

Cryoablation Plus Pre-incision Regional Block: Maximizing Pain Relief In Pectus Excavatum Surgery

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Introduction

- **Condition and Procedure:**
 - Pectus excavatum is the most common congenital chest wall deformity in children and adolescents.¹
 - Minimally invasive repair of pectus excavatum (MIRPE) is a widely performed corrective thoracic surgery.
- **Pain Management Challenge:**
 - Thoracic surgeries like MIRPE are inherently painful, prompting research to improve perioperative pain management.
 - Effective perioperative pain control is crucial to enhance recovery and reduce hospital stay.
- **Newer Pain Management Technique - Intercostal Nerve Cryoablation (INC):**
 - Performed by surgeons and temporarily ablates intercostal nerves, offering extended pain relief and potentially reducing opioid use.
 - Studies show cryoablation reduces hospital stays and perioperative opioid requirements but does not consistently improve pain scores.^{2,3}
- **Combination Therapy Potential:**
 - Combining INC with peripheral nerve blocks (e.g., Erector spinae plane block (ESPB), serratus anterior plane block (SAPB), or paravertebral blocks) may improve pain scores and outcomes
 - No current studies examine the combined use of INC with ESPB or SAPB for MIRPE patients.
- **Study Purpose:**
 - Evaluate the impact of cryoablation combined with ESPB or SAPB on postoperative outcomes in MIRPE patients.

Methods

- **Study Design:** Retrospective cohort study on patients undergoing MIRPE at an academic children’s hospital, IRB approved (2020-2023).
- **Groups:** Intercostal nerve cryoablation (n=59) vs. no cryoablation (n=34), with chest wall block type per surgical/anesthesia team discretion.
- **Primary Outcomes:** Hospital length of stay (LOS), PACU pain scores, and opioid consumption (MME)
- **Analysis:** Mann-Whitney U test for continuous variables, Fisher’s exact or chi-square for categorical; linear regression for LOS and opioid use predictors (p < 0.05).

Figures and Tables

Schematic Diagrams of Nerve Block Techniques

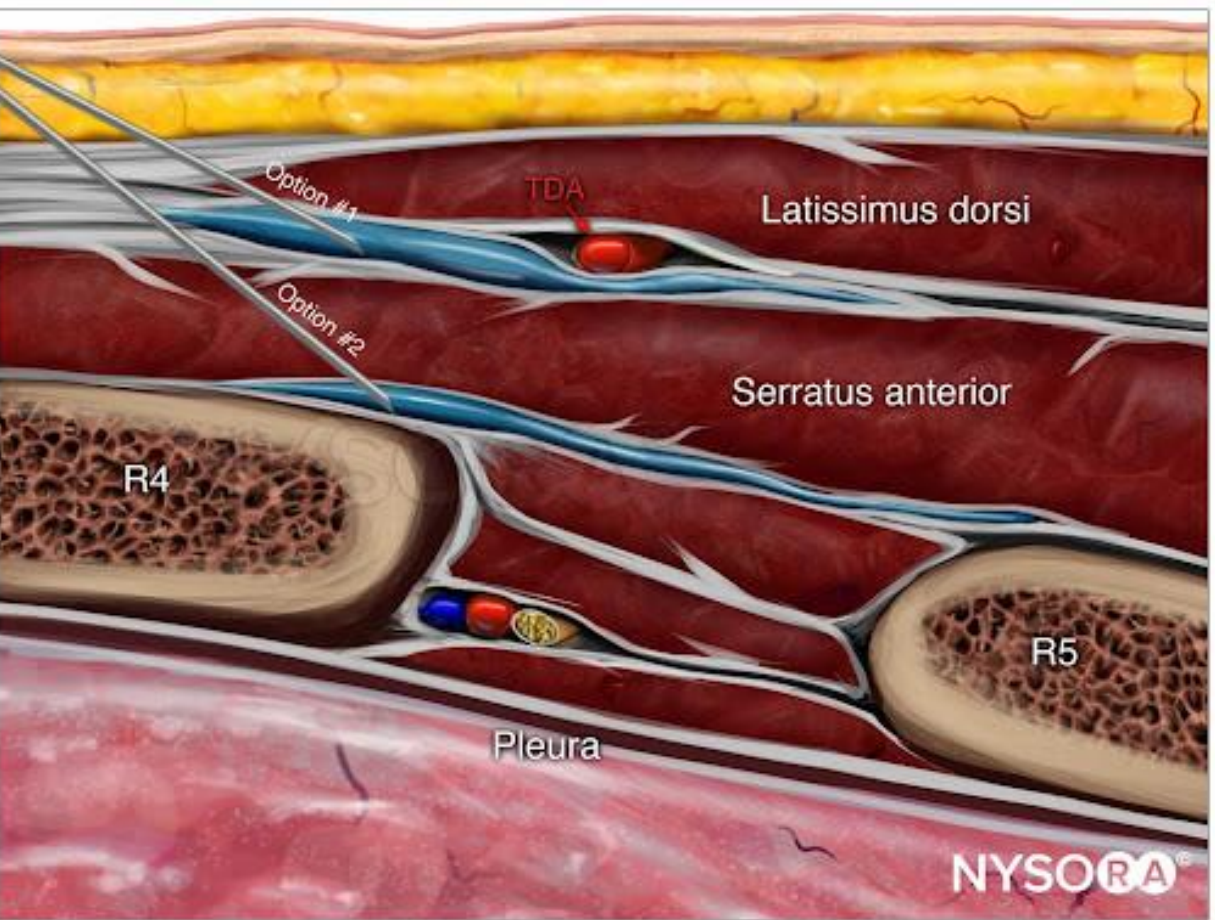


Figure 1: Serratus Anterior Plane Block
The needle is placed under the serratus anterior muscle to target lateral cutaneous branches, offering effective analgesia for thoracic surgery. Image source: NYSORA⁴

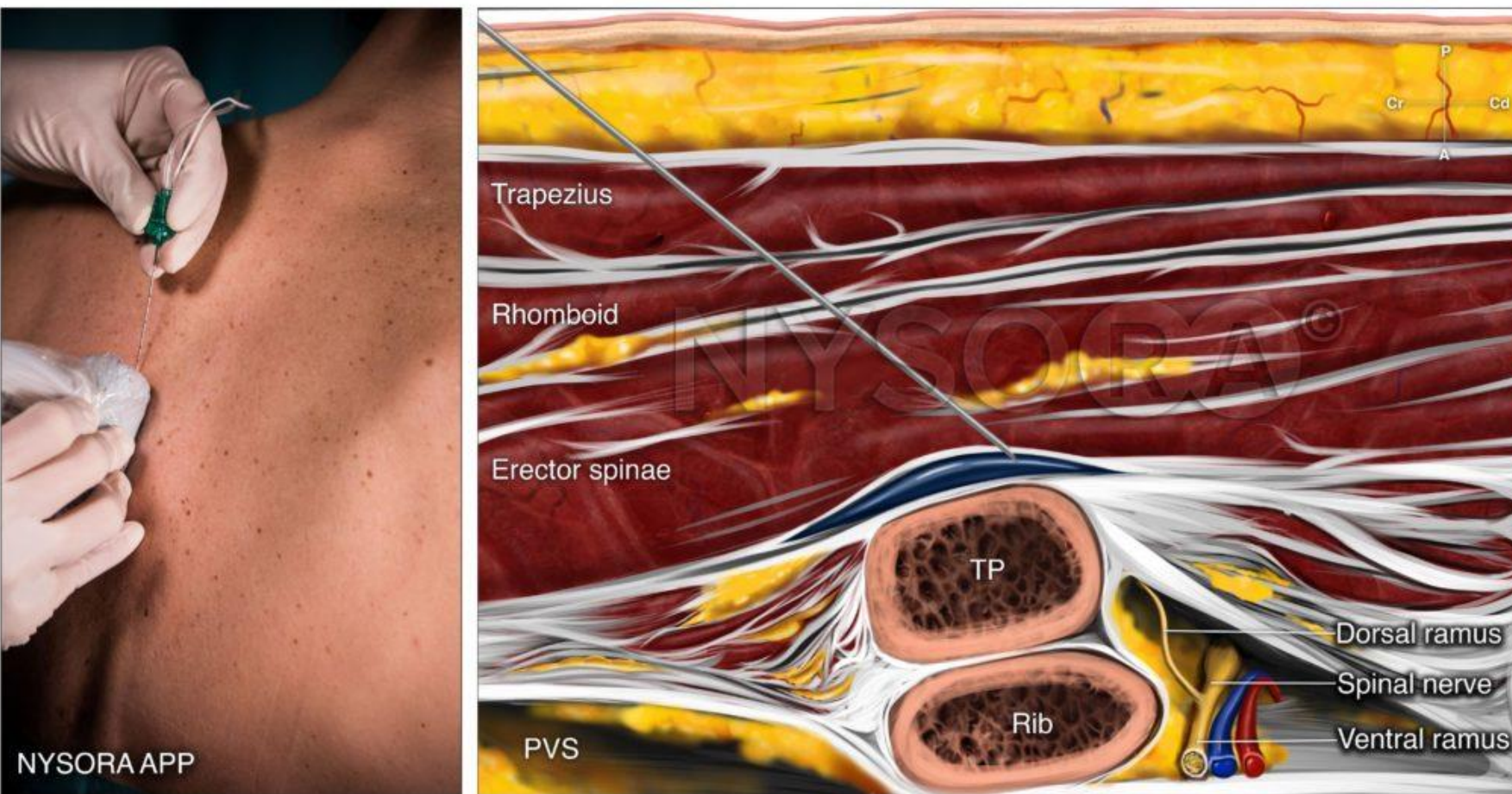


Figure 2: Erector Spinae Plane Block
The needle is inserted at the level of the transverse process to administer anesthetic near the erector spinae muscle, targeting dorsal and ventral rami for thoracic pain relief. Image source: NYSORA⁵

Table 1: Outcomes of Cryoablation vs. No Cryoablation

Outcome	No Cryoablation (N = 34)	Cryoablation (N = 59)	p - value
Hospital Length of Stay (hours)	74.06 (58.83 – 97.28)	35.25 (31.32 – 55.13)	<0.001
PACU Length of Stay (hours)	124.5 (96 – 164.3)	97 (75 – 127)	0.0074
Operative Time (minutes)	187 (170.5 – 220.25)	236 (216 – 264)	<0.001
PACU total postoperative opioid administration (mg/kg morphine equivalents)	0.930(0.550 – 1.265)	0.660 (0.530 – 0.930)	0.0355
Inpatient Hourly Opioid consumption (mg/kg morphine equivalents/hours)	.0477(.0364 – .0638)	0.0081 (0.0046 – 0.0135)	<0.001
Mean Pain score in PACU	3.75 (0.75 – 6.0)	2.0 (0.0 – 4.0)	0.0254
PCA administered (% of patients)	21 (62%)	1 (1.7%)	<0.001
Complications (e.g., nausea, vomiting, readmission)	Minimal difference	Minimal difference	>.05

NOTE. Data are presented as median [interquartile range of 25th to 75th percentiles] or absolute number (with the percentage of the whole). P-values using Mann-Whitney test for continuous variables and Pearson Chi-square for categorical values

Table 2: Post Hoc Analysis - Cryoablation with Different Blocks

Outcome	Cryo + Serratus (n=12)	Cryo + Erector (n = 47)	p-value
Hospital LOS (hours)	53.74	33.90	0.014
Operative time (min)	237	236	0.791
Total inpatient opioid (MME/kg)	.585	0.290	0.044

Post hoc analysis presents the results from the Mann-Whitney U test model, comparing the medians from cryoablation patients with serratus anterior block and erector spinae blocks. The model displayed statistically significant difference (p<.0001) from the Hospital length of stay, operative time, and total MME/kg.

Results

- **Hospital Length of Stay (LOS):** Patients who received intercostal nerve cryoablation had a significantly shorter hospital LOS (35.25 hours vs. 74.06 hours, p<0.001) and PACU LOS (97 hours vs. 124.5 hours, p=0.0074) compared to those who did not receive cryoablation.
- **Opioid Consumption:** Cryoablation significantly reduced postoperative opioid use, both in the PACU (0.660 mg/kg vs. 0.930 mg/kg, p=0.0355) and inpatient hourly opioid consumption (0.0081 mg/kg/h vs. 0.0477 mg/kg/h, p<0.001).
- **Pain Scores and PCA Usage:** Patients in the cryoablation group had lower pain scores in the PACU (mean 2.0 vs. 3.75, p=0.0254) and a markedly lower rate of PCA use (1.7% vs. 62%, p<0.001).
- **Block Type Comparison:** Among patients who received cryoablation, those with erector spinae blocks had shorter LOS (33.90 hours vs. 53.74 hours, p=0.014) and lower total opioid consumption (0.290 MME vs. 0.585 MME, p=0.044) than those with serratus anterior blocks.

Conclusions

- **Improved Outcomes with Cryoablation:** Intercostal nerve cryoablation (INC), when combined with either ESPB or SAPB, significantly reduced hospital and PACU length of stay, postoperative opioid consumption, and pain scores in MIRPE patients.
- **ESPB Advantage:** INC with ESPB was associated with the greatest reduction in opioid use and LOS, suggesting a potential advantage of ESPB over SAPB in this setting.
- **Predictors of Reduced LOS:** The combination of cryoablation and ESPB was the strongest predictor for reducing hospital LOS.

References

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