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.

Background & Significance

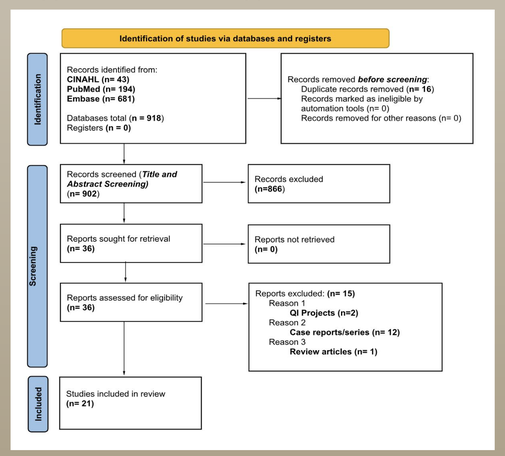
- In the United States, the incidence of rib fractures is increasing and is associated with increased mortality and morbidity. Martin et al. 2019 reported 248,000 patients treated annually with rib-fracture related injuries.
  - Rib fractures cost an average cost of $10,169 per hospitalization.
- Pain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

Clinical Question

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

Methods

- **Review design**: Integrative review
- **21 articles** met inclusion criteria
- **Databases search:** CINAHL, EMBASE and PubMed
- **Outcome variables of interest:**
  - ***Primary outcomes-*** Pain scores and respiratory function
  - ***Secondary outcomes-*** Total analgesia consumption, hospital length of stay, and adverse events.
- **Critical appraisal:** JBI critical appraisal tools



Results

- **Pain scores**
  - 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.
- **Respiratory Function**
  - vs. SAPB and systemic opioid
    - ESPB has ***better*** respiratory outcomes
  - vs. TEA
    - **no difference**
- **Total analgesia consumption**
  - ESPB patients received ***less*** rescue analgesia doses vs. SAPB and systemic opioid groups
  - ***no difference*** vs. TEA and PVB
- **Hospital length of stay**
  - ***no difference*** vs. TEA
- **Adverse events**
  - **TEA-** Bradycardia, hypotension, pneumonia, nausea, vomiting
  - **PVB-** Bradycardia, hypotension, vascular puncture
  - **ESPB-** Catheter-related complications

Comparison of Pain Scores Between ESPB and Other Groups

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.

Comparison of Respiratory Function Between ESPB and other groups

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

Comparison of Total Analgesic Consumption Between ESPB and other groups

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 use 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 it is associated with hemodynamic compromise.
- Compared to TEA, ESPB allows prophylactic anticoagulant treatment to reduce incidence of venous thromboembolism.

Recommendation

- ESPB is recommended for adult patients with one or more rib fracture to improve pain scores and respiratory function for up to 96 hours, thereby reducing opioid consumption and hospital LOS.
- High risk venous thromboembolism patients receiving chemoprophylaxis are good candidates for ESPB as it permits concomitant administration of anticoagulation without the need for interruption of therapy.
- ESPB provides better hemodynamic stability making it the preferred block for patients with hemodynamic instability.
- ESPB administered within 24 hours of a rib fractured patient's admission arrival to the hospital, improves patient outcome and decreases the likelihood of ICU admission
- Local anesthetics of choice recommended for ESPB include bupivacaine and ropivacaine at concentrations of 0.125 % to 0.5 %.

Conclusion

- ESPB performed within 24 hours of admission reduces risk of pneumonia, pulmonary embolism, and respiratory failure.
- This integrative review revealed that although TEA, the current preferred analgesic treatment, provide lower pain scores compare to ESPB, it has a higher incidence of bradycardia and hypotension which is unfavorable in this patient population.
- ESPB provides improved pain scores and respiratory function when compared to SAPB or systemic opioid administration.
- Future research to investigate the adverse effects of ESPB in comparison with other therapies will aid providers in selecting the safest analgesic treatment for patients with rib fractures.