% (2, 14%)]	*P* = 1.0
Baseline pain score*	8 [7–8]	8 [7–8]	*P* = 0.22

HZ: herpes zoster, HTN: hypertension, DM: diabetes mellitus, *: Pain score on an 11-point (0–10) numerical rating scale, C: cervical, T: thoracic, L: lumbar.

Data are represented as mean ± standard deviation, median [interquartile range], or number [% (95% confidence interval)].

Table 4. Comparison of pain scores between the groups for cervical, thoracic, and lumbar levels

	Cervical area				Thoracic are
	Acute HZ (≤ 30 days) Esopocan group (n = 14)	Acute HZ (≤ 30 days) Epistim group (n = 13)	*P* value	Acute HZ (≤ 30 days) Esopocan group (n = 36)	Acute HZ (≤ 30 days) Epistim grou (n = 33)
Baseline pain score	7.8 ± 1.4	6.9 ± 1.3	*P* = 0.13	7.4 ± 1.6	7
Pain score* immediately after epidural procedure	3.8 ± 2.0	3.0 ± 2.1	*P* = 0.44	3.5 ± 2.0	3
Pain score* 14 days after epidural procedure	3.2 ± 2.1	1.7 ± 0.8	*P* = 0.02	2.8 ± 1.9	1
Pain score* 1 month after epidural procedure	3.4 ± 2.5	1.9 ± 1.2	*P* = 0.06	2.9 ± 2.1	2
Pain score* 3 months after epidural procedure	2.3 ± 1.3	1.3 ± 1.3	*P* = 0.04	2.6 ± 2.0	1
Pain score* six months after epidural procedure	2.2 ± 1.8	1.2 ± 1.1	*P* = 0.03	2.2 ± 1.8	1

HZ: herpes zoster, *: Pain score on an 11-point (0–10) numerical rating scale

Data are represented as adjusted mean ± standard deviation. Data were analyzed for differences in pain score between the groups using covariance analysis. Adjustments were made for age, sex, time from rash to epidural procedure, hypertension, diabetes mellitus, asthma, hepatic disease, and kidney disease.

Figures

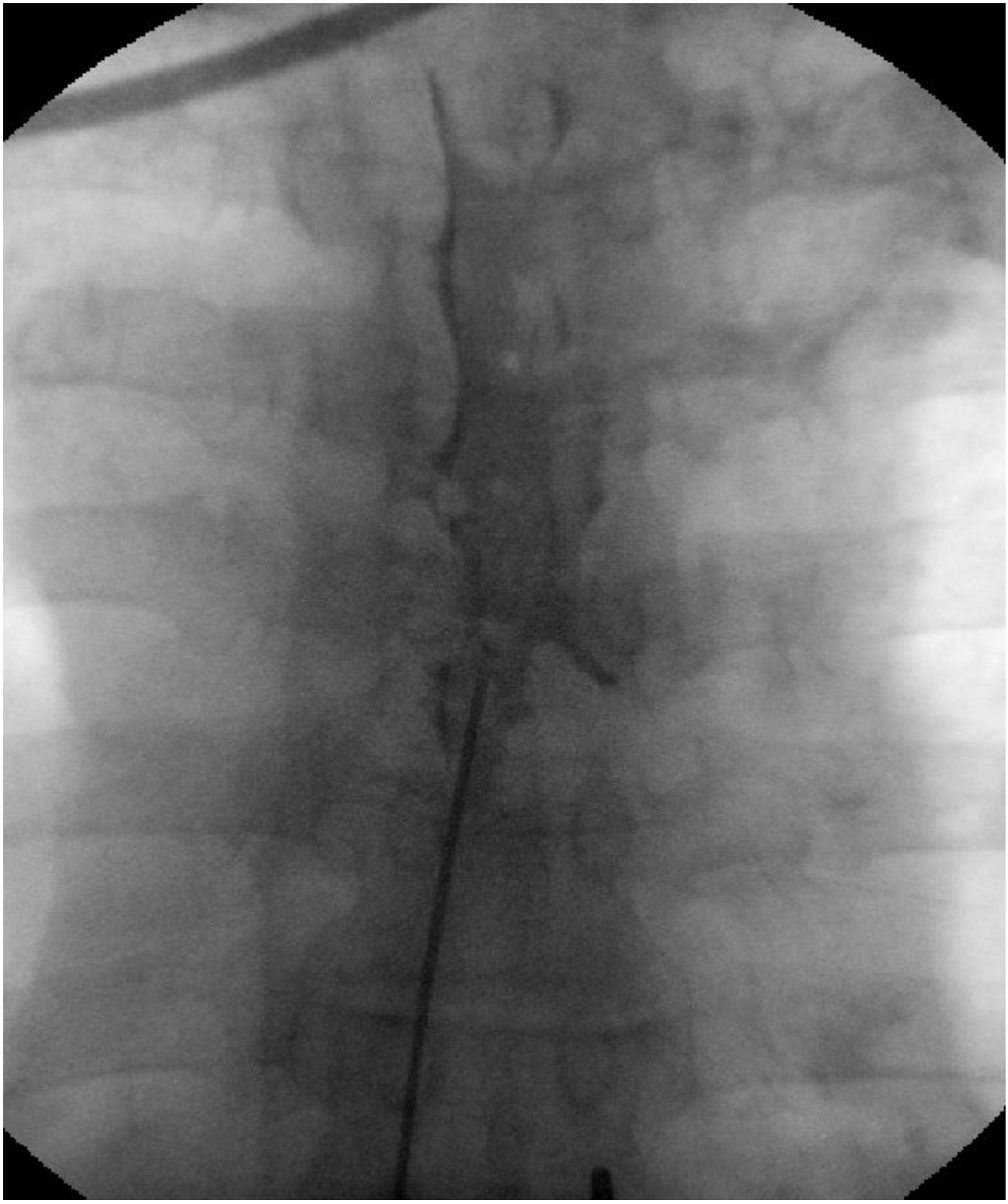

Figure 1

Fluoroscopic images of conventional continuous epidural block. The position of the catheter tip was confirmed using a contrast agent.

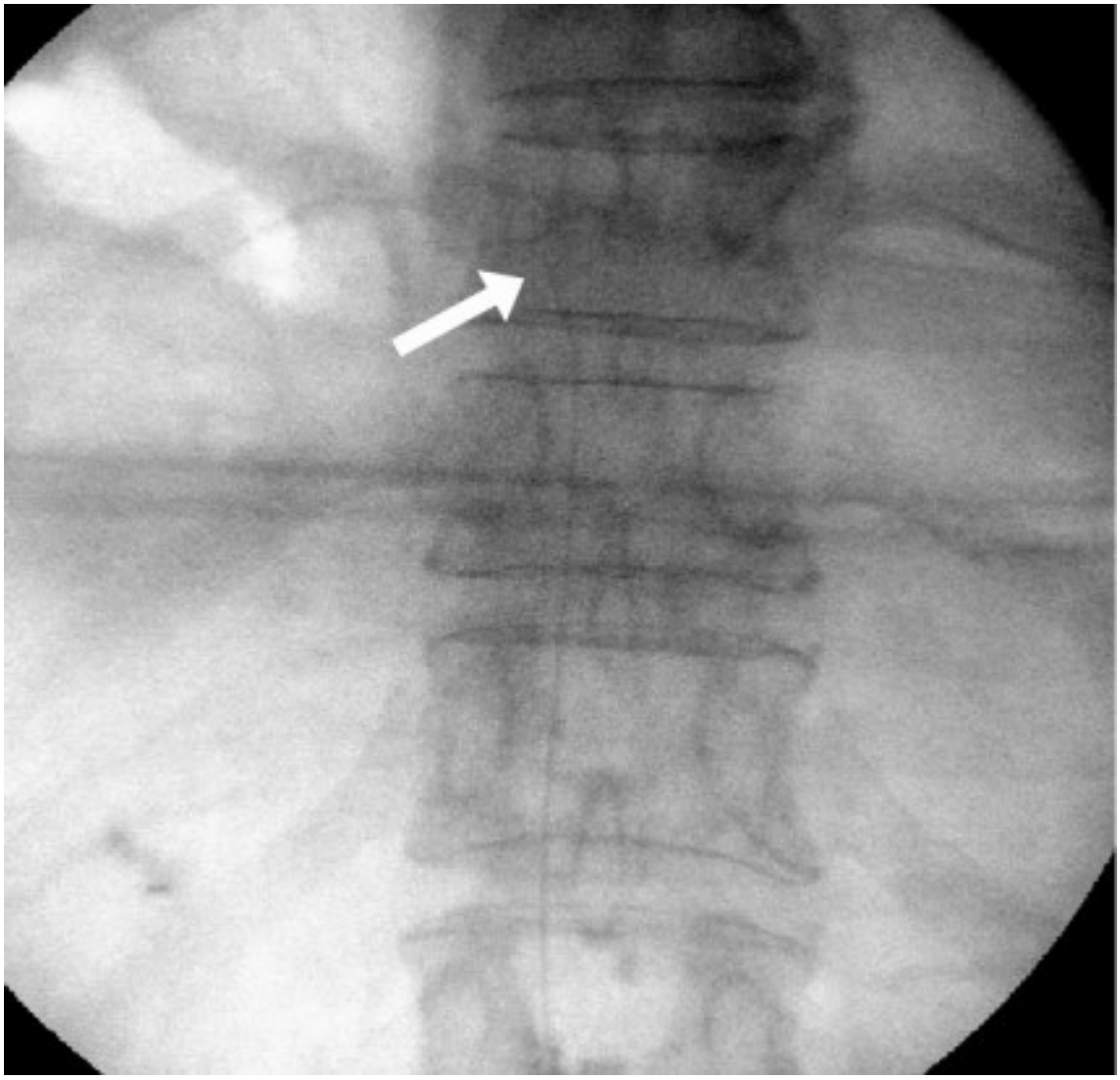

Figure 2

Fluoroscopic images of continuous epidural block using the epistim catheter. This catheter has a built-in conductive guidewire that allows the detection of catheter tip location using radiography along with electrical stimulation. Arrow indicates the guidewire in the epistim catheter.

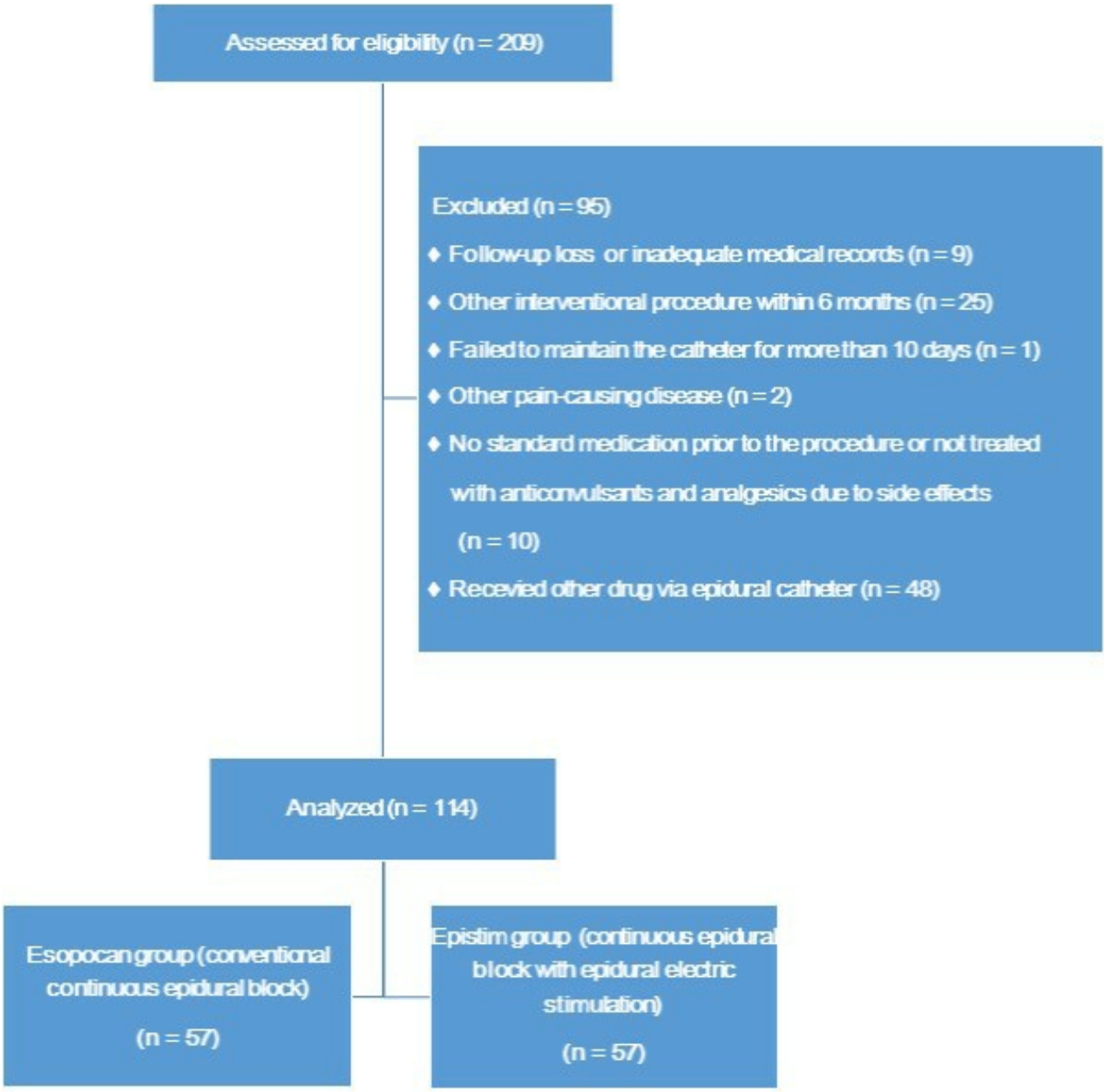

Figure 3

Flow diagram showing patient inclusion.

Supplementary Files

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S1 file.xlsx