The Analgesic Effect of Erector Spinae Plane Block on Adult Patients with Rib Fractures: An Integrative Review

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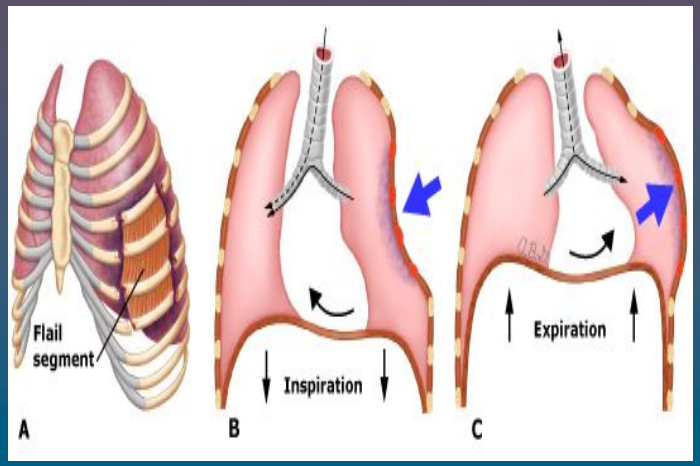
Objectives

- Identify the effects of inadequate analgesia in adult patients with rib fractures.
- Compare the outcomes of erector spinae plane block with alternative treatments when used as an analgesic treatment for adult patients with rib fractures using an evidence synthesis methodology.
- Understand the clinical application of erector spinae plane block as an analgesic treatment in adult patients with rib fractures, including the appropriate block timing, choice of local anesthetic, and suggested adjuncts.

Rib Fracture and its Significance

- In the United States, the incidence of rib fractures continually grows, associated with increased mortality and morbidity.
  - Martin et al. 2019 reported 248,000 patients treated annually with rib-fracture related injury.
  - It has an average cost of $10,169 per hospitalization.
- Pain and chest wall impairment impacts patient's physiologic function and quality of life.
- Effective analgesia is critical to improved outcomes.

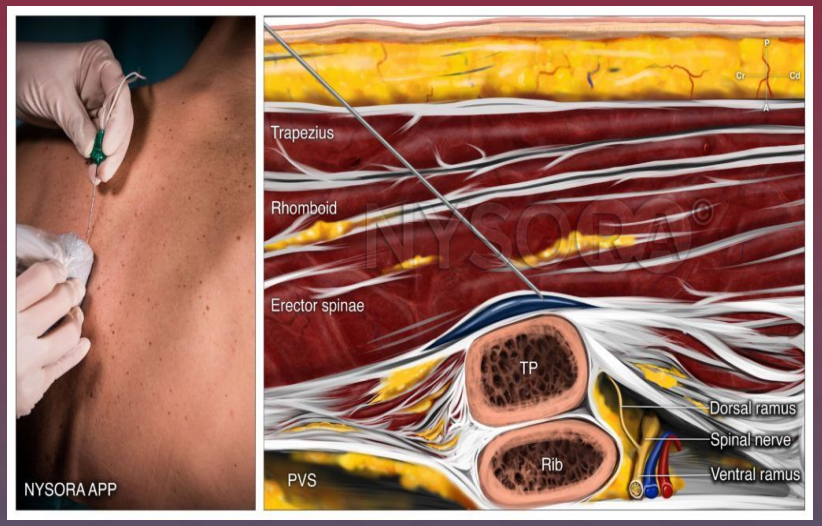


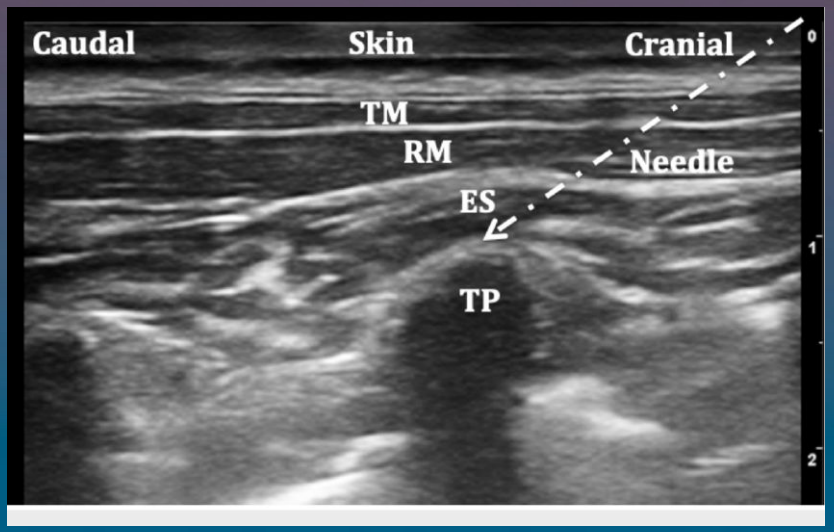
Current Analgesic Practice For Rib Fractures

- According to Beard et al. (2019), these are the current preferred analgesic treatments for patients with rib fractures.
  - Patient controlled analgesia ~38.6%
  - Thoracic epidural analgesia (TEA) ~30%*
  - Continuous opioid infusion ~18.6%
- Opioid further implicates patient's respiratory function.
- TEA use is limited due to complications, contraindications, and provider's skill.
- This warrants an alternative treatment that is safe and effective.

Erector Spinae Plane Block

- It is an ultrasound-guided fascial plane block technique with local anesthetic injected between the erector spinae muscle and the thoracic transverse process.
- It provides sensory blockade to the dorsal rami of the thoracic and abdominal spinal nerves.
- There is a low risk for complication as the injection site is far from the spinal cord and the pleura.





PICO Question

- In adults with rib fractures, how does an erector spinae plane block (ESPB) affect pain compared to patients who do not receive an ESPB?

Methods

Search

Database search:
CINAHL, Pubmed, Embase

keywords:
erector spinae plane block, fascia plane block, rib fractures, nerve block, pain.

Appraisal

21 research studies.

13 cohort studies, **7** RCTs, **1** quasi experimental design

JBI critical appraisal tool used to evaluate quality and assign level of evidence.

Extraction

Two independent reviewers

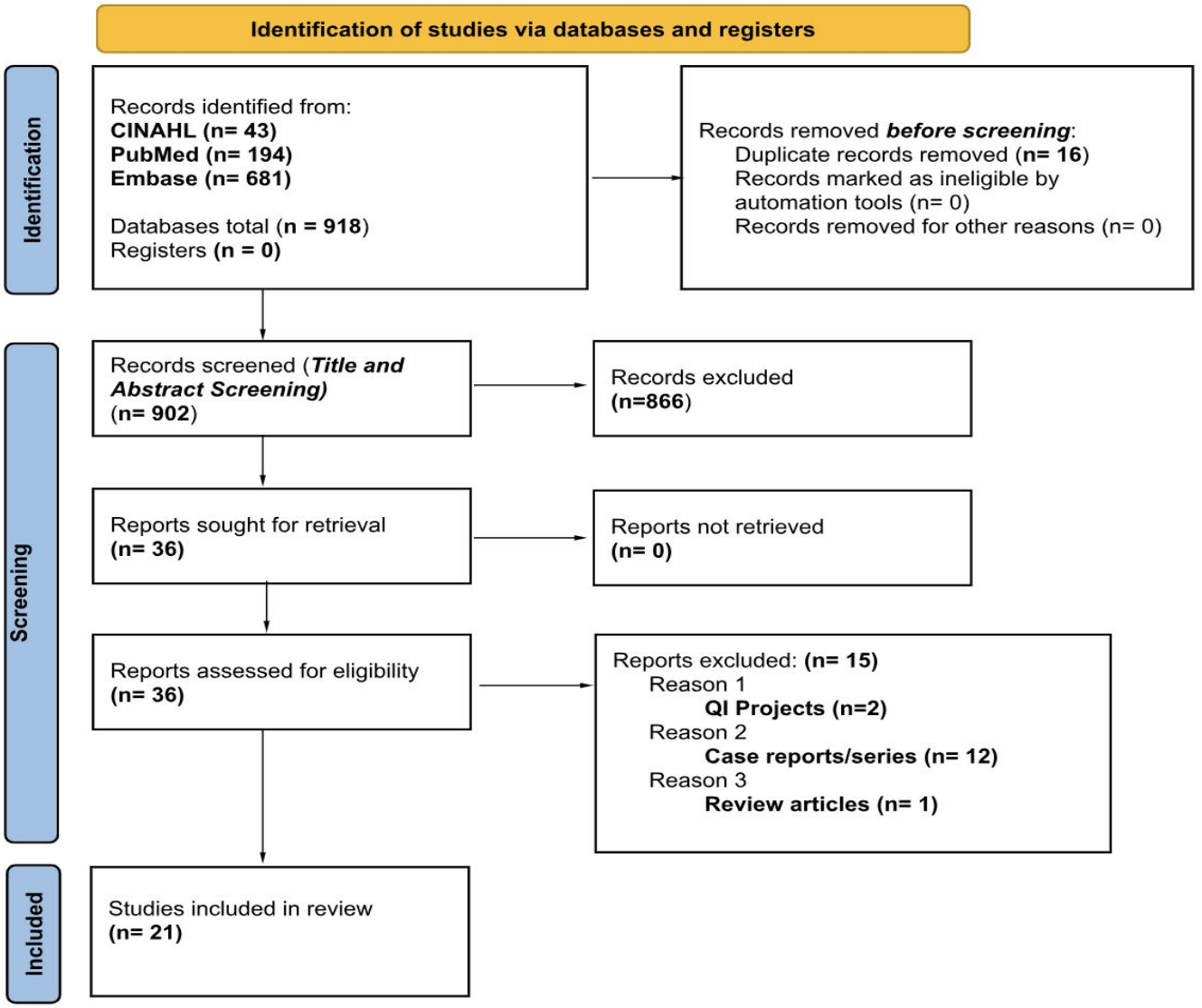
Data illustrated on a **matrix table** (study design, subject characteristics, dependent and independent variables)

Synthesis

This integrative review appraised evidence available on ESPB analgesic effect on rib fractures.

ESPB was compared to (Thoracic epidural, Paravertebral block, Serratus anterior block, retrolaminar block, systemic opioid)

PRISMA


Identification of studies via databases and registers
Identification
Records identified from:
CINAHL (n= 43)
PubMed (n= 194)
Embase (n= 681)
Databases total (n = 918)
Registers (n = 0)
Records removed before screening:
Duplicate records removed (n= 16)
Records marked as ineligible by automation tools (n= 0)
Records removed for other reasons (n= 0)
Screening
Records screened (Title and Abstract Screening) (n= 902)
Records excluded (n=866)
Reports sought for retrieval (n= 36)
Reports not retrieved (n= 0)
Reports assessed for eligibility (n= 36)
Reports excluded: (n= 15)
Reason 1
QI Projects (n=2)
Reason 2
Case reports/series (n= 12)
Reason 3
Review articles (n= 1)
Included
Studies included in review (n= 21)

Review Outcomes

- **Primary outcome**
  - Pain scores
  - Respiratory function
- **Secondary outcome**
  - Total analgesia consumption
  - Hospital length of stay
  - Adverse events

Results

Comparison of pain scores between studies

Study	Comparison group	Scale	Pain scores							
			12h		24h		48h		96h	
			At rest	with cough	At rest	with cough	At rest	with cough	At rest	with cough
Elawamy et al. (2022)	TPVB	VAS	p= 0.707	p= 0.975	p= 0.166	p= 0.352.				
Malla et al. (2021)	SAPB	NRS	p= 0.002	p= 0.000	p= 0.048	p= 0.015				
Shapirova et al. (2023)	Systemic opioid	NRS			p<0.001	p<0.001	p<0.001	p<0.001		
Syal et al. (2021)		VAS							p<0.0001	
Xu et al. (2021)	TEA	NRS			p<0.05		p<0.05			
Zhao et al. (2022)	RLB	VAS	p<0.05		p<0.05		p>0.05			

Note. NRS: Numeric Rating Scale; VAS: Visual Analogue Scale; ESPB: Erector Spinae Plane Block; SAPB: Serratus Anterior Plane Block; TEA: Thoracic Epidural Analgesia; RLB: Retrolaminar Block; PVB: Paravertebral block; TPVB: Thoracic Paravertebral Block; NR: Not reported.

- vs. TPVB
  - ***no difference*** in pain scores
- vs. SAPB/Systemic opioid
  - ESPB has ***lesser*** pain scores
- vs. TEA
  - ESPB has ***greater*** pain scores
- vs. RLB
  - ESPB with ***greater*** pain scores up to 24 hours.

Comparison of respiratory function

Study	Comparison group	Respiratory outcome measured	Results			
			Baseline	12 hr	24 hr	48 hr
Malla et al. (2021)	SAPB	Diaphragmatic excursion (cm)	p= 0.425	p= 0.027	p=0.042	
Shapirova et al. (2023)	Systemic opioid	FVC (% of predicted value)	p= 0.244.		p= 0.002	p= 0.016
Xu et al. (2021)	TEA	Incentive spirometer volume (ml)	1000 vs. 1000		1000 vs. 1000	1000 vs. 1000

Note. ESPB: Erector Spinae Plane Block; ml: Milliliters; cm: Centimeter; FVC: Forced Vital Capacity; TEA: Thoracic Epidural Analgesia; SAPB: Serratus Anterior Plane Block

- Respiratory function was assessed using spirometry values, arterial blood gas, diaphragm activity, and vital signs.
- vs. SAPB and systemic opioid
  - ESPB has ***better*** respiratory outcomes
- vs. TEA
  - **no difference**
- ESPB performed within 24 hours of admission reduces risk of pneumonia, pulmonary embolism, and respiratory failure.

Secondary Outcomes

- **Total analgesia consumption**
  - ESPB received ***lesser*** rescue analgesia vs. SAPB and systemic opioid.
  - ***no difference*** vs. TEA and PVB.
- **Hospital length of stay**
  - ***no difference*** vs. TEA
- **Adverse events**
  - TEA
    - Bradycardia, hypotension, pneumonia, nausea and vomiting.
  - PVB
    - Hypotension, bradycardia and vascular puncture in the PVB group.
  - ESPB
    - Catheter-related complications

Total Analgesia Consumption

Study	Comparison group	Rescue analgesia administered	P value
Elawamy et al. (2022)	TPVB	Morphine (mg)	p= 0.198
Elmansy et al. (2023	Systemic opioid	Morphine (mg)	P=0.03
Malla et al. (2021)	SAPB	Tramadol (mg)	P=0.004
Singh et al. (2023)	TEA	Morphine (mg)	P=0.88

Note. mg: Milligrams; ESPB: Erector Spinae Plane Block; SAPB: Serratus Anterior Plane Block; TEA: Thoracic Epidural Analgesia; TPVB: Thoracic Paravertebral Block.

Discussion

- ESPB provided superior analgesia and better improvement in respiratory function compared to systemic opioid and SAPB for up to 96 hours.
- ESPB is a safer analgesic treatment when compared to PVB, which has complications such as bradycardia, hypotension, vascular puncture, and catheter failure.
- TEA, the current gold standard treatment provides better analgesia but is associated with hemodynamic compromise.
- Compared to TEA, ESPB allows prophylactic anticoagulant treatment to reduce incidence of VTE.

Limitations

- The heterogeneity of study designs in this review impacts its ability to draw distinct conclusions about the role of ESP.
- Thirteen (**62%**) of the studies in the review are retrospective studies, which produce weak evidence for causal connection.
- This review is limited to investigating the analgesic effect of ESPB in comparison to other analgesia techniques.
- Recommendation for future research include investigating the safety profile of ESPB with other analgesia techniques.

Recommendation for Practice

- Based on evidence from this synthesis review the following recommendations can be applied to practice.
- ESPB is recommended for adult patients with one or more rib fractures to improve pain scores and respiratory function for up to 96 hours, thereby reducing opioid consumption and hospital LOS.
- ESPB administered within 24 hours of patient arrival to hospital with rib fracture, improves patient outcome and lessens the likelihood of admission to ICU.

Recommendation for Practice

- Local Anesthetics of choice recommended for ESPB are bupivacaine and ropivacaine with concentrations ranging from 0.125 % to 0.5 %.
- Adjuncts to these local Anesthetics that will prolong its analgesic effects includes: dexamethasone, epinephrine, clonidine, toradol and fentanyl.
- A single administration of 0.5% ropivacaine without an adjunct provided analgesia for up to 48 hours.

Recommendation for Practice

- High risk VTE patients on chemoprophylaxis are good candidates for ESPB as it allows concomitant administration administration of anticoagulant without the need for any interruption.
- Continuous ESBP catheter can provide analgesia for 96 hours compared to a single administration whose duration is only 48 hours.
- ESBP provides better hemodynamic stability making it the preferred block for patients that are hemodynamically unstable.

Conclusion

This integrative review revealed that although thoracic epidural analgesia (TEA), the current preferred analgesic treatment, provides lower pain scores compared to ESPB, it has a higher incidence of bradycardia and hypotension which is unfavorable in this patient population.

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