

Brief Review

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Erector spinae plane block (ESPB) for intractable, non-surgical abdominal pain: a scoping review

Running Title: ESPB in Intractable, Non-Surgical Abdominal Pain

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Capsule Summary:

What is already known: Erector spinae plane block (ESPB) is an ultrasound-guided nerve block that has shown effectiveness in treating visceral and somatic pain.

What is new in the current study: Our review provides support for ESPB in the management of intractable, non-surgical abdominal pain. ESPB demonstrates efficacy in alleviating various conditions such as functional abdominal pain, renal colic, pancreatitis, herpetic pain, and cancer-related pain.

Pre-proofs

Abstract:

Abdominal pain is one of the most common presenting chief complaints in the emergency department (ED). Erector spinae plane block (ESPB) is an ultrasound-guided nerve block with proven effectiveness in treating visceral and somatic abdominal pain. Despite the increasing popularity of ESPB, its role in the management of non-surgical abdominal pain has not yet been characterized. Our scoping review aims to review the current literature on the safety and efficacy of ESPB in the management of patients experiencing intractable, non-surgical abdominal pain.

We searched PubMed and Scopus to evaluate the existing literature on ESPB for non-surgical abdominal pain. Reviewers screened 30 titles and abstracts that met the predefined inclusion and exclusion criteria. Following initial screening, 24 articles underwent full-text review. Two reviewers also screened references included in each study.

A total of 14 journal articles were reviewed, including 12 case-based studies, one systematic review, and one narrative review of ESPB in the treatment of non-surgical abdominal pain. All cases described the successful use of ESPB in treating abdominal pain refractory to oral or intravenous analgesic medications, and each case reported no complications.

This scoping review provides support for ESPB in the management of intractable, non-surgical abdominal pain. ESPB demonstrates efficacy in alleviating various conditions such as functional abdominal pain, renal colic, pancreatitis, herpetic pain, and cancer-related pain. Theoretical risks such as pneumothorax, bleeding, and infection are possible, although the studies reviewed did not report such complications.

Keywords: abdominal pain, erector spinae plane block, nerve block, ultrasound, regional anesthesia

Introduction:

Abdominal pain is a common presenting chief complaint in the emergency department (ED) and accounts for approximately 5-10% of annual ED visits [1]. The ongoing opioid epidemic and serious adverse events related to opioids create additional challenges for physicians when managing both acute

and chronic abdominal pain. In recent years, regional anesthesia such as celiac plexus nerve blocks have been used to manage visceral components of chronic, functional abdominal pain [2]. Erector spinae plane block (ESPB) is an ultrasound-guided nerve block that was introduced in 2016 and shows promise in treating visceral pain as well as somatic abdominal pain [3]. Using an ultrasound probe in the cephalocaudal orientation approximately 3cm from midline, the transverse process is identified and the needle is guided to the posterior surface of the transverse process (Figure 1). Analgesia is achieved with long-acting regional anesthetic injected into the erector spinae fascial plane, either as a bolus or a continuous infusion [4]. Nerve blocks including the ESPB are favored due to their efficacy and limited adverse effects compared to pharmacologic agents [4]. The mainstream use of ultrasound to guide the procedure makes ESPB one of the safest peripheral nerve blocks. Despite the increasing popularity of ESPB, its role in the management of intractable, non-surgical abdominal pain has not yet been fully characterized.

This scoping review aims to provide a better understanding of safety and efficacy of ESPB in the management of patients experiencing intractable, non-surgical abdominal pain. We have chosen to do a scoping review due to limited prospective, randomized studies on this nerve block. This review includes all studies related to the use of ESPB for intractable, non-surgical abdominal pain.

Methods:

PubMed and Scopus were queried to evaluate existing literature on ESPB for intractable, non-surgical abdominal pain. This scoping review follows the PRISMA Extension for Scoping Reviews (PRISMA-ScR) checklist (Appendix 1) [5].

Eligibility Criteria

Articles of all study types published in English prior to July 1, 2023 were considered for inclusion in this scoping review. We included studies evaluating the use of ESPB to manage intractable, non-surgical abdominal pain in adult patients, and excluded studies pertaining to perioperative pain. These

indications included but are not limited to pancreatitis, renal colic, herpetic pain, and functional abdominal pain. We defined “intractable” as refractory to at least one dose of oral or intravenous systemic pain medications.

We initially identified 30 published articles using the following search query: (TITLE-ABS-KEY ("erector spinae")) AND (TITLE-ABS-KEY ("plane block" or "nerve block")) AND (TITLE-ABS-KEY ("abdominal pain")).

Two reviewers (A.M.) and (C.B.H.) independently screened a total of 30 titles and abstracts that met our predefined inclusion and exclusion criteria. Discrepancies between the reviewers were resolved by a third reviewer (S.S.) Following our initial screening, 24 articles underwent full-text review. We screened the references of all studies meeting our criteria to find additional studies. A total of 14 studies were ultimately included in this review (Figure 2). Key aspects of each study were summarized in Table 1.

Results:

A total of 14 journal articles from eight countries between 2018 – 2023 were selected for scoping review based on their description of ESPB for intractable, non-surgical abdominal pain (Table 1). There were 12 case-based studies, one systematic review, and one narrative review of ESPB in the treatment of intractable, non-surgical abdominal pain. Of these 14 studies, eight took place in the emergency department, three involved patients evaluated by an inpatient pain service, two were from outpatient pain clinics, and one study combined multiple settings. There were 181 total described nerve blocks in the studies related to intractable, non-surgical abdominal pain. No complications were reported in any of these studies.

Both single erector spinae plane blocks and continuous nerve catheters were described in the included articles, with injections performed at the level of sixth to the eleventh thoracic spine levels. Medications used included single anesthetic as well as combinations of long-acting local anesthetics such as bupivacaine, ropivacaine, and levobupivacaine, while others used the short-acting lidocaine, corticosteroids, and normal saline for hydrodissection. Our review found that bupivacaine was used most, frequently used with lidocaine for immediate effect. Ropivacaine and lidocaine were also used alone to achieve analgesia. All studies using lidocaine injected it either as a mixture with a long-acting anesthetic or as a bolus before continuous infusion of a long-acting anesthetic [6-9].

There were 85 cases described in 14 articles that used ESPB for intractable, non-surgical abdominal pain that were not a result of trauma or burns (Table 1). All the cases described used ESPB to treat abdominal pain refractory to at least one dose of oral or intravenous pain medications (which we have defined as “intractable”). Six total cases were described using ESPB bilaterally to successfully treat refractory cancer-related pain due to colorectal cancer or cholangiocarcinoma [9-12]. Four studies described ESPB for acute pancreatitis (10 total cases), while another study described ESPB for pain relief in one case of necrotizing pancreatitis [8, 13-15]. This resulted in a total of 11 cases of pancreatitis in which ESPB was successfully utilized to achieve pain control [8, 13-16].

One case series of three patients described the successful use of ESPB followed by continuous infusion of 0.187% ropivacaine to treat functional abdominal pain presenting to the outpatient pain clinic, with a total resolution of pain in a 6-month follow-up for two patients [7]. Two cases showed the use of ESPB in treating pain from postherpetic neuralgia, with one block performed at the tenth thoracic spine level for abdominal pain and another block used for cervicothoracic and even shoulder pain [7,17]. Two prospective studies of ESPB for postherpetic neuralgia were also found: one observational study including 34 patients and one randomized controlled trial with 50 patients (26 randomized to the treatment group) [12]. One case series in the emergency department used ESPB for renal colic, demonstrating an improvement in the pain score by an average of 8 using the average Visual Analogue

Score (VAS), and additional pain medications were not required following these blocks for 8-11 hours [6]. A case report indicated the usefulness of ESPB in treating abdominal pain from mesenteric ischemia with improvement in pain from 2/3 to 0/3 [18].

This review identified multiple methods of ESPB, combining injectable anesthetics with corticosteroids in some instances and using continuous regional anesthetic infusions in others. This resulted in a wide variation in the duration of analgesia. Continuous infusions led to a decreased analgesic requirement that lasted throughout catheter placement and in some instances led to pain relief lasting up to 12 weeks [7,12]. However, continuous infusions were largely performed by inpatient or outpatient pain services [7-8,13,17-18]. In the emergency department studies (8 total), single blocks were used and demonstrated variable duration. Studies of ESPB for renal colic showed no further oral or intravenous analgesic requirement for a range of 8-11 hours [6, 19]. A case report of ESPB for pancreatitis reported 24 hours of pain relief, while another described 19 hours of analgesia [14,15]. A case series of ESPB used in patients with pancreatitis showed a median time of the next oral or intravenous analgesic requirement of nine hours [9]. One study performed ESPB using ropivacaine and methylprednisolone for cancer-related pain and provided an improved pain score using the Numerical Rating Scale (NRS) for >2 weeks [11].

Discussion:

In this review, we found significant data supporting the effectiveness of ESPB in treating intractable, non-surgical abdominal pain. While there are clear benefits of the procedure, there are several concerns that require consideration prior to widespread use of ESPB in the emergency department setting.

Unlike many other forms of pain relief, ESPB offers multi-dermatomal analgesia to the thoracic and abdominal walls anteriorly, posteriorly, and laterally [20]. This is achieved by the analgesic spreading along fascial planes throughout multiple vertebral levels, effectively anesthetizing a large area. Our review demonstrated that ESPB provides a targeted approach to administering analgesia, effectively

treating both somatic and visceral pain without the systemic side effects seen with oral or intravenous pain medications.

ESPB can serve as an opioid-sparing alternative to improve abdominal pain, including cancer-related pain [21]. Similarly, for chronic non-cancer pain, evidence suggests that while opioids show a statistically significant improvement in pain, the magnitude of such improvement is small [22]. ESPB can be used to address this discrepancy. Moreover, while opioids may reduce pain, they may also lead to numerous adverse effects including nausea, vomiting, constipation, hyperalgesia, bradycardia, dizziness, syncope, delirium, and dependence [22-23]. Our review described multiple instances of patients on high doses of opioids who were able to reduce their opioid dosage after receiving ESPB.

ESPB and other regional nerve blocks may also effectively avoid non-opioid medication-related adverse effects. Common effects of non-steroidal anti-inflammatory drugs (NSAIDs) include renal injury, gastritis/peptic ulcer disease, and gastrointestinal bleeding [24]. Additionally, muscle relaxants and neuropathic pain medications such as anticonvulsants and antidepressants can cause dizziness, drowsiness, and somnolence [25-26]. These systemic side effects are especially important to consider in the elderly who are most at-risk for these adverse medication reactions. Using ESPB in the elderly for the treatment of abdominal pain could be an effective and safe alternative to systemic pain medications.

Finally, ESPB has been performed in multiple EDs throughout different countries, in addition to inpatient pain services and pain clinics. Our review found significant evidence of the safe, effective use of ESPB by emergency physicians. With ubiquitous access to ultrasound machines and increasing emergency physician proficiency in ultrasound-guided procedures, there is significant potential for expanding the use of this regional nerve block in the ED.

While ESPB has broad utility, some adjustments to the ED workflow may be required for the block to be feasible. Developing nerve block kits including the equipment necessary including the local anesthetic, nerve block needle, syringe, extension tubing, sterile gel, ultrasound probe cover, and ChloroPrep facilitate the procedure for busy emergency physicians. The time to pain control can be delayed while physicians obtain consent and prepare for the procedure, therefore, it is pertinent to

decrease the time required for the acquisition of materials. Additionally, physicians without adequate point-of-care-ultrasound training may be hesitant to conduct the regional nerve block, which could be mitigated by departmental training. It would be beneficial for emergency medicine residents and attendings to receive training on performing ESPB under ultrasound guidance to increase physician comfortability performing the block. Finally, many of the studies described continuous infusions via nerve catheters by pain specialists which is not feasible in the emergency setting. Thus, while EPSB may be useful for short-term pain relief of up to 24 hours, additional pain management may be required after the anesthetic wears off, and appropriate follow up would be necessary.

Despite the various benefits of ESPB, there are several risks that require consideration. While this is rare under ultrasound guidance, it is possible to cause a pneumothorax while performing this nerve block, although there were no reported pneumothoraces in any of the reviewed studies. A pneumothorax may occur as the result of poor hand-eye coordination or a miscalculation of the proper injection site if the provider loses visualization of the needle tip under ultrasound guidance [27]. Additionally, as with any injection, there is risk of infection if sterility is broken, and risk of bleeding if the provider penetrates a blood vessel or if the patient is prone to bleeding. Furthermore, while there are theoretical complications such as local anesthetic systemic toxicity (LAST) or neurovascular injury, this is extremely rare and none of these complications were reported in our reviewed studies.

While ESPB effectiveness and safety has been demonstrated, and the time required to perform the procedure may decrease provider willingness, the pain associated with receiving an injection may decrease patient willingness. Additionally, depending on the ED length of stay, a patient may require multiple nerve blocks once the anesthetic wears off, which can be time-consuming for both the physician and the patient. While the overall benefits of EPSB may outweigh these negative aspects, patient and provider preference and treatment goals should be taken into consideration.

An important limitation of this scoping review is the lack of data and randomized controlled trials on ESPB. Over a 5-year period, 14 journal articles were found that met the inclusion criteria. As such, our findings suggest several potential uses of this nerve block while lacking a large body of evidence to

support it. Prospective studies are needed to provide further evidence supporting the feasibility and safety of ESPB. Additionally, given that our criteria involved only articles published in English, there is the possibility of missing supporting evidence from non-English articles, and further investigation is required to expand the applicability to a larger population scale.

In summary, the current literature illustrates the potential benefits of ESPB in patients experiencing intractable, non-surgical abdominal pain. As the current literature is further explored and additional research is conducted, our understanding of ESPB will grow. Based on the current literature, emergency physicians will have a promising alternative to standard systemic pain medications, thereby reducing potential systemic side effects, especially in at-risk populations such as the elderly. In regard to feasibility, more studies are needed to show that this regional nerve block is both feasible and cost-effective in the ED setting. To conclude, the current literature seems to support that ESPB can provide safe, effective analgesia for intractable, non-surgical abdominal pain of multiple etiologies. However, our review highlights a need for prospective, randomized controlled trials to provide more conclusive evidence.

Ethical Statement: This study was a retrospective review of previously de-identified, publicly available data and did not involve human subjects.

Conflicts of Interest: The authors have no conflicts of interest to disclose.

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Pre-proofs

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Table 1. Summary of published studies discussing the use of ESPB in intractable, nonfunctional abdominal pain.

<u>Study Details:</u>	<u>Authors, Year of Publication, Country of Origin</u>	<u>Indication for ESPB</u>	<u>Practice Setting</u>	<u>Study population /sample size</u>	<u>Type of Study</u>	<u>Details of Block</u>	<u>Outcome Measure</u>	<u>Key Findings</u>
	Abdelhamid et al, 2020, Canada	Review article of ESPB in the emergency department	Emergency Department	10 included studies	Systematic Review	N/A	Indications for ESPB in emergency department	10 total articles, 9 were case reports or series, 101 total cases. Rib fractures, spine fractures, burns, herpes zoster, renal colic, and pancreatitis all listed as potential indications
	Abdelhamid et al, 2023, Canada	Pain from mesenteric ischemia	Inpatient Pain Service	70 male with pain from mesenteric ischemia	Case Report	ESPB bilaterally at T6 using 20mL 0.2% ropivacaine followed by 0.2% 0-10mL/hr infusion	Improvement of 3-point VAS	Patient with improvement from 2-3/3 to 0/3 after ESPB
	Ahiskalioglu et al, 2018, Turkey	Pain from herpes zoster	Outpatient Pain Clinic	72 male with herpes zoster related abdominal pain	Case Report	ESPB at T10 with 20ml of 0.25% bupivacaine	Improvement of VAS	VAS improved from 9/10 to 3/10
	Allos et al, 2021, United States	Pain from necrotizing pancreatitis	Inpatient Pain Service	27-year-old female with post-operative necrotizing pancreatitis	Case Report	ESP catheter at T7, 30mL of 0.25% bupivacaine	Improvement of VAS, use of other pain medications	VAS improved from 10/10 to 0/10 after 1 hour. Opioid, precedex, and ketamine use was decreased
	Ashworth et al, 2022, United States	Chronic pain from metastatic cancer	Emergency Department	54 female with metastatic colon cancer	Case Report	ESPB at T9 with 20mL of 0.5% bupivacaine	Improvement of pain indicated by numeric pain rating	Patient reported complete resolution of pain after 30 minutes of the ESPB and reported 1/10 pain afterwards. She was able to be discharged

	Aydin et al, 2018, Turkey	Refractory pain from confirmed renal colic	Emergency Department	3 cases (56 male, 50 female, 52 female) with confirmed urolithiasis	Case Series	ESPB at T8, T9 with 20-30 mL of 0.25% bupivacaine mixed with 2% lidocaine	Improvement of VAS, time needed before next oral analgesic	Improvement of VAS from 10/10 to 0/10 (3 min), VAS from 8/10 to 2/10, VAS from 10/10 to 2/10, analgesic requirement time between 8-11 hours
	Chung et al, 2021, South Korea	Functional abdominal pain	Outpatient Pain Clinic	3 cases (59 male, 31 female, 34 female) with chronic abdominal pain, no structural etiology	Case Series	ESPB at T10, T7 bilaterally (2) with 15mL 0.5% lidocaine injected (single ESPB) and 10mL 0.5% lidocaine followed by 2mL/hour of 0.187% ropivacaine (continuous ESP catheter)	Improvement of NRS directly after procedure, questionnaire of abdominal pain weeks-months after	Initial: Improvement of NRS from 8 to 3, NRS from 9 to 3 (30 min), NRS from 7 to 2 (30 min). Long-term: Two patients had no return in pain after 6 months, one had repeat procedure in 2 weeks with NRS maintained in 2-3 range
	Das et al, 2023, United Kingdom	Pain from acute pancreatitis	Inpatient Pain Service	72 male with acute pancreatitis	Case Report	ESP at T8 with 20mL 1% lidocaine followed by 1ml/hr 0.125% continuous infusion of levobupivacaine	Improvement of VAS, reduction of oxycodone consumption	VAS improved from 8-9/10 to 3-4/10 at 30 minutes, 1/10 at 1 hour. Oxycodone with significant reduction within 10 hours, none at 24 hours
	Elkoundi et al, 2019, Morocco	Pain from acute pancreatitis	Emergency Department	58 male with refractory pain in acute pancreatitis	Case Report	ESPB at T6, 15mL of 0.5% bupivacaine	Improvement of NRS	NRS improved from 10/10 to 2/10, pain reduction lasted until the next day
	Elsharydah et al, 2023, United States	Pain from postherpetic neuralgia (PHN), chronic lumbar pain	Various settings	2 studies, 1 case in postherpetic neuralgia (PHN), 1 case, 1 case	Narrative Review	N/A	Previous evidence of ESPB efficacy	Observational study (n = 34), RCT (n = 26 in block group) supporting use in PHN, cases supporting use in

				series in chronic low back pain				PHN, chronic low back pain (1), cancer-related pain (3)
	Gopinath et al, 2021, India	Pain from pancreatitis	Emergency Department	50 female, 36 female, 44 male, 15 male with acute pancreatitis . 38 male and 30 male with chronic pancreatitis	Case Series	ESPB at T7 with 30mL of 1% lidocaine 5 mg/kg, 0.5% bupivacaine 2 mg/kg, and dexamethasone 8 mg bilaterally.	Improvement of DVPRS	The median DVPRS before and after the procedure was 8 interquartile range (IQR)7 and 3 (IQR:2.5) 30 minutes following ESPB. At 60 minutes it was reduced to 2 (IQR:4)
	Gopinath et al, 2022, India	Chronic pain from cholangiocarcinoma	Emergency Department	62 male with refractory pain from cholangiocarcinoma	Case Report	ESPB at T7 bilaterally, 30 mL mixture of 1% lidocaine (2mg/kg), 0.5% bupivacaine (1mg/kg), 4mg dexamethasone injected	Improvement of DVPRS, improvement of sleep	Pain rating decreased from 8/10 pre-procedure to 3/10 (15 min), 2/10 (1 hour), sleep improved over next 4 days
	Bugada et al, 2020, Italy	Chronic pain from colorectal cancer	Emergency Department	20 male with refractory pain from colorectal cancer	Case Report	ESPB at T7 bilaterally, 20mL of 0.5% ropivacaine with 40mg methylprednisolone injected	Improvement of NRS over two weeks	NRS values decreased, maintained low for more than two weeks, no rescue morphine needed in 3 days after procedure
	Mantuani et al, 2020, United States	Pain from acute pancreatitis	Emergency Department	32 male with refractory pain from acute pancreatitis	Case Report	ESPB at T7 bilaterally with 10mL normal saline for hydrodissection, 15mL of 0.5% bupivacain	Improvement of patient-reported numeric pain rating	0/10 pain reported (30min), 2/10 pain (5 hour, given 0.5mg hydromorphone), 0/10 pain (19 hr)

						e with epinephrine		
<u>Summary:</u>	14 total studies, 8 countries, 2018 - 2023	Traumatic fractures (84), mechanical low back pain (11), Pancreatitis (11), Cancer-related chronic abdominal pain (6), renal colic (3), functional abdominal pain (3), herpes zoster (61), burns (1): Total described cases (181)	8 emergency department, 3 inpatient pain service, 2 outpatient pain clinic, 1 review		12 case reports, 1 systematic review, 1 narrative review	ESPB described from T6-T10, often bilaterally		Support of ESPB in all studies, pain relief reported within first 30 min, some with no recurrence of pain

^aVAS=Visual Analogue Scale, NRS=Numerical Rating Scale, DVPRS= Defense and Veteran Pain Rating Scale

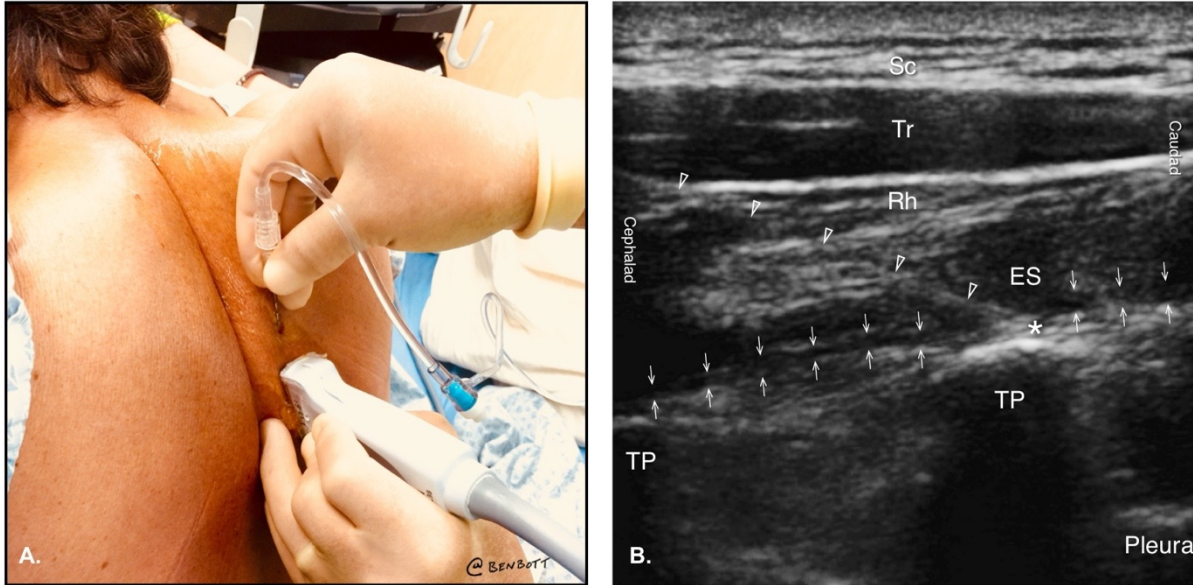


Figure 1. Insertion site and ultrasound view (image source: highlandultrasound.com)

- A. The transducer is oriented cephalocaudal and held over the transverse process. The needle insertion may be 1-2 cm from the probe.
- B. Ultrasound view demonstrating needle contacted the posterior surface of the transverse process. SC= subcutaneous tissue, TR= trapezius muscle, RH=rhomboid muscle, ES= erector spinae muscle, ESP= erector spinae plane, TP=transverse process, Triangles=needle, Asterisk= needle tip, Arrows= local anesthetic in the erector spinae plane lifting the erector spinae off the transverse process.

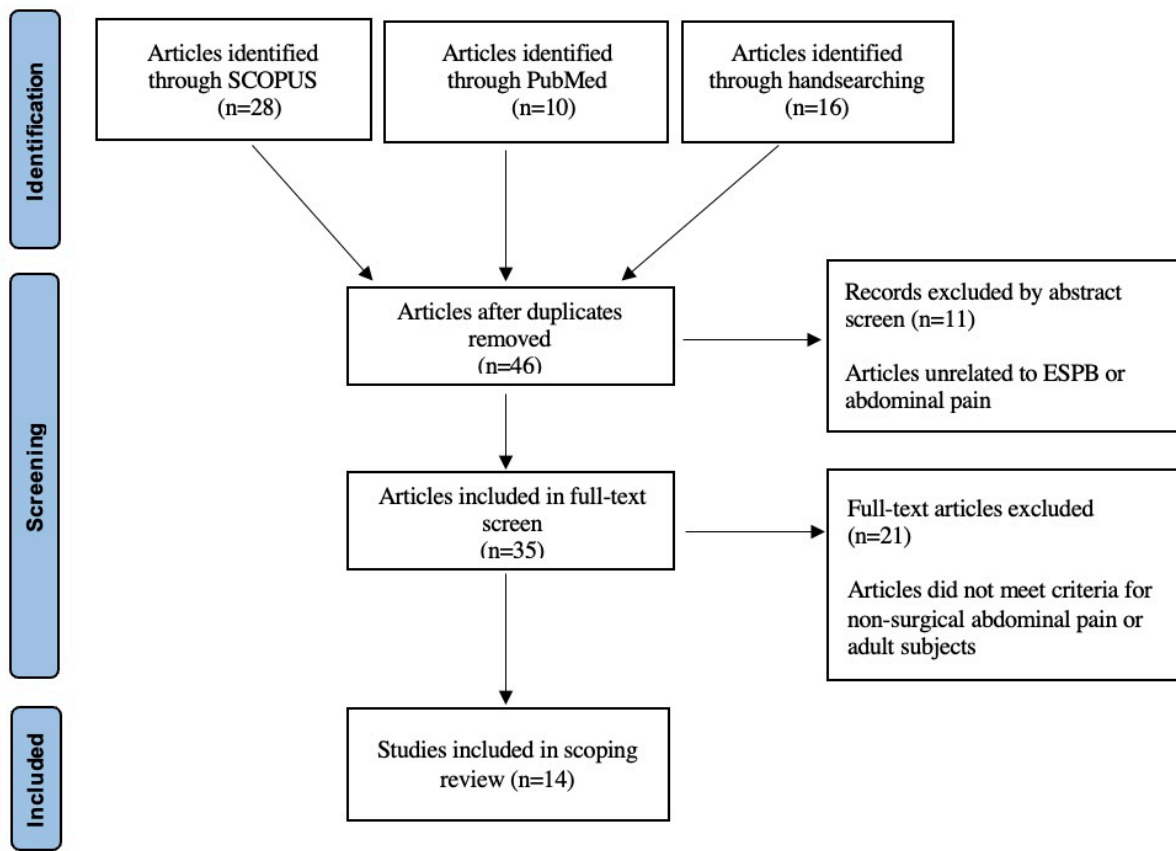


Figure 2. Flow diagram of search strategy for ESPB in non-surgical abdominal pain.