Pain Control

After Thoracic Surgery

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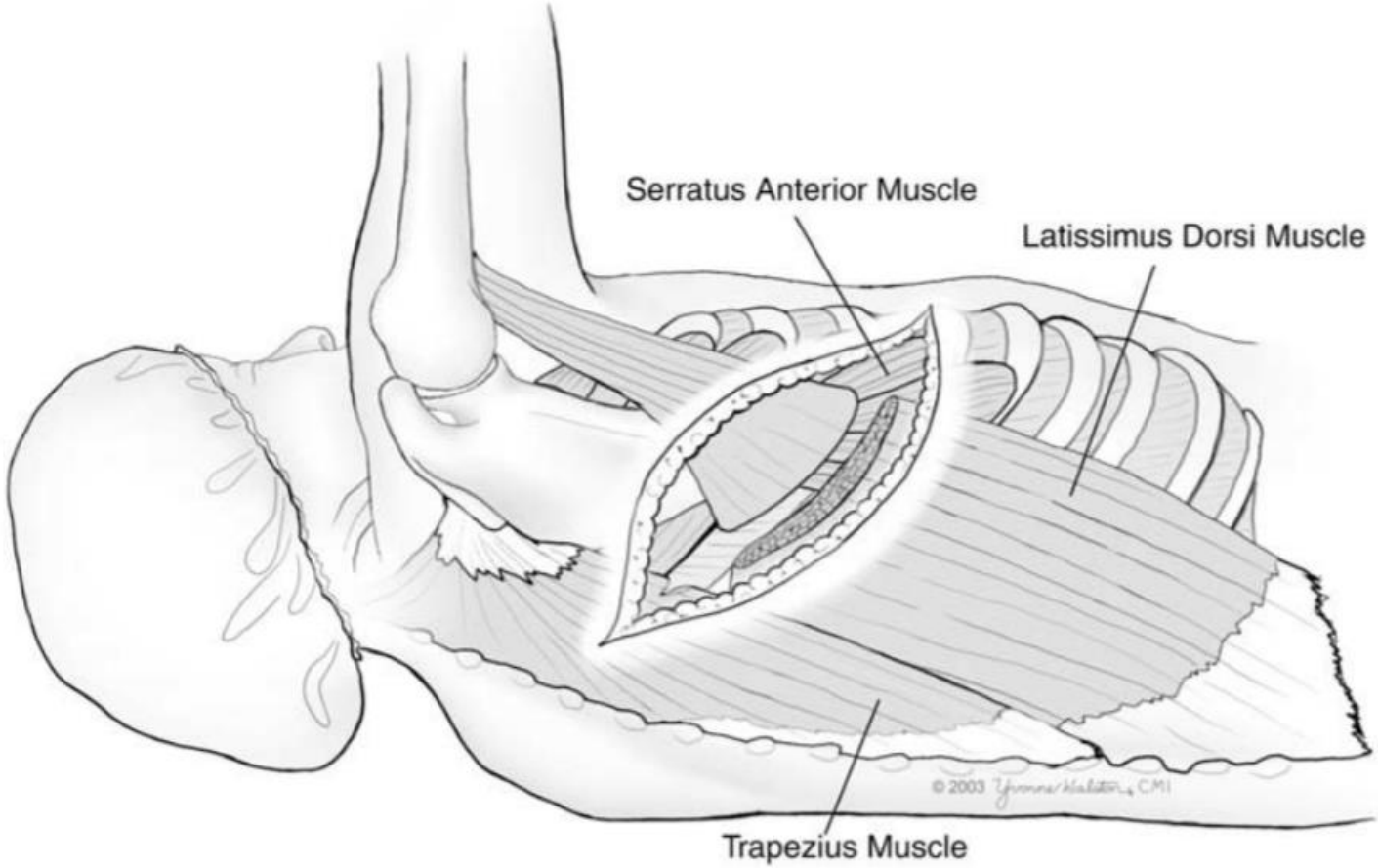
Posterolateral thoracotomy



Pathophysiology of post-thoracotomy pain

- Skin incision
- Division and retraction of the muscles
- Sometimes fracture of rib
- Stretched ligaments
- Dislocated costochondral joints
- Injured intercostal nerves
- Inflammatory response; pleural injury, chest tube drains, residual blood

- Central transmission of these **multiple, complex** nociceptive signals amplifies pain transmission and increases pain perception through central sensitization.

Post-thoracotomy pain

- Most painful incision
- Poorly treated post-thoracotomy reduces
  - patient satisfaction
  - quality of their life, their loved ones
  - ability to co-operate with postop. physiotherapy and remobilization

- Effective pain control can facilitate a reduction in postop. complications, particularly pulmonary complications.

Post-thoracotomy pain & Pulmonary function

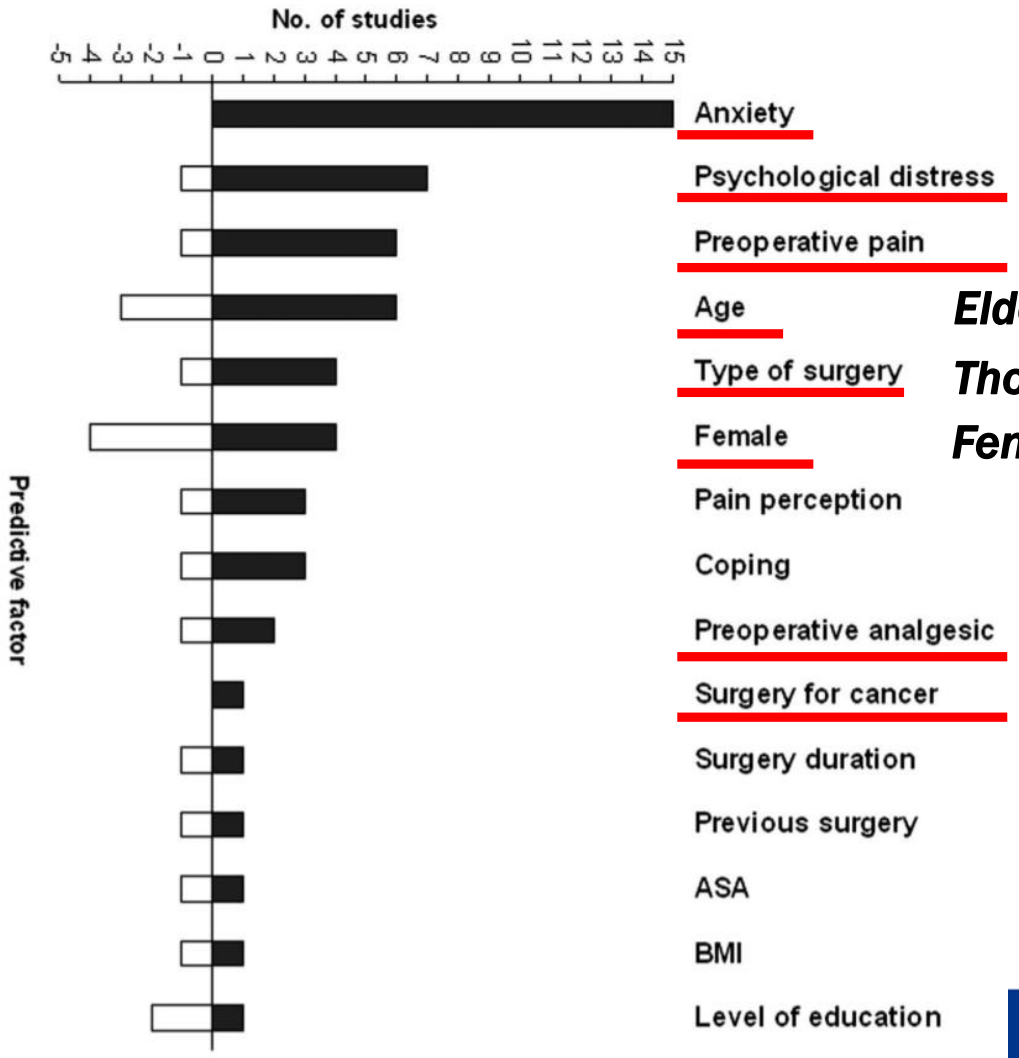
- **Inspiration stretches the injured structures initiating a reflex contraction of the expiratory muscles.**
- **Splinting of the injured hemi-thorax limit the distraction of the injured structures.**

- **Reduced FVC**
- **Aggravate atelectasis, shunting, and hypoxemia**
- **Reduced inspiration, and effective coughing, expectoration**

Predictors of Postoperative Pain and Analgesic Consumption

A Qualitative Systematic Review

Hui Yun Vivian Ip, M.B.Ch.B., M.R.C.P., F.R.C.A.,* Amir Abrishami, M.D.,† Philip W. H. Peng, M.B.B.S., F.R.C.P.C.,‡ Jean Wong, M.D., F.R.C.P.C.,§ Frances Chung, M.D., F.R.C.P.C.‖



Elderly patients : more susceptive to opioid analgesia

Thoracic surgery, abdominal surgery, OS op..

Feminine personality > masculine personality

Preemptive

Anesthesiology 2009; 111:657–77

Pre-operative Preparedness

- **Pre-operative Preparedness**

; Well-informed patients may experience less pain

; Patients should receive a full explanation of the analgesic protocol, its limitations, and potential side effects

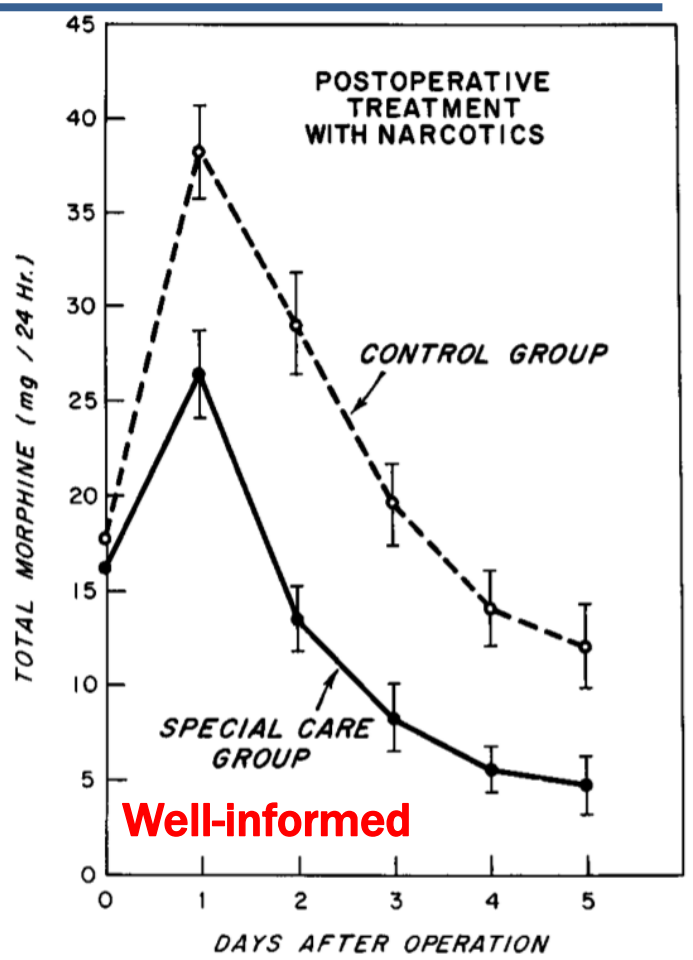


FIGURE 1. *Postoperative Treatment with Narcotics (Means for Each Day ± Standard Error of the Mean).*

NEJM 1964;270:825–7

Pain scale

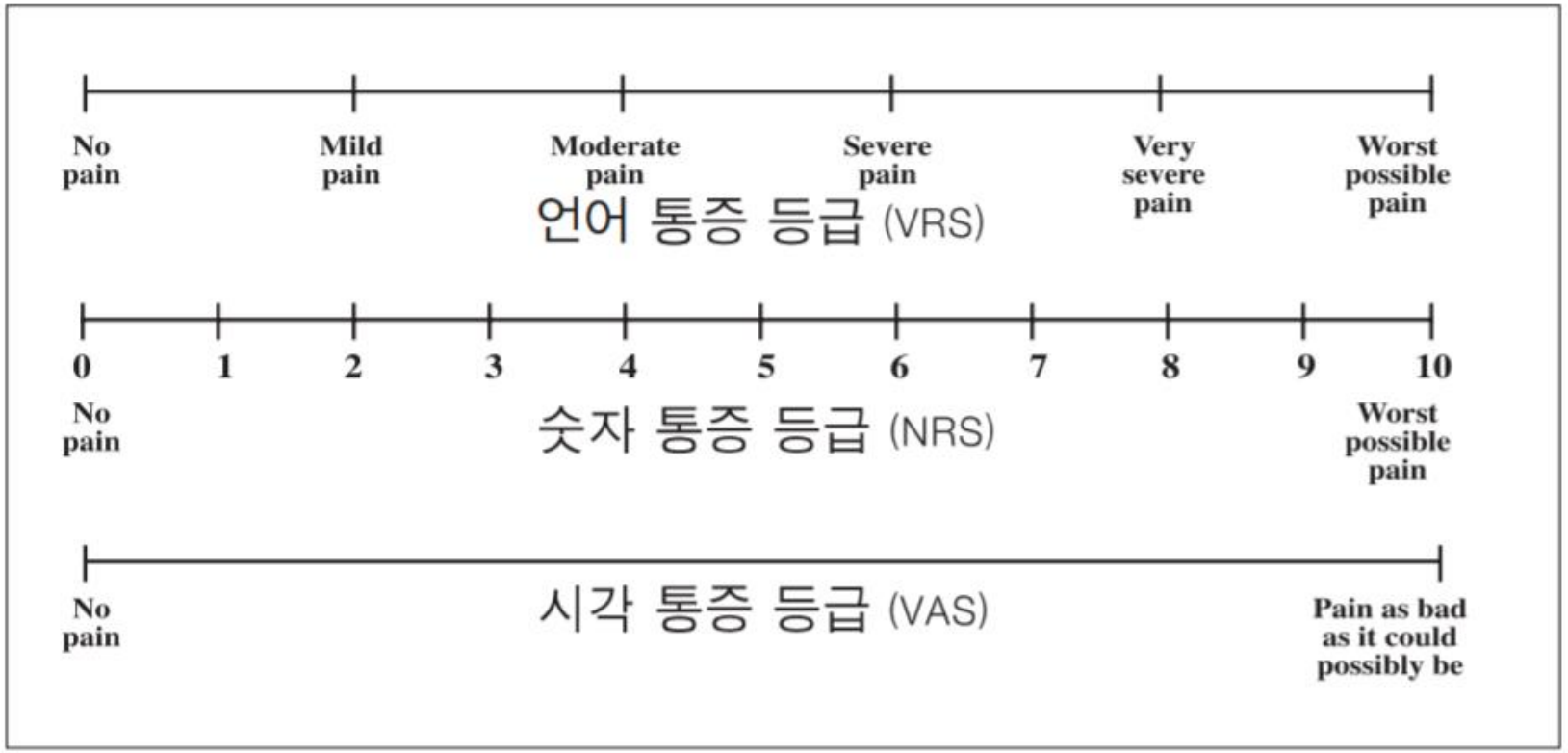
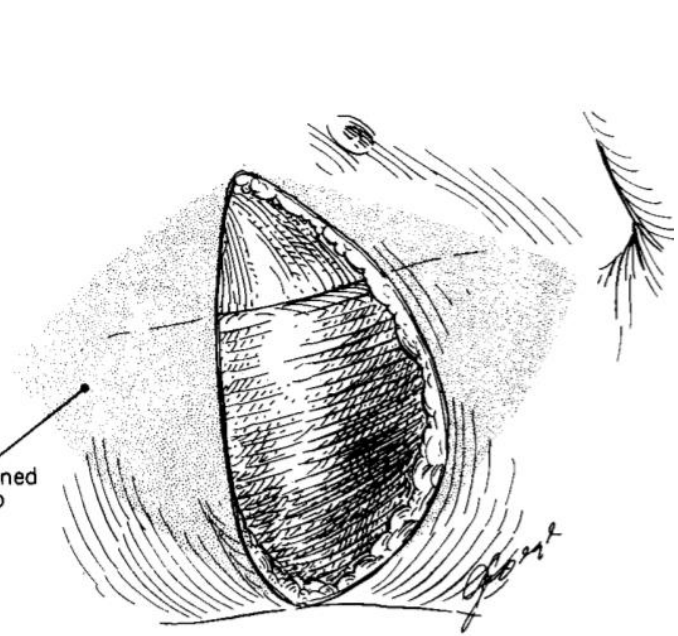
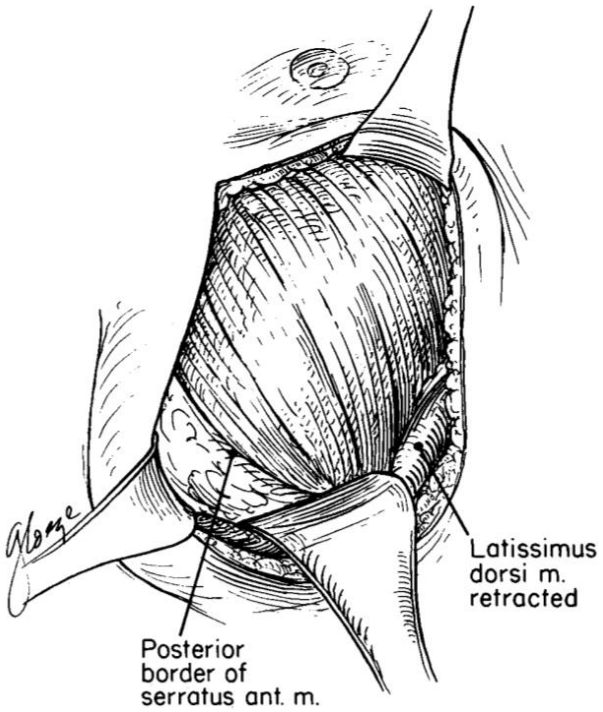


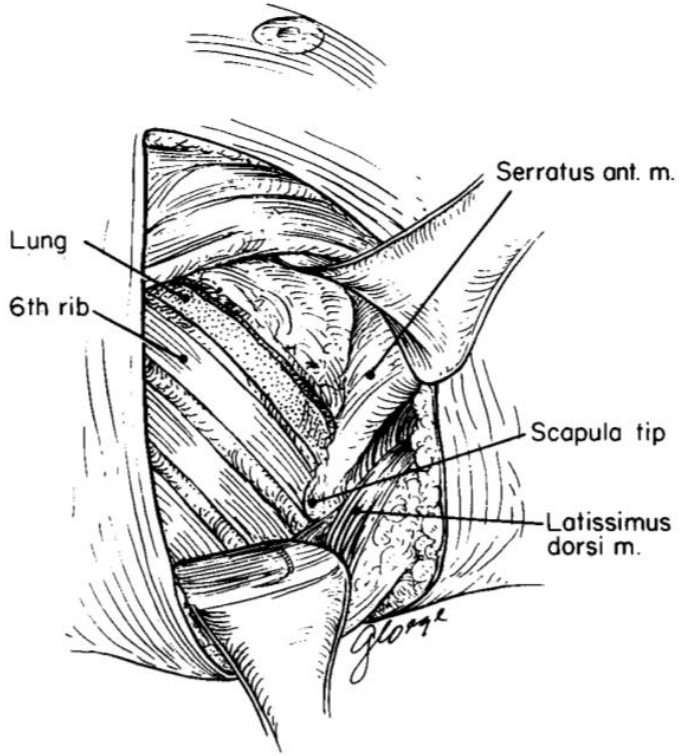
Figure 1. Visual Analogue Scale (VAS), Numerical Rating Scale (NRS) and Verbal Rating Scale (VRS) (2).

Surgical Technique

Muscle-sparing thoracotomy

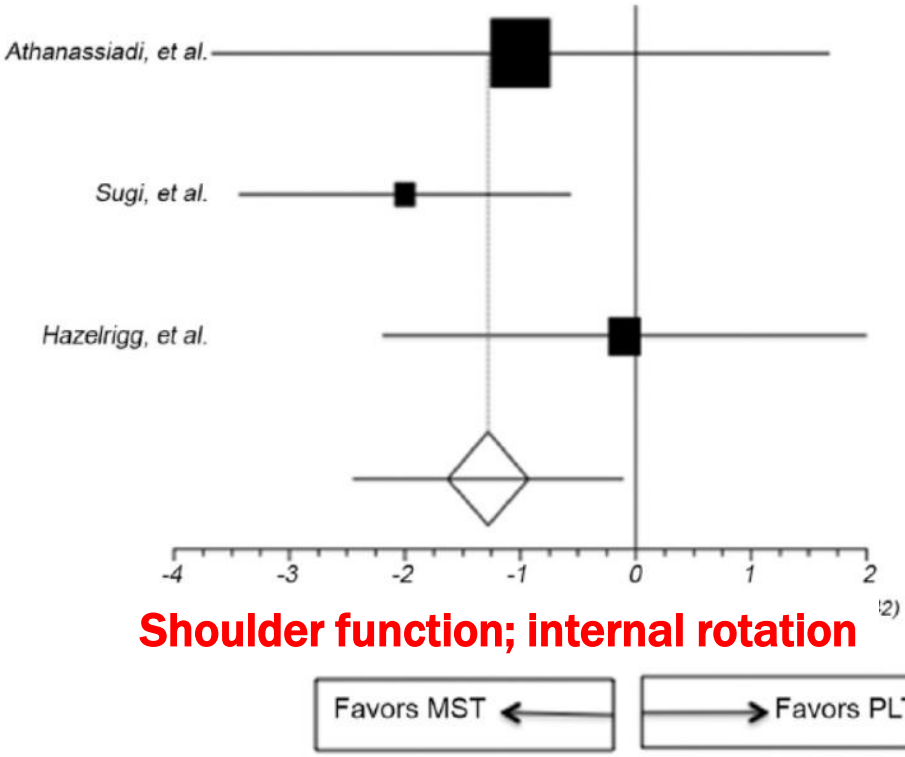




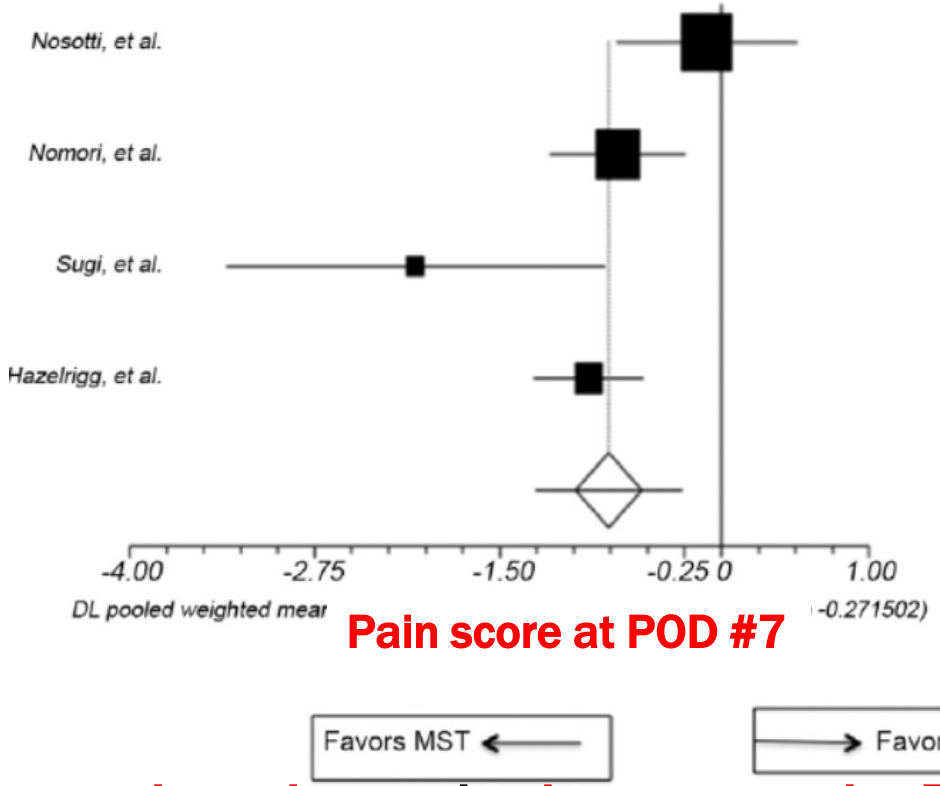


A Meta-Analysis Comparing Muscle-Sparing and Posterolateral Thoracotomy

Ann Thorac Surg 2014;97:1093–102



Shoulder function; internal rotation

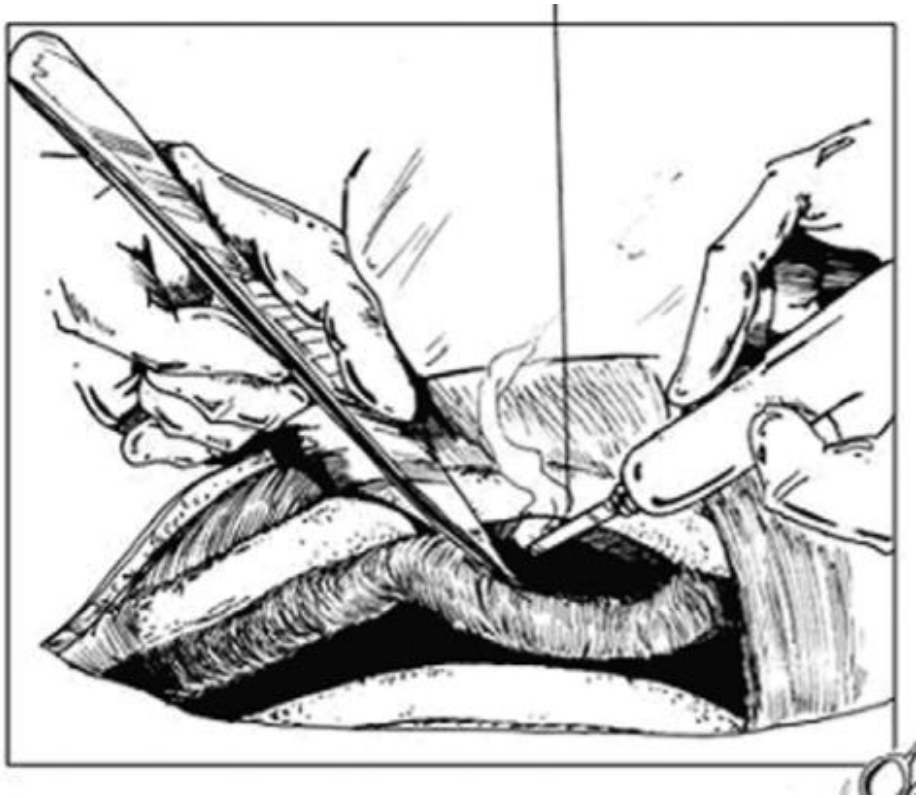


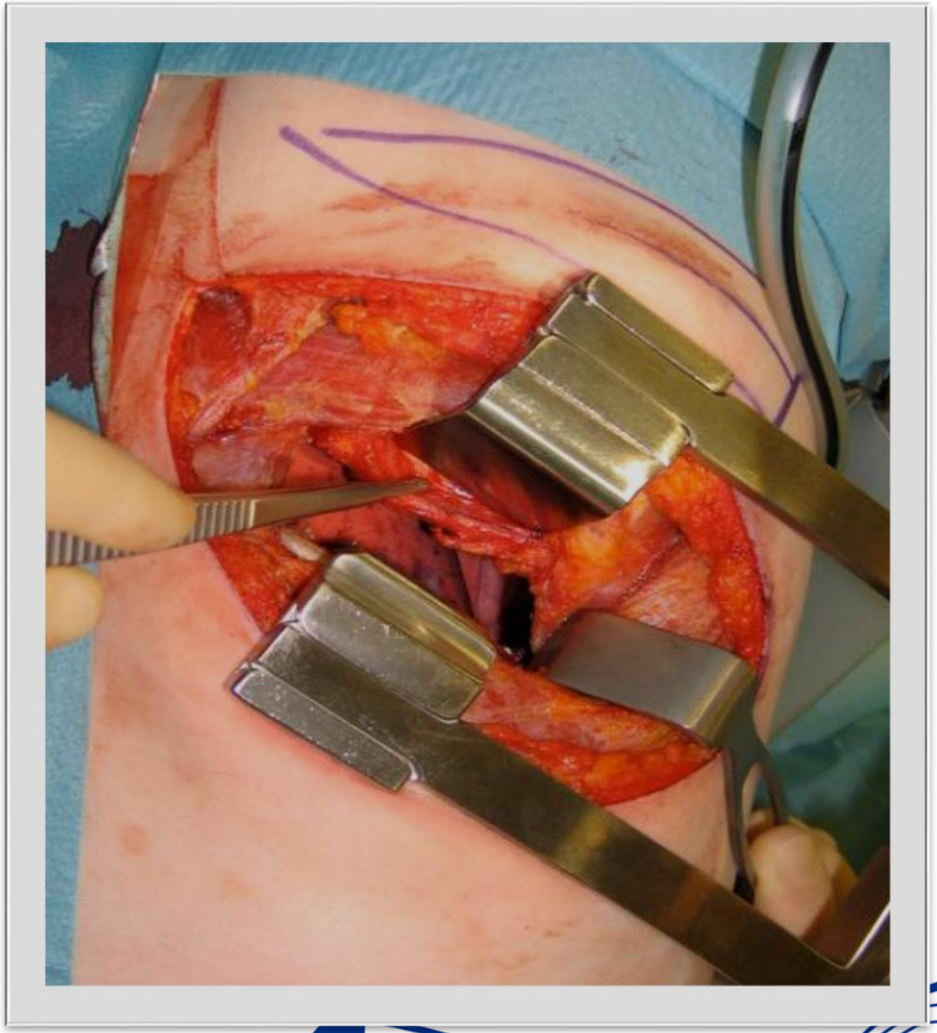
Pain score at POD #7

There was significantly improved shoulder internal rotation, and pain scores on day 7.

Higher incidence of seroma, similar postop pulmonary function, and complications.

Non-divided intercostal muscle flap





Non-divided intercostal muscle flap

RCT

A Nondivided Intercostal Muscle Flap Further Reduces Pain of Thoracotomy: A Prospective Randomized Trial

Robert James Cerfolio, MD, Ayesha S. Bryant, MSPH, MD, and Lee M. Maniscalco, BS

Division of Cardiothoracic Surgery, Departments of Surgery and Cardiothoracic Surgery, University of Alabama at Birmingham, Birmingham, and University of South Alabama, Mobile, Alabama

Ann Thorac Surg 2008;85:1901–7

RCT

Intercostal Muscle Flap for Decreasing Pain After Thoracotomy: A Prospective Randomized Trial

Amr Mohammad Allama, MD

Cardiothoracic Surgery Department, Faculty of Medicine, Menoufia University, Menoufia, Egypt

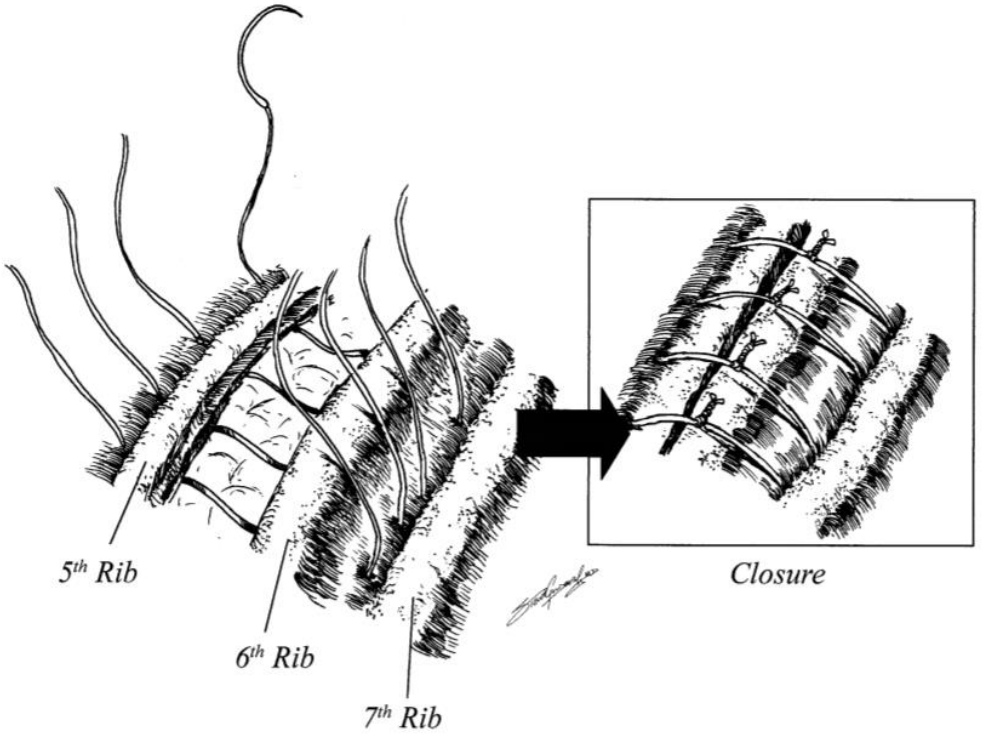
Ann Thorac Surg 2010;89:195–9

Non-divided intercostal muscle flap

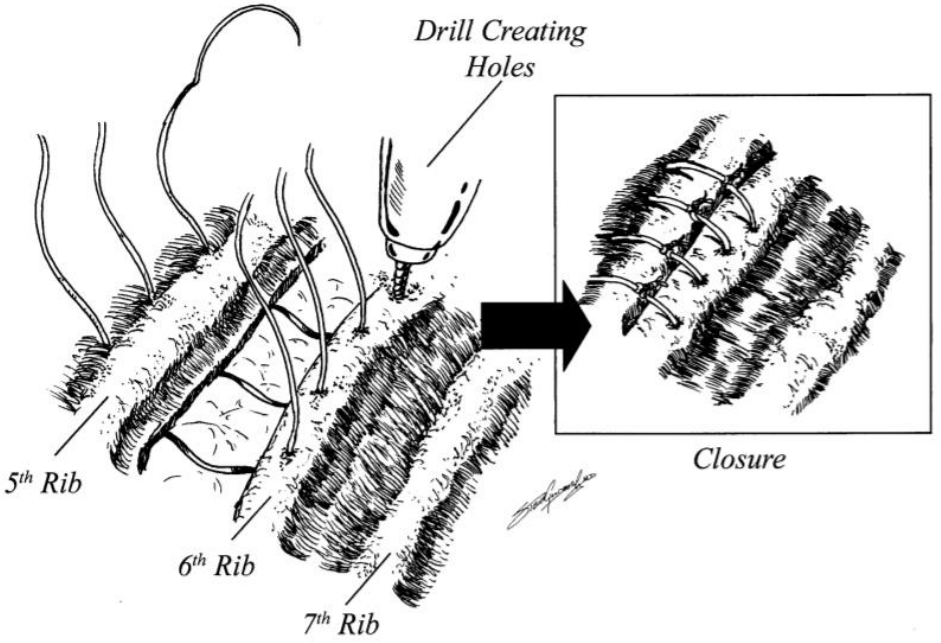
Variable	IMF Group (n = 60)	PCS Group (n = 60)	*p* Value
Postoperative FEV_1 (% predicted)	63.28 ± 8.84	62.83 ± 10.2	0.797
Time to ambulation (hours)	15.31 ± 3	17.43 ± 4.61	0.003[a]
Pain score (0–10)			
Day 1	5.17 ± 0.99	5.6 ± 1.15	0.029[a]
Day 2	4.18 ± 0.96	4.62 ± 1.11	0.024[a]
Day 3	3.28 ± 0.96	3.72 ± 0.97	0.016[a]
Day 4	2.63 ± 0.86	3 ± 0.97	0.019[a]
Day 5	1.92 ± 0.81	2.27 ± 0.94	0.034[a]
Day 6	1.5 ± 0.62	1.78 ± 0.76	0.04[a]
Day 7	1.15 ± 0.48	1.4 ± 0.56	0.012[a]
Number of analgesic doses injected in the epidural catheter	3 ± 0.9	3.6 ± 1.1	0.002[a]
Complications			0.959
Air leak	6 (10%)	5 (8.3%)	
Empyema	1 (1.7%)	1 (1.7%)	
Bleeding	1 (1.7%)	2 (3.3%)	
Wound infection	3 (5%)	2 (3.3%)	
Chest tube drainage (mL)	480.8 ± 184.1	458.3 ± 173.5	0.506
Hospital stay (days)	4.6 ± 2.7	4.7 ± 2.3	0.429
Return to normal daily activities (days)	13.25 ± 4	14.8 ± 3.3	0.024[a]

Intercostals muscle flap and intracostal sutures are rapid, safe, and effective procedures in decreasing early pain after thoracotomy.

Intra-costal sutures



Peri-costal sutures



Intra-costal sutures

Intracostal Sutures Decrease the Pain of Thoracotomy

Robert J. Cerfolio, MD, FACS, Theolynn N. Price, MD, Ayesha S. Bryant, MSPH, Cynthia Sale Bass, RN, MSN, and Alfred A. Bartolucci, PhD

Departments of Cardiothoracic Surgery and Biostatistics, University of Alabama at Birmingham, Birmingham, Alabama

Propensity score-matched

Ann Thorac Surg 2003;76:407–12

Table 4. Mean Pain Scores With Standard Deviations at 2 Weeks, and 1, 2, and 3 Months After Thoracotomy for the Two Groups

	Pericostal Group (N=140)	Intracostal Group (N=140)	*p* Value
2 weeks	5.5 ± 1.4	3.3 ± 1.9	0.004
1 month	3.8 ± 1.3	1.7 ± 1.4	0.001
2 months	2.3 ± 1.0	1.1 ± 0.9	< 0.001
3 months	1.6 ± 0.8	0.6 ± 0.7	< 0.001

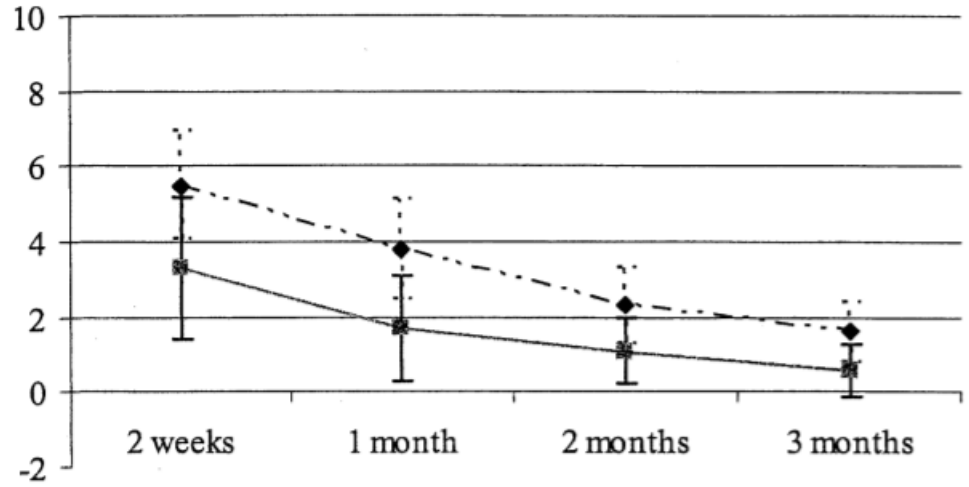
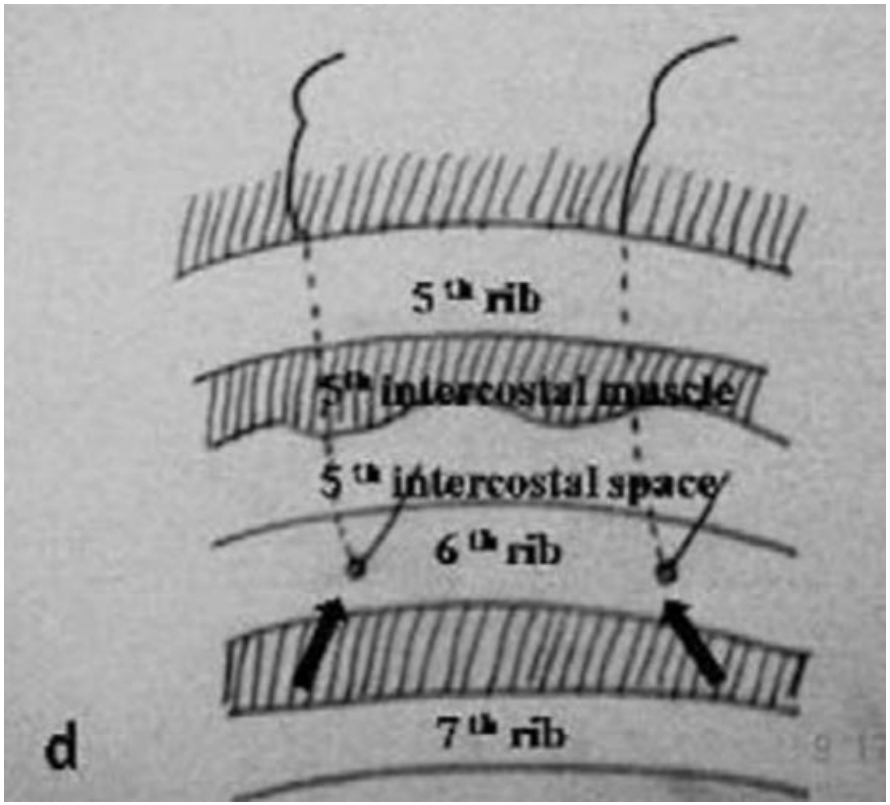
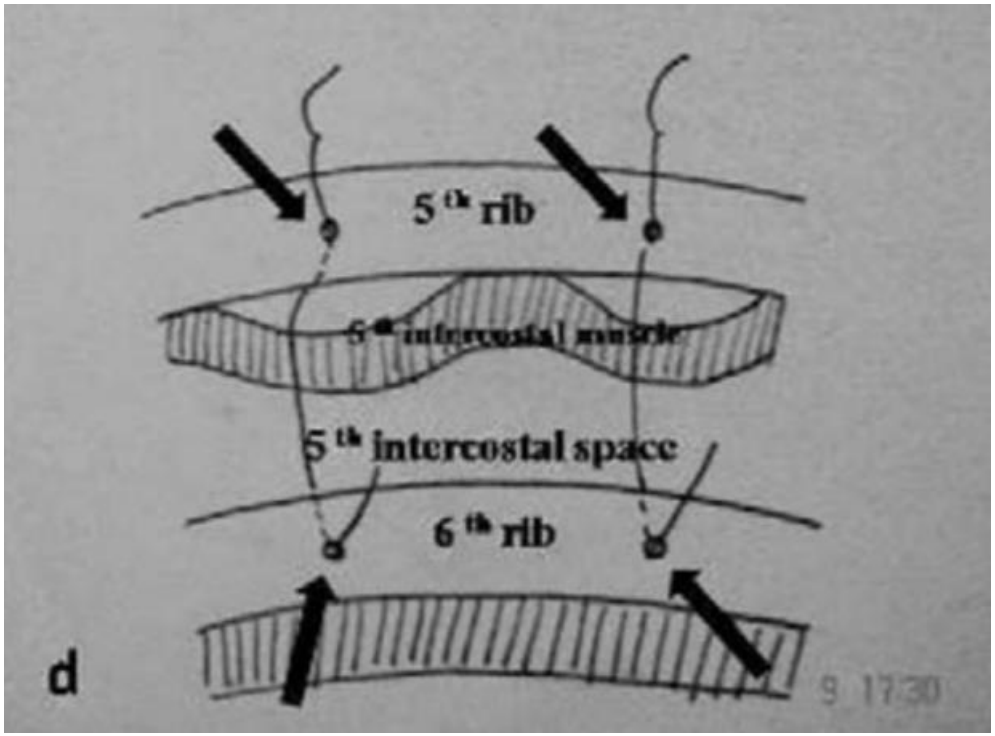


Fig 3. Mean pain scores with standard deviations. (◆ = P group; □ = I group.)

Intercostal nerve compression



Intracostal sutures only



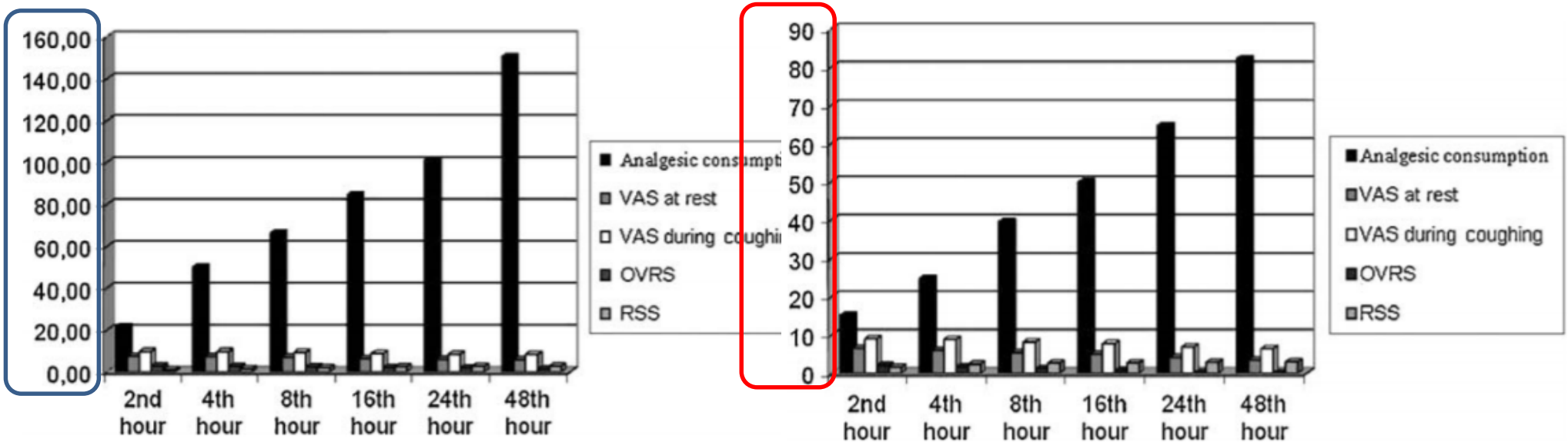
Intracostal sutures +
intercostal muscle dissection

Rib approximation without intercostal nerve compression reduces post-thoracotomy pain: a prospective randomized study

Ahmet Sami Bayram [a,*], Metin Ozcan [a], Fatma Nur Kaya [b], Cengiz Gebitekin [a]

RCT

Eur J Cardiothorac Surg. 2011;39:570-4



Intracostal sutures only (n=30)

Intracostal sutures + intercostal muscle dissection (n=30)

RCT

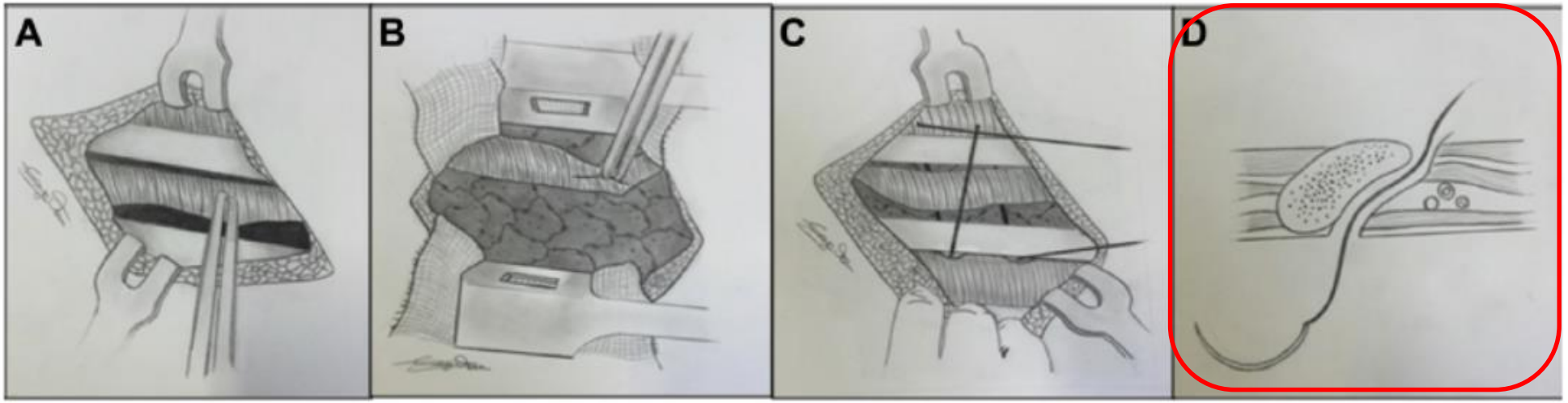
ORIGINAL ARTICLE

IASLC

Does a Multimodal No-Compression Suture Technique of the Intercostal Space Reduce Chronic Postthoracotomy Pain? A Prospective Randomized Study

CrossMark

J Thorac Oncol. 2016;11:1460-8

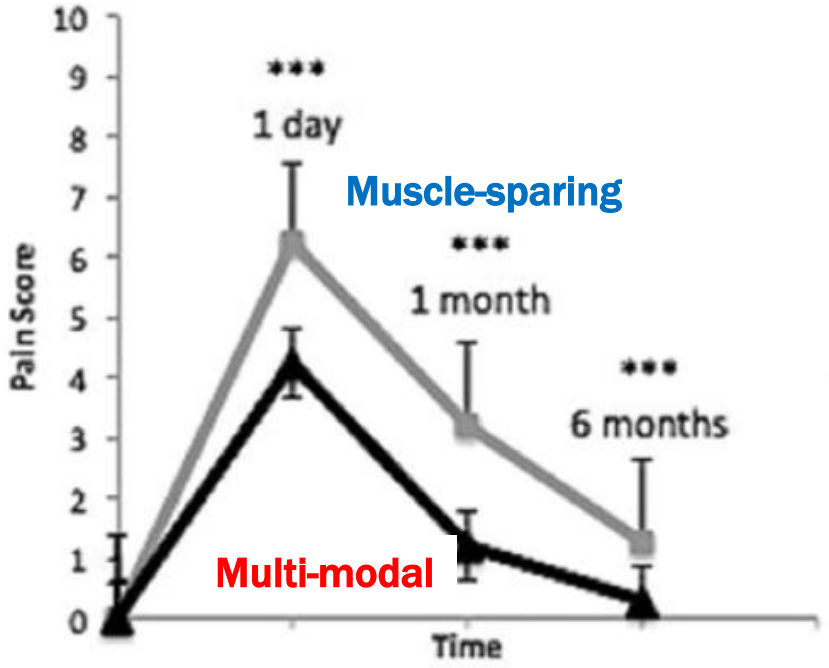


Intercostal muscle flap & Pericostal no-compression suture (n=146)

VS **Muscle-sparing minithoracotomy (n=151)**

Table 2. Postoperative Results

Variable	Muscle-sparing	Multi-modal	*p* Value	95% CI of Difference
Mean operative time ± SD, min	73.7 ± 10.7	78.9 ± 17.0	0.0001	-10.000 to -3.800
Mean hospital stay ± SD, d	4.6 ± 1.3	3.6 ± 1.2	0.0001	0.714-1.260
Mean chest tube permanence ± SD, d	4.3 ± 1.1	3.4 ± 0.9	0.0001	0.622-1.058
Mean postoperative FEV_1 at 1 mo ± SD, % of predicted value	68.8 ± 17.4	83.1 ± 7.4	0.023	-0.331 to -0.027
Mean postoperative FEV_1 at 6 mo ± SD, % of predicted value	72.8 ± 10.5	86.4 ± 12.8	0.013	-0.351 to -0.049
Mean postoperative 6MWT distance at 1 mo ± SD, m	311.1 ± 51.0	371.2 ± 54.8	0.0001	-74.177 to -50.103
Postoperative 6MWT distance at 6 mo ± SD, m	329.9 ± 54.8	395.7 ± 56.4	0.0001	-79.374 to -54.093
Atelectasis, n (%)	35 (23.2)	10 (6.8)	0.008	-0.042 to 0.108
Arrhythmias, n (%)	21 (13.9)	16 (10.9)	0.396	-0.040 to 0.128
Rib fracture occurrence, n (%)	17 (11.3)	14 (9.6)	0.345	-0.038 to 0.138



*** Statistically significant, p=0.001

J Thorac Oncol. 2016;11:1460-8

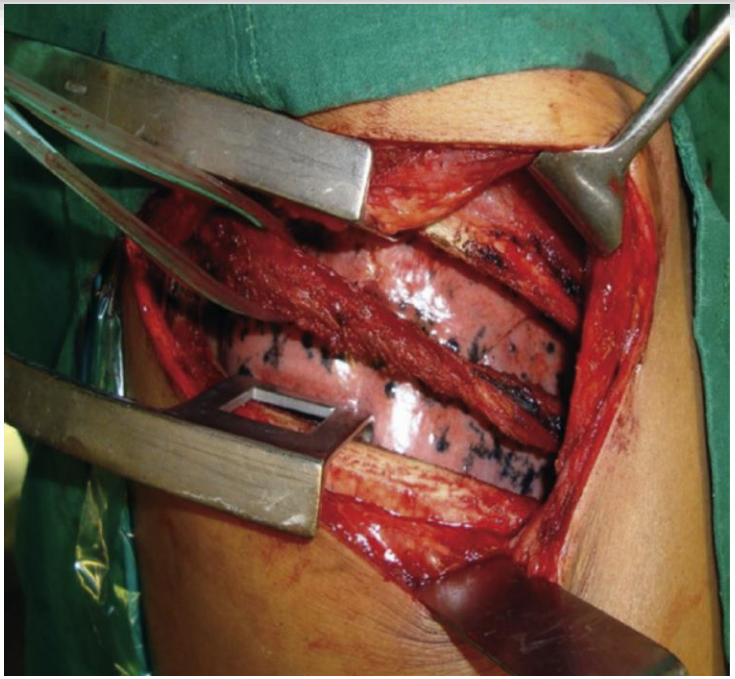
Double blinded RCT

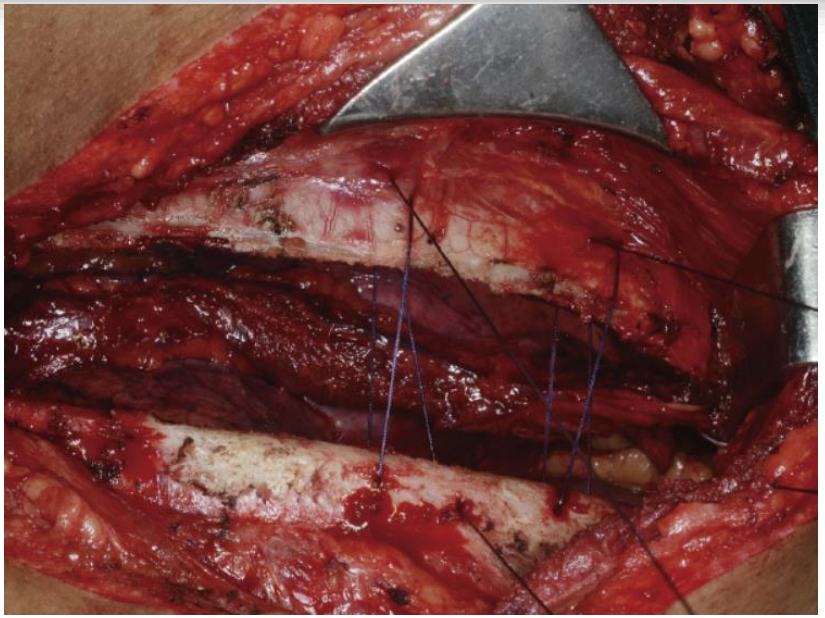
Pain after posterolateral versus nerve-sparing thoracotomy: A randomized trial

Check for updates

J Thorac Cardiovasc Surg. 2019;157:380-6

Sabita Jiwnani, MCh, MRCS,[a] Priya Ranganathan, MD,[b] Vijaya Patil, MD,[b]
Vandana Agarwal, MD, FRCA,[b] George Karimundackal, MCh, MRCS,[a] and C. S. Pramesh, MS, FRCS[a]





Intercostal muscle flap + Intracostal suture (n=45)

VS **PL thoracotomy (n=45)**

J Thorac Cardiovasc Surg. 2019;157:380-6

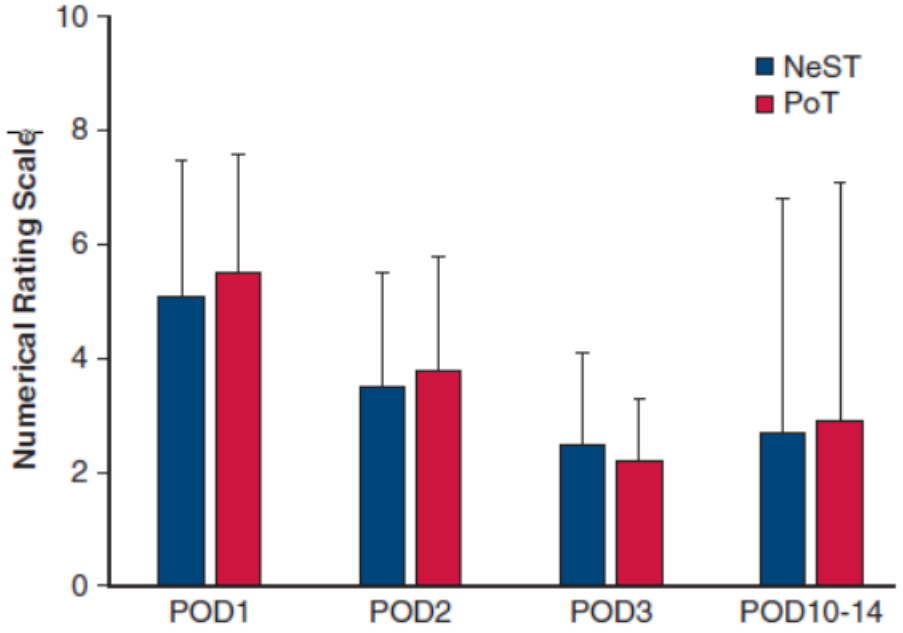


FIGURE 6. Box and whiskers plot of mean maximum pain levels on days

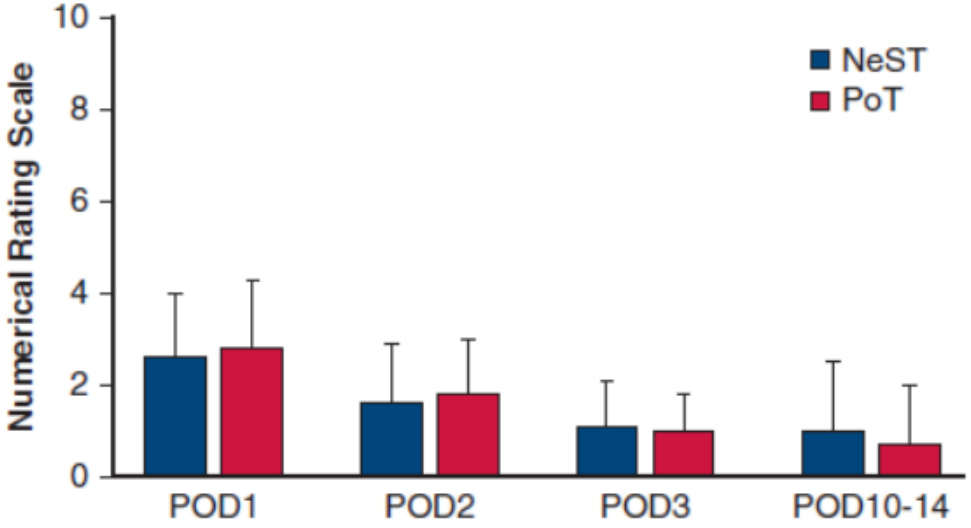
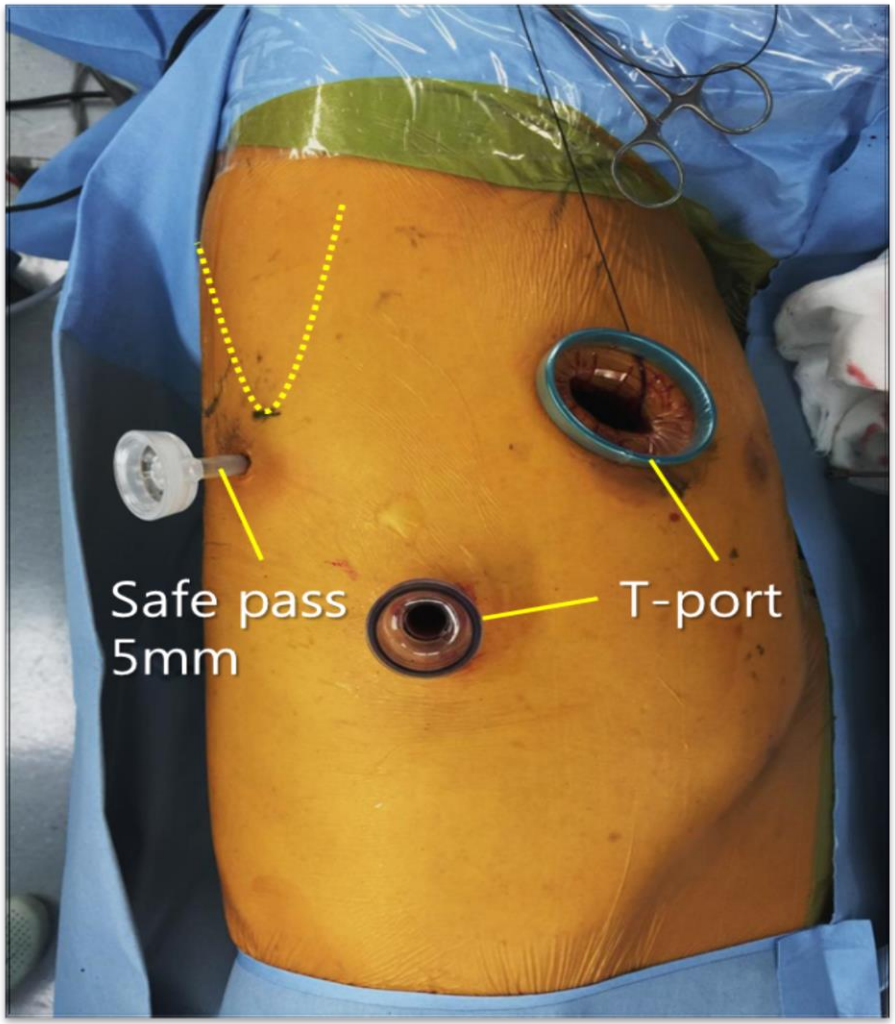
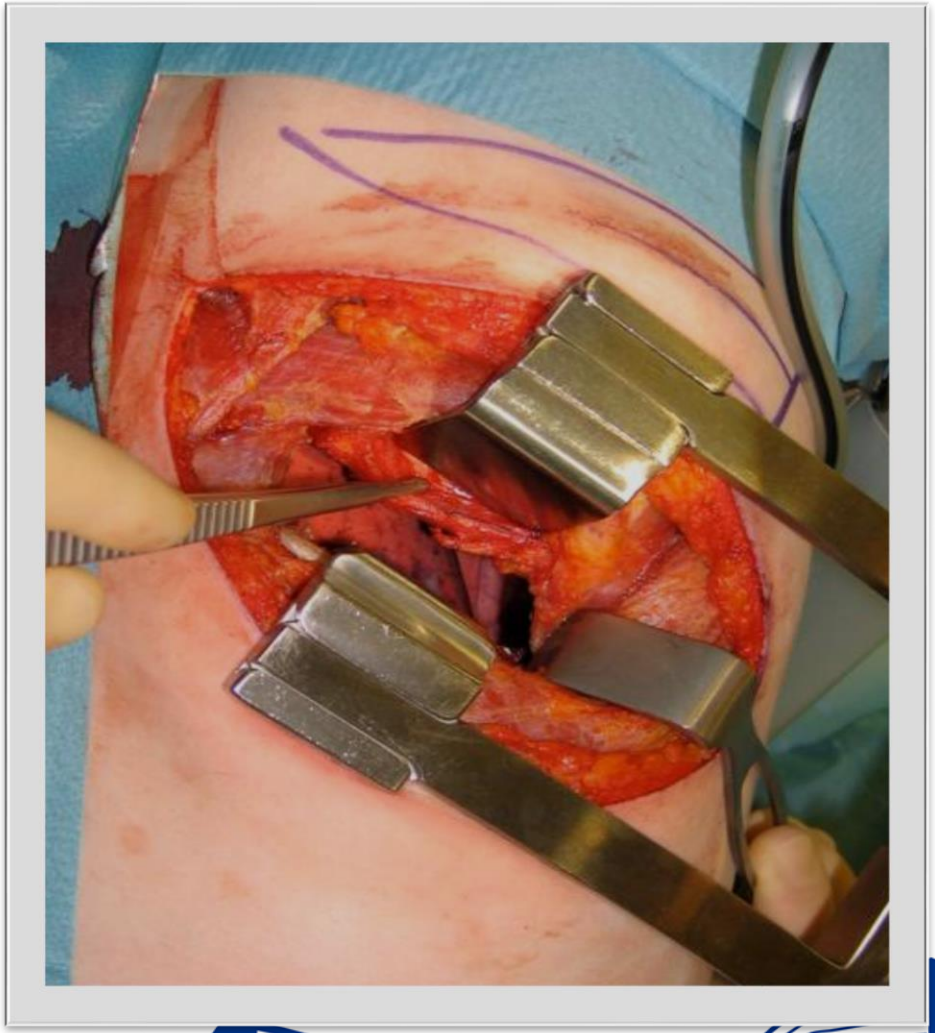


FIGURE 7. Box and whiskers plot of mean average pain levels on days 1,

Nerve-sparing thoracotomy technique does not reduce post-thoracotomy pain.

Video-assisted thoracic surgery (VATS)



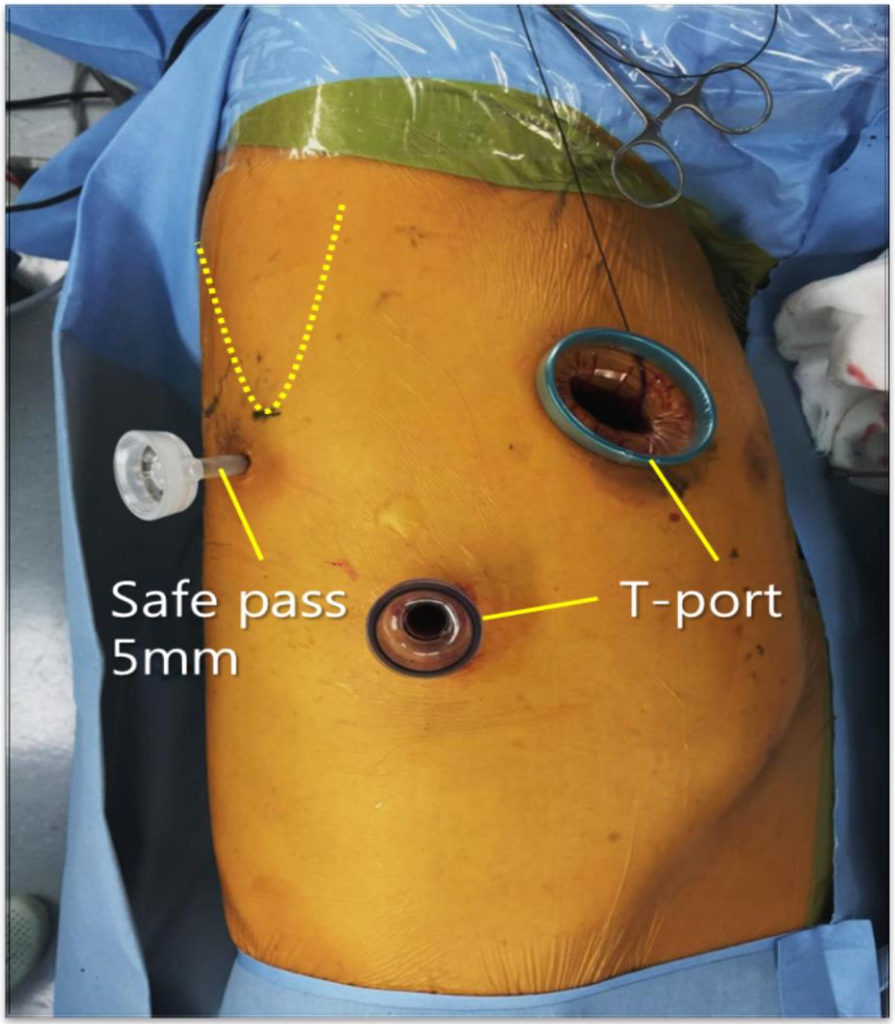


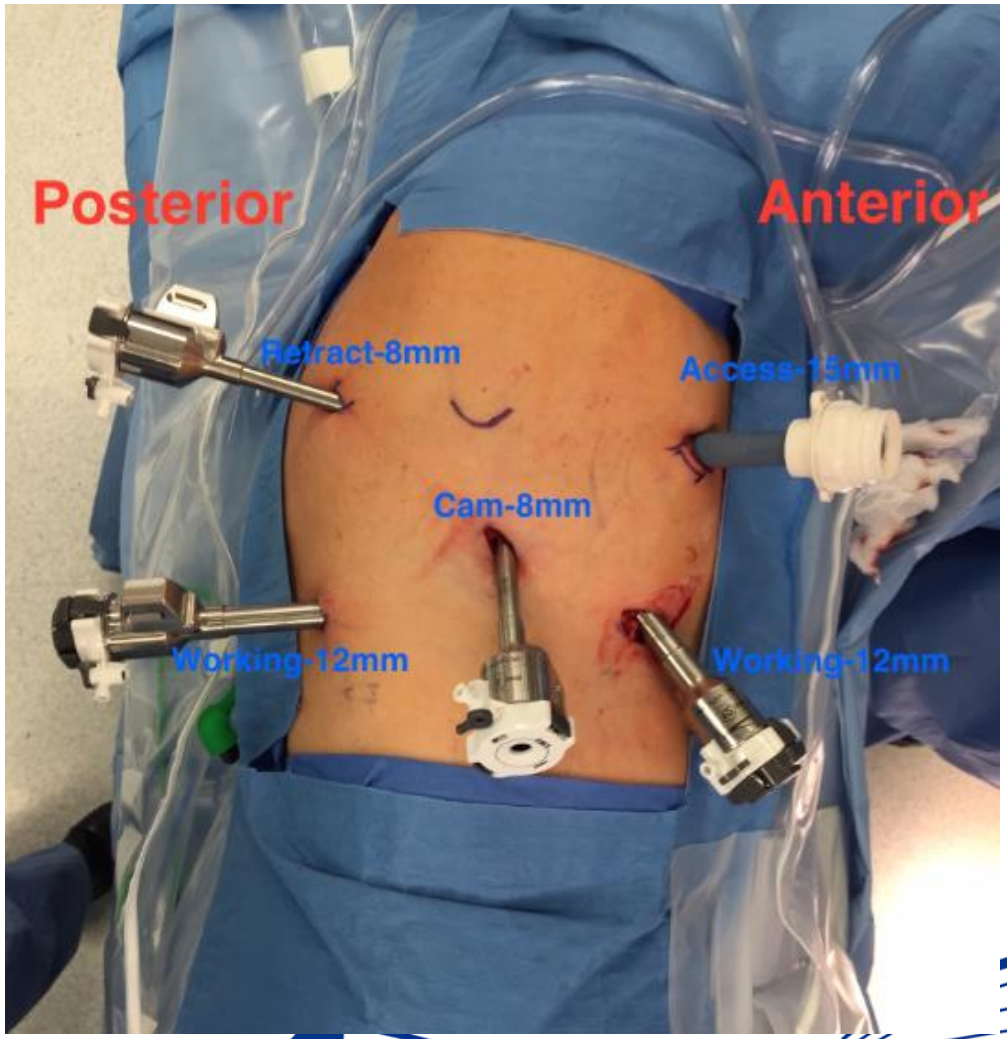
VATS VS Thoracotomy

- Fewer complications — Paul[1]
- Less pain — Nagahiro[2]
- Better quality of life — Handy[3]
- Better PFTs — Nakata[4]
- Less pneumonia — Whitson[5]
- Earlier recovery — Flores[6]
- Easier for octogenarians — Port[7]
- Better compliance with adjuvant chemotherapy — Petersen[8]

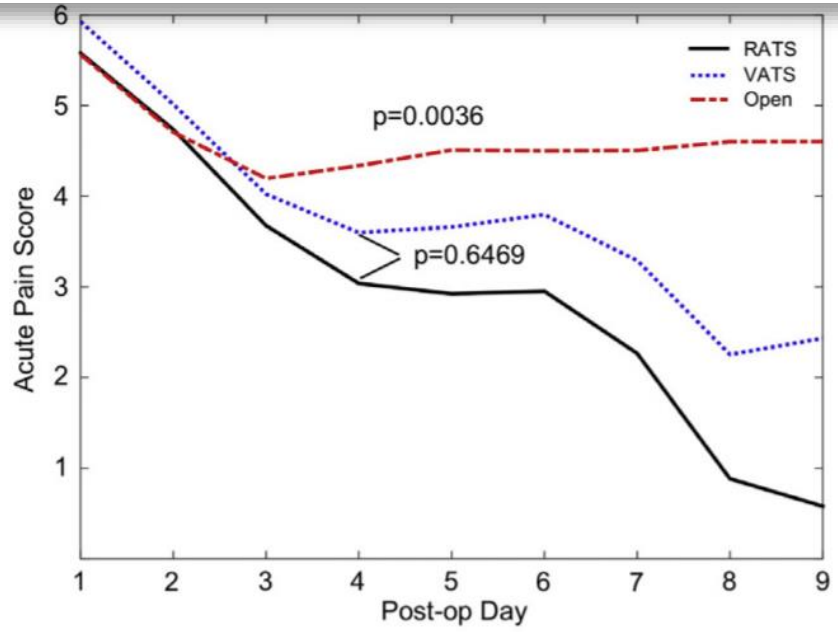
1. *J Thorac Cardiovasc Surg. 2010;139:366-78*
2. *Ann Thorac Surg 2001;72:362-5*
3. *Eur J Cardiothorac Surg 2010 ;37:451-5*
4. *Ann Thorac Surg. 2000;70:938-41*
5. *Ann Thorac Surg. 2007;83:1965-70*
6. *J Thorac Cardiovasc Surg 2009;138:11-8*
7. *Ann Thorac Surg 2011;92:1951-7*
8. *Ann Thorac Surg. 2007;83:1245-9*

VATS VS Robotic





Evaluation of acute and chronic pain outcomes after robotic, video-assisted thoracoscopic surgery, or open anatomic pulmonary resection



J Thorac Cardiovasc Surg 2017;154:652-9

The benefits of RATS lobectomy in terms of acute and chronic pain outcomes is unclear.

	Acute pain score difference between RATS vs VATS		Acute pain score difference between MIS vs open	
	Confidence interval	*P*	Confidence interval	*P*
POD1	−1.0491 to 0.3522	.3294	−0.7768 to 0.2096	.2596
POD2	−0.8575 to 0.3002	.3452	−0.6298 to 0.1624	.2474
POD3	−0.9258 to 0.2341	.2423	−0.1411 to 0.6508	.2070
POD4	−1.3696 to 0.2447	.1719	0.3810 to 1.3176	**.0004**
POD5	−1.6257 to 0.1500	.1033	0.5030 to 1.4892	**<.0001**
POD6	−2.1261 to 0.4178	.1950	0.1855 to 1.5872	**.0132**
POD7	−2.4716 to 0.4178	.1634	0.6688 to 2.2302	**.0003**
POD8	−4.0033 to 1.2640	.3078	1.3177 to 3.9896	**.0001**
POD9	−5.3282 to 1.6299	.2959	0.8405 to 4.2324	**.0034**

Single-incision thoracoscopic surgery (SITS)

Uniportal video-assisted thoracoscopic lobectomy versus other video-assisted thoracoscopic lobectomy techniques: a randomized study

Valerio Perna*, Angel Francisco Carvajal, Juan Antonio Torrecilla and Orlando Gigirey

Eur J Cardiothorac Surg. 2016;50:411-5

Table 3: Primary outcomes: Group A and Group B

	Group A	Group B	*P*-value
Patients, *n*	51	55	
Median VAS in the first 24 h	3	3	0.58
Median VAS on the second day	2	2	0.64
Median VAS on the third day	1	1	0.85
Median morphine use in the first 24 h (mg)	14	11	0.72
Median morphine use on the second day (mg)	8	7	0.81
Median morphine use on the third day (mg)	2	2	0.64

Table 4: Secondary outcomes with interquartile and confidence interval: Group A and Group B

	Group A	Group B	*P*-value
Patients, *n*	51	55	
Median duration of PVC	1 (1, 1)	1 (1, 2)	0.82
Median duration of chest drain (days)	2 (2, 3)	2 (1, 4)	0.65
Median in-hospital stay (days)	3 (2, 5)	3 (2, 5)	0.62
Reoperation	0	1	0.24
Operative or 30-day mortality	0	0	1

SITS lobectomy does not present better postoperative outcomes than VATS lobectomy.

Single-incision thoracoscopic surgery (SITS)

Single-incision thoracoscopic surgery for primary spontaneous pneumothorax using the SILS port compared with conventional three-port surgery

Hee Chul Yang · Sukki Cho · Sanghoon Jheon

Surg Endosc. 2013;27:139-45

SITS (n=27) VS conventional 3-port procedures (n=13)

Single-incision thoracoscopic surgery (SITS)

Table 3 Efficacy of the uniport group compared with the three-port group

Variable	Uniport ($n = 27$)	Three-port ($n = 13$)	p value
Pain score			
Day 0	4.1 ± 1.7	4.8 ± 2.2	0.26
Day 1	3.2 ± 1.4	2.8 ± 1.4	0.33
Day 2	2.7 ± 1.0	2.6 ± 1.1	0.61
IV analgesics	2.8 ± 1.0	3.5 ± 2.5	0.23
Paresthesia: *n* (%)			
Yes	9 (33.3)	10 (76.9)	0.01
No	18 (66.7)	3 (23.1)	
Cosmesis: *n* (%)			
Satisfied	19 (70.4)	4 (30.7)	0.03
Fair	7 (25.9)	5 (38.6)	
Dissatisfied	1 (3.7)	4 (30.7)	
Total surgical material cost (US$)	1,810 ± 320[a]	1,741 ± 329[a]	0.58

Subxiphoid approach

Original research

Subxiphoid vs intercostal single-incision video-assisted thoracoscopic surgery for spontaneous pneumothorax: A randomised controlled trial

Lin Li, Hui Tian*, Weiming Yue, Shuhai Li, Cun Gao, Libo Si

Department of Thoracic Surgery, Qilu Hospital, Shandong University, Jinan, China

Int J Surg. 2016;30:99-103

Table 3
VAS scores of unilateral postoperative pain.

	SUV (n = 16)		IUV (n = 15)	*p*-value
VAS scores				
POD 0	2.0 ± 0.81	<	4.20 ± 0.86	<0.001
POD 1	1.37 ± 0.50		3.0 ± 0.84	<0.001
POD 2	0.56 ± 0.51		1.20 ± 0.67	<0.001
POD 3	0.12 ± 0.34		0.66 ± 0.48	0.001

SUV: Subxiphoid uniport VATS, IUV: Intercostal uniport VATS.

Table 4
VAS scores of bilateral postoperative pain.

	SUV (n = 6)		IUV (n = 6)	*p*-value
VAS scores				
POD 0	3. 0 ± 0.89	<	4.66 ± 0.51	0.003
POD 1	1.66 ± 0.51		3.0 ± 0.63	0.003
POD 2	0.66 ± 0.52		1.50 ± 0.54	0.023
POD 3	0.33 ± 0.51		1.16 ± 0.40	0.011

SUV: Subxiphoid uniport VATS, IUV: Intercostal uniport VATS.

Single-incision subxiphoid approach seemed to be associated with lower postoperative pain.

Chest tube removal

The impact of chest tube removal on pain and pulmonary function after pulmonary resection†

Majed Refai*, Alessandro Brunelli, Michele Salati, Francesco Xiumè, Cecilia Pompili and Armando Sabbatini

Eur J Cardiothorac Surg. 201;41:820-2

Table 2: Comparison of the pre- and post-removal pain and FEV1

Variables	Pre-removal	Post-removal	*P*-value
Static pain	2.6 (2)	1.5 (1.5)	<0.0001
Dynamic pain	4.1 (2.1)	2.4 (1.9)	<0.0001
FEV1 (l/s)	1.5 (0.8)	1.7 (0.9)	0.0004
FEV1%	53 (24.7)	60.2 (30.8)	0.0004

ERAS protocol

Pain Management in an Enhanced Recovery Pathway After Thoracic Surgical Procedures

Reza J. Mehran, MD, Linda W. Martin, MD, MPH, Carla M. Baker, MS, Gabriel E. Mena, MD, and David C. Rice, MD

Departments of Thoracic and Cardiovascular Surgery, and Anesthesia, The University of Texas MD Anderson Cancer Center, Houston, Texas; and Division of Thoracic and Cardiovascular Surgery, University of Virginia School of Medicine, Charlottesville, Virginia

Ann Thorac Surg 2016;102:e595–6

Review Article

Pain management within an enhanced recovery program after thoracic surgery

J Thorac Dis. 2018;10:S3773-S3780

ERAS protocol

ERAS guidelines recommend multimodal pain management strategies.

(I) The use of a variety of analgesic medications to target different mechanisms of action in the peripheral and/or central nervous system;

(II) The use of regional anesthesia;

(III) Avoidance of opioids whenever possible;

(IV) Transitioning to oral medications as soon as possible;

(V) Chest drainage removal as soon as possible.

ERAS protocol

Pre-, intra-operative

- **Detailed written information about operation and perioperative care**
- **Gabapentin 300 mg and tramadol 300 mg orally within 45 min of the induction**
- **Thoracotomy : multilevel posterior intercostal nerve block, before & after incision**
- **Minimally invasive procedures : preemptive injection into intercostal space**

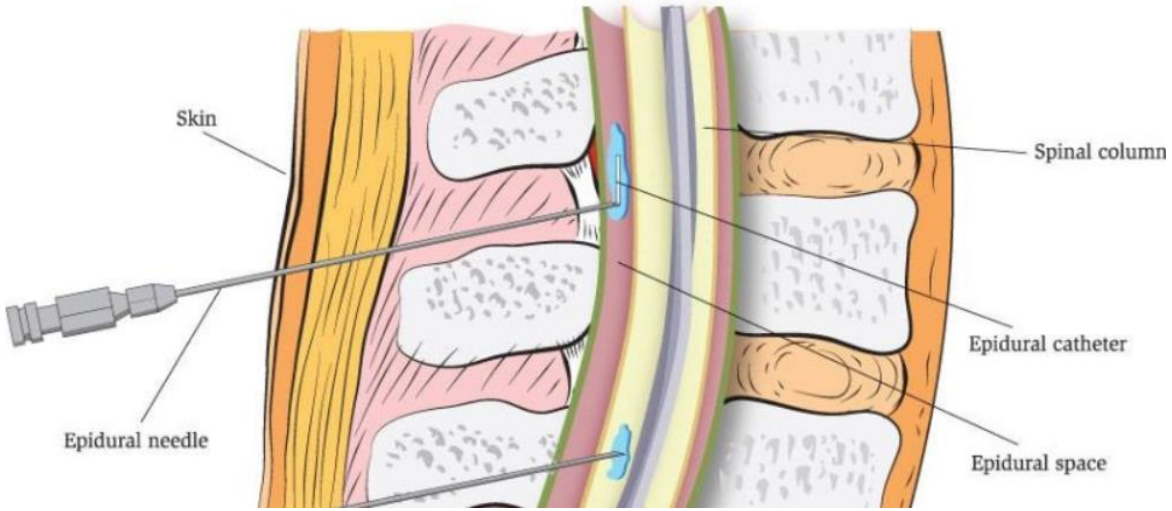
Post-operative

- **Remove chest tube as quickly as possible**
- **Gabapentin 300mg po tid, 30 days**
- **AAP 1000mg qid IVS -> oral AAP**
- **Tramadol 50mg po qid**
- **Prn) Hydromorphone**

Ann Thorac Surg 2016;102:e595–6

Regional analgesia

Thoracic epidural analgesia (TEA)

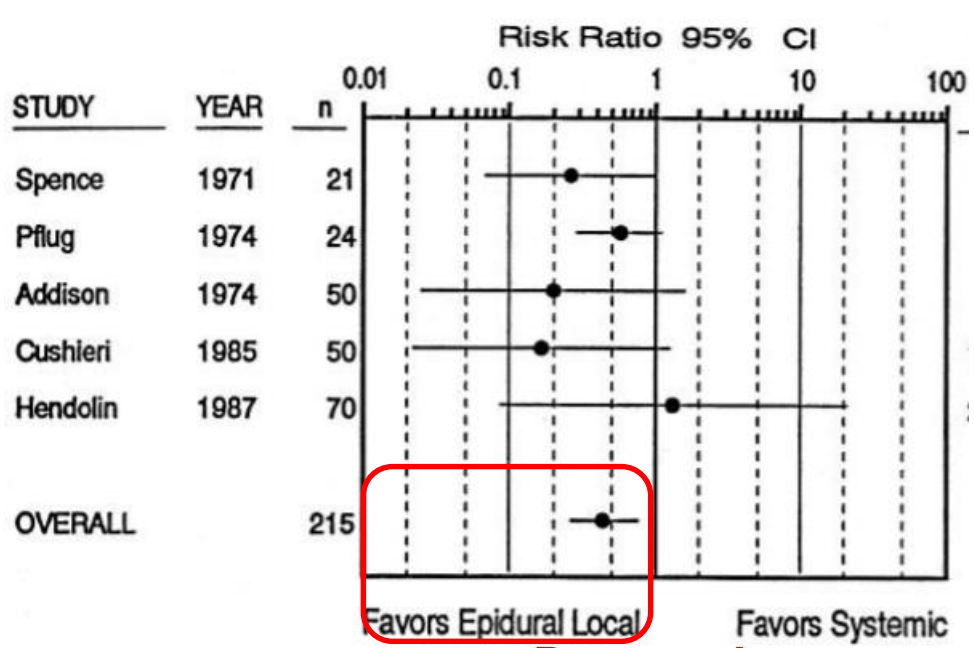


- mid-1970s; for high risk patients,

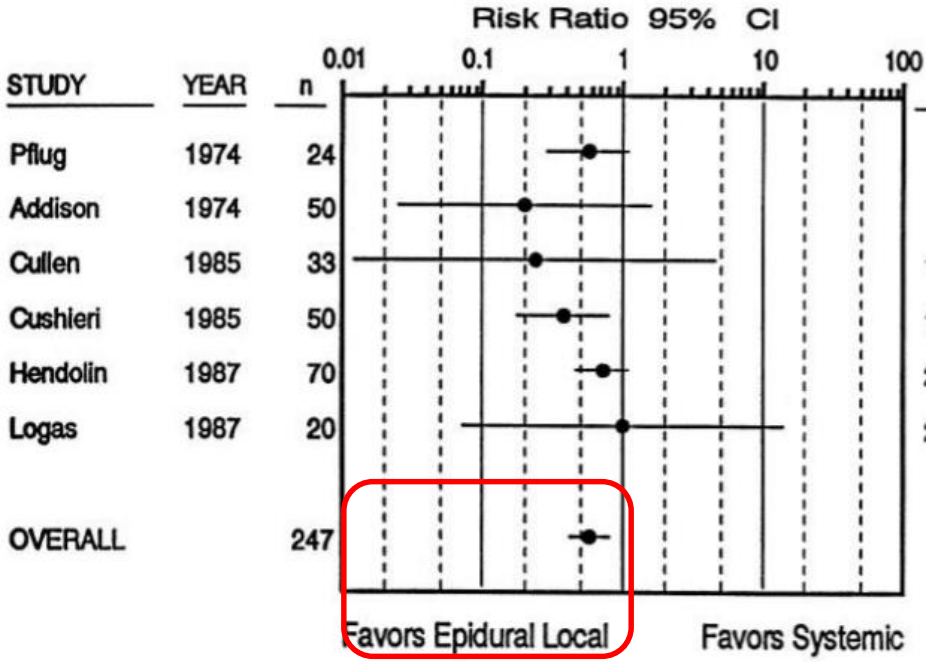
  1990s; mainstay of post-thoracotomy analgesia
- "Gold standard" for post-thoracotomy analgesia, traditionally
- Provide effective, and reliable post-thoracotomy analgesia
- Reduce pulmonary complications, and improve the outcome after thoracic surgery.

The Comparative Effects of Postoperative Analgesic Therapies on Pulmonary Outcome: Cumulative Meta-Analyses of Randomized, Controlled Trials

Anesth Analg 1998;86:598-612



Pneumonia



Pulmonary Cx

- **Postoperative TEA** can significantly decrease the incidence of pulmonary morbidity c/w other local anesthetic methods, and systemic opioid.

Pre-emptive analgesia

- **Pre-emptive analgesia**

; anti-nociceptive treatment started before the noxious stimulus

; to prevent the establishment of altered central processing of sensory input that amplifies postoperative pain

; decrease acute post-operative pain

; inhibit the development of chronic post-operative pain

pre-incisional thoracic epidurals, paravertebral blocks, NMDA antagonists, gabapentin and systemic opioids.

Pre-emptive thoracic epidural analgesia (TEA)

Clinical Study

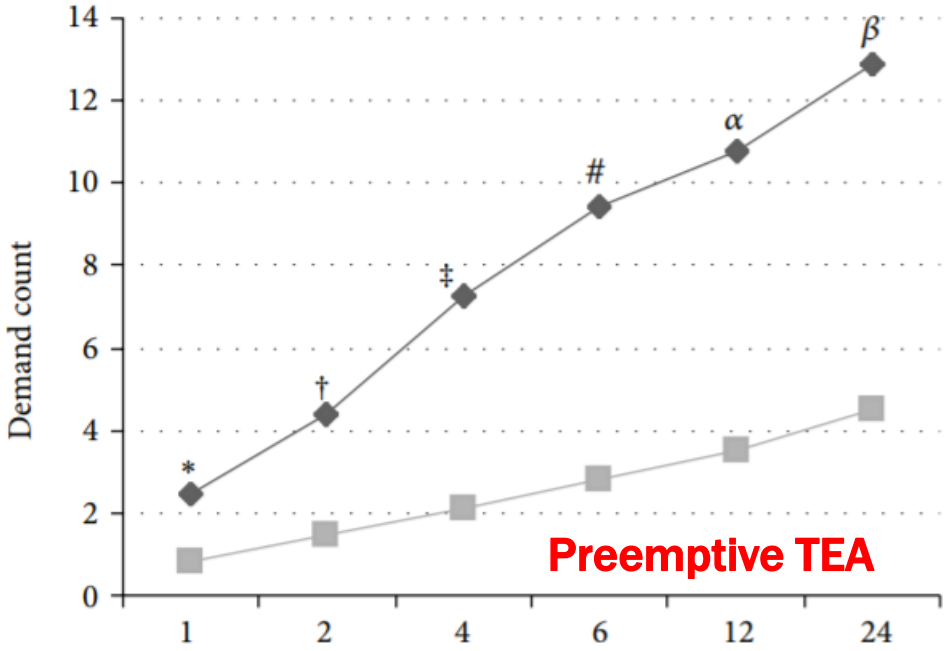
The Effectiveness of Preemptive Thoracic Epidural Analgesia in Thoracic Surgery

Engin Erturk,[1] Ferdane Aydogdu Kaya,[1] Dilek Kutanis,[1] Ahmet Besir,[1] Ali Akdogan,[1] Sükran Geze,[1] and Ersagun Tugcugil[2]

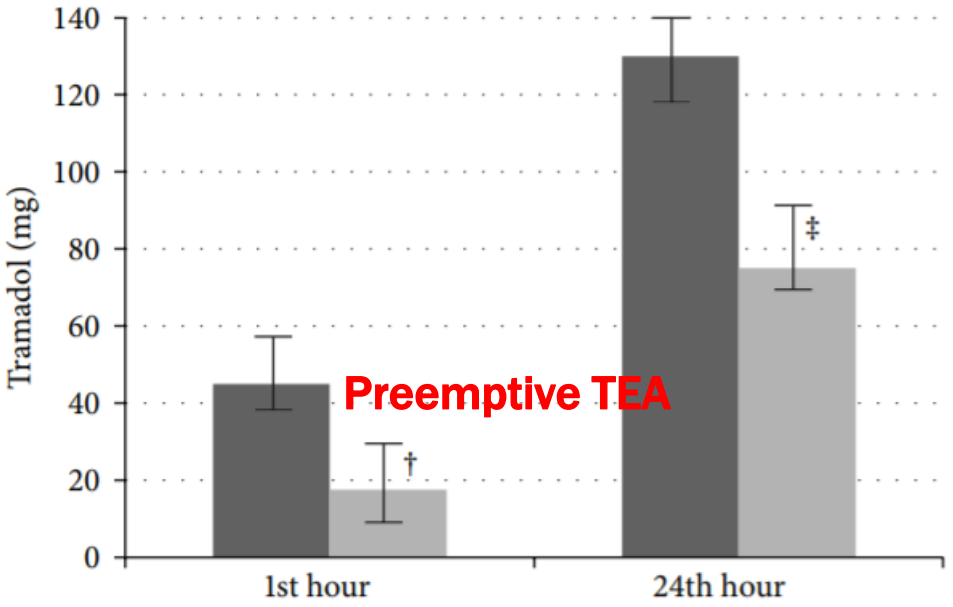
- RCT, Patients who underwent thoracotomy
- Preemptive TEA (n = 22) vs. Postop. TEA only (n = 22)

Biomed Res Int. 2014;673682

Pre-emptive thoracic epidural analgesia (TEA)



Patient's demand count on PCEA



Total analgesic requirement

Biomed Res Int. 2014;673682

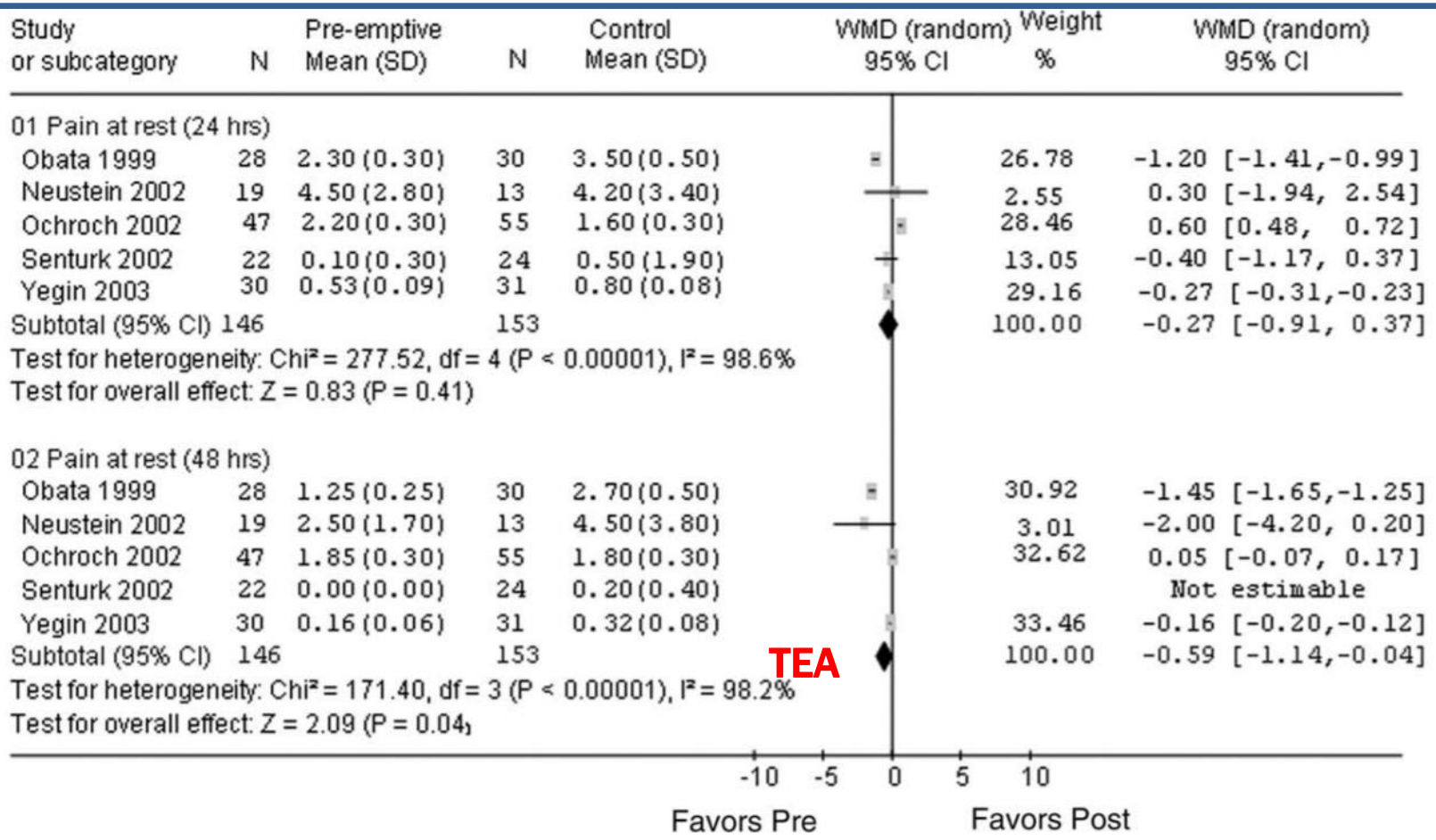
Pre-emptive thoracic epidural analgesia (TEA)

Postop pain score (VAS)

	Group C		Group P	*P* value
Postoperative 1st hour	$4.05 \pm 2.18^{\beta}$	>	1.90 ± 1.21	**0.002**
Postoperative 2nd hour	$3.45 \pm 2.23^{\alpha}$		1.40 ± 0.94	**0.001**
Postoperative 4th hour	$2.60 \pm 1.93^{*}$		1.20 ± 0.83	**0.009**
Postoperative 6th hour	1.45 ± 1.27		1.05 ± 1.63	0.134
Postoperative 12th hour	1.10 ± 1.37		0.50 ± 0.82	0.134
Postoperative 24th hour	0.75 ± 1.02		0.35 ± 0.81	0.192

Biomed Res Int. 2014;673682

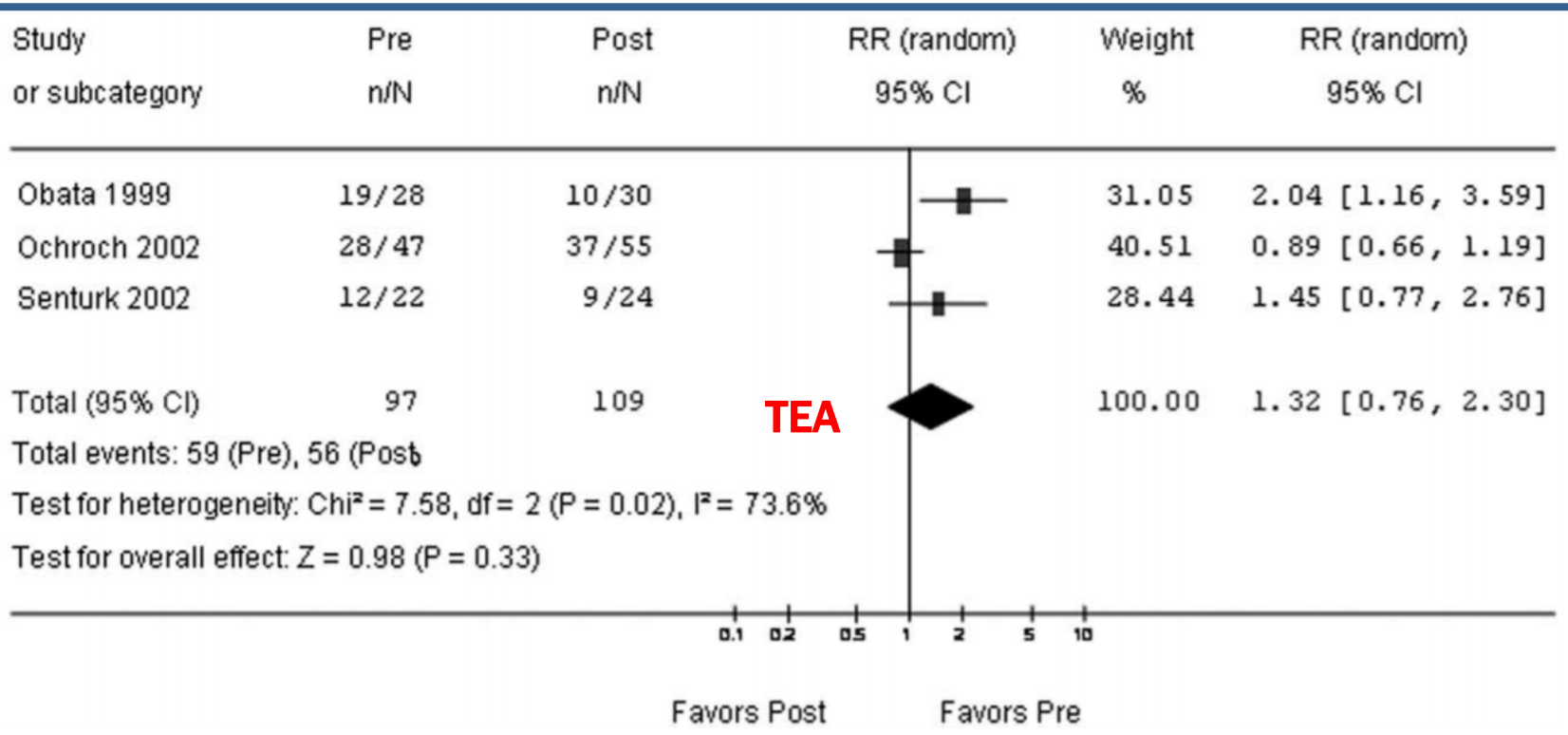
Pre-emptive thoracic epidural analgesia (TEA)



Acute pain

J Cardiothorac Vasc Anesth. 2005;19:786-93

Pre-emptive thoracic epidural analgesia (TEA)



Chronic pain

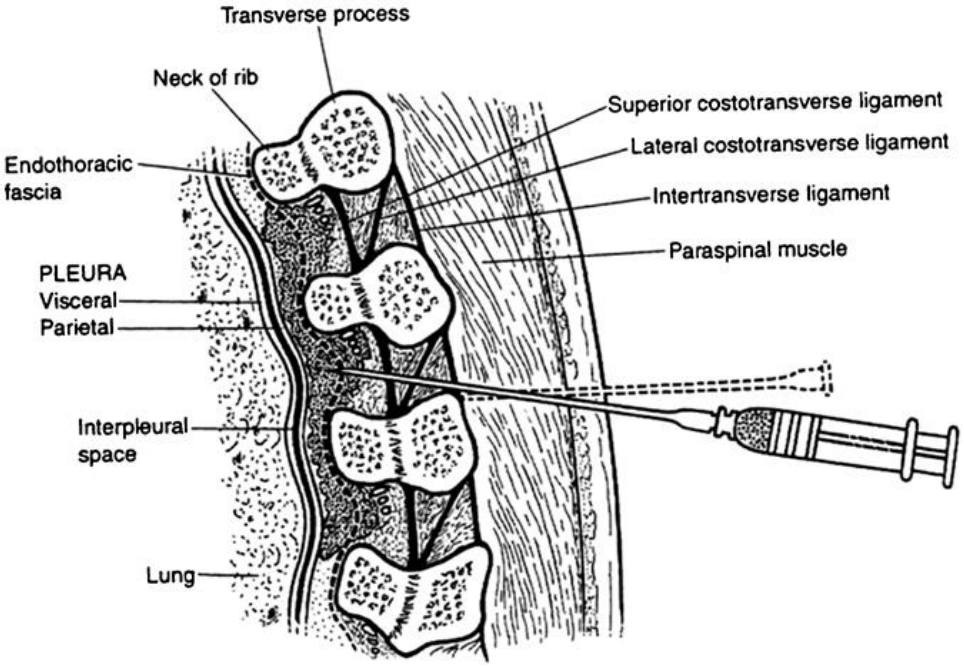
Preemptive TEA appeared to reduce the severity of acute pain but had no effect on the incidence of chronic pain.

J Cardiothorac Vasc Anesth. 2005;19:786-93

TEA: Limitations

- Failure rate ~ 15%
- Major complication ~0.02%
  - Respiratory depression
  - Epidural hematoma; anticoagulants – contra indication
  - Epidural abscess
  - Urinary retention: m/c complication

Paravertebral blocks



Percutaneous

Intraoperative

Paravertebral blocks

- Continuous thoracic paravertebral blocks > single bolus
- Rates of failed block were lower
- Provide comparable pain relief
- Better side-effect profile (hypotension, urinary retention, nausea, vomiting)
- Reduction in pulmonary complications
- Cost ?

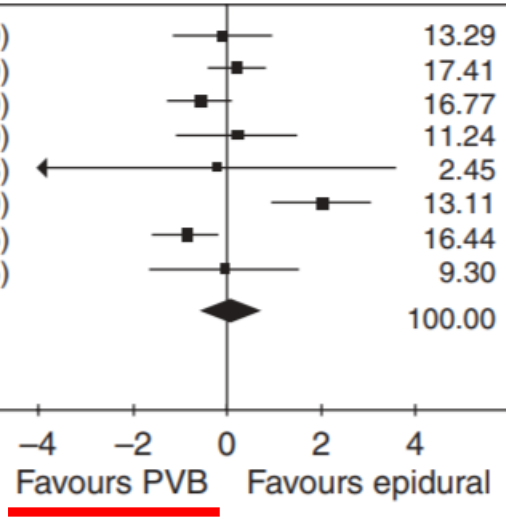
REVIEW ARTICLE

A comparison of the analgesic efficacy and side-effects of paravertebral *vs* epidural blockade for thoracotomy—a systematic review and meta-analysis of randomized trials

Br J Anaesth 2006;96: 418–26

Study or sub-category	PVB N	PVB mean (SD)	Epidural N	Epidural mean (SD)	WMD (random) 95% CI	Weight %	WMD (random) 95% CI
De Cosmo *et al.*[8]	25	3.60 (1.00)	25	3.70 (2.50)		13.29	–0.10 (–1.16, 0.96)
Luketich *et al.*[28]	47	2.60 (1.50)	44	2.40 (1.50)		17.41	0.20 (–0.42, 0.82)
Mathews *et al.*[30]	7	0.60 (0.60)	9	1.20 (0.80)		16.77	–0.60 (–1.29, 0.09)
Perttunen *et al.*[35]	15	7.00 (1.60)	15	6.80 (2.00)		11.24	0.20 (–1.10, 1.50)
Kaiser *et al.*[17]	13	4.00 (5.28)	13	4.25 (4.73)		2.45	–0.25 (–4.10, 3.60)
Bimston *et al.*[3]	30	3.30 (1.90)	20	1.30 (1.90)		13.11	2.00 (0.92, 3.08)
Richardson *et al.*[38]	46	1.50 (1.50)	49	2.38 (2.06)		16.44	–0.88 (–1.60, –0.16)
Leaver *et al.*[24]	14	4.07 (1.82)	15	4.13 (2.45)		9.30	–0.06 (–1.62, 1.50)
Total (95% CI)	197		190			100.00	0.05 (–0.59, 0.69)

Test for heterogeneity: χ^2=22.29, df=6 (P=0.002), I^2=68.6%
Test for overall effect: Z=0.15 (P=0.88)



Comparable pain profile

Study or sub-category	PVB n/N	Epidural n/N	OR (fixed) 95% CI	Weight %	OR (fixed) 95% CI
Kaiser *et al.*[11]	0/13	2/13		15.46	0.17 (0.01, 3.92)
Bimston *et al.*[3]	4/30	3/20		20.01	0.87 (0.17, 4.39)
Richardson *et al.*[38]	1/46	8/49		48.61	0.11 (0.01, 0.95)
Leaver *et al.*[24]	2/14	3/15		15.92	0.67 (0.09, 4.73)
Total (95% CI)	103	97		100.00	0.36 (0.14, 0.92)

Total events: 7 (PVB), 16 (Epidural)
Test for heterogeneity: χ^2=2.87, df=3 (P=0.41), I^2=0%
Test for overall effect: Z=2.13 (P=0.03)

0.01 0.1 1 10 100
Favours PVB Favours epidural

Pulmonary Cx.

Study or sub-category	PVB n/N	Epidural n/N	OR (fixed) 95% CI	Weight %	OR (fixed) 95% CI
Mathews *et al.*[30]	1/10	6/9		21.54	0.06 (0.00, 0.67)
Bimston *et al.*[3]	0/30	6/20		28.89	0.04 (0.00, 0.69)
Richardson *et al.*[38]	5/46	11/49		35.98	0.42 (0.13, 1.32)
Leaver *et al.*[24]	10/14	13/15		13.59	0.38 (0.06, 2.54)
Total (95% CI)	100	93		100.00	0.23 (0.10, 0.51)

Total events: 16 (PVB), 36 (Epidural)
Test for heterogeneity: χ^2=4.13, df=3 (P=0.25), I^2=27.4%
Test for overall effect: Z=3.54 (P=0.0004)

0.01 0.1 1 10 100
Favours PVB Favours epidural

Urinary retention

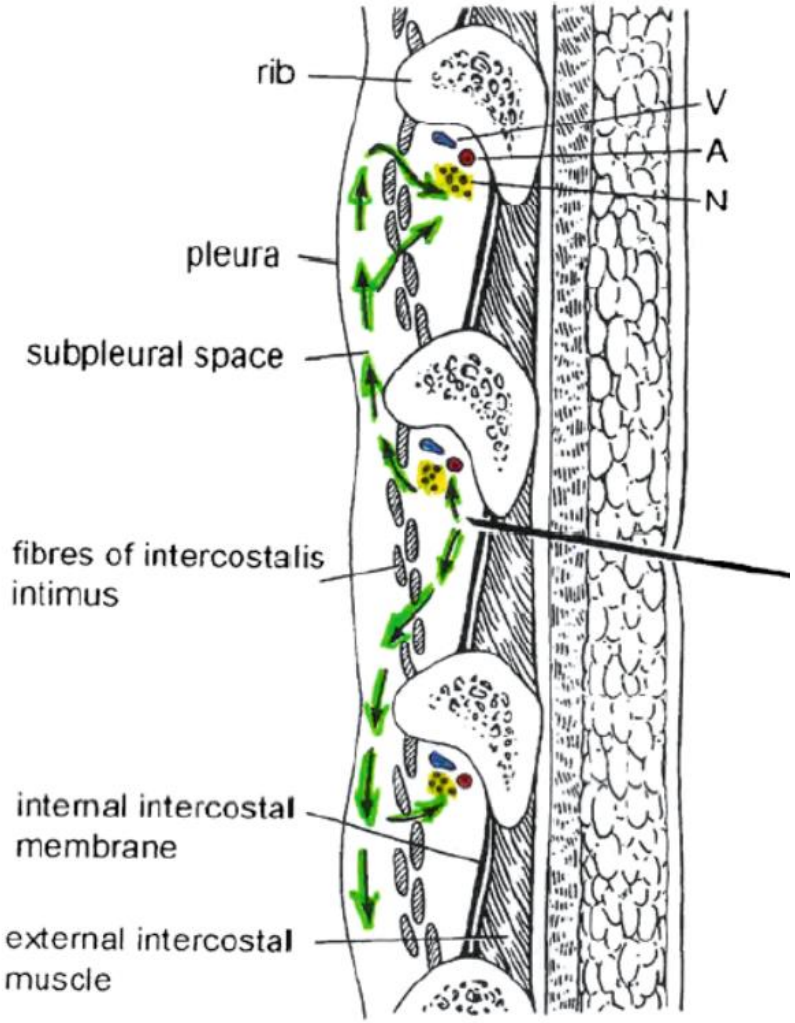
Study or sub-category	PVB n/N	Epidural n/N	OR (fixed) 95% CI	Weight %	OR (fixed) 95% CI
De Cosmo *et al.*[8]	0/25	3/25		13.02	0.13 (0.01, 2.58)
Mathews *et al.*[30]	0/10	6/9		24.65	0.03 (0.00, 0.58)
Bimston *et al.*[3]	1/30	1/20		4.40	0.66 (0.04, 11.12)
Richardson*et al.*[38]	0/46	7/49		27.27	0.06 (0.00, 1.10)
Dhole *et al.*[10]	0/20	1/20		5.55	0.32 (0.01, 0.26)
Leaver *et al.*[24]	2/14	8/15		25.11	0.15 (0.02, 0.89)
Total (95% CI)	145	138		100.00	0.12 (0.04, 0.34)

Total events: 3 (PVB), 26 (Epidural)
Test for heterogeneity: χ^2=2.90, df=5 (P=0.72), I^2=0%
Test for overall effect: Z = 4.01 (P<0.0001)

0.01 0.1 1 10 100
Favours PVB Favours epidural

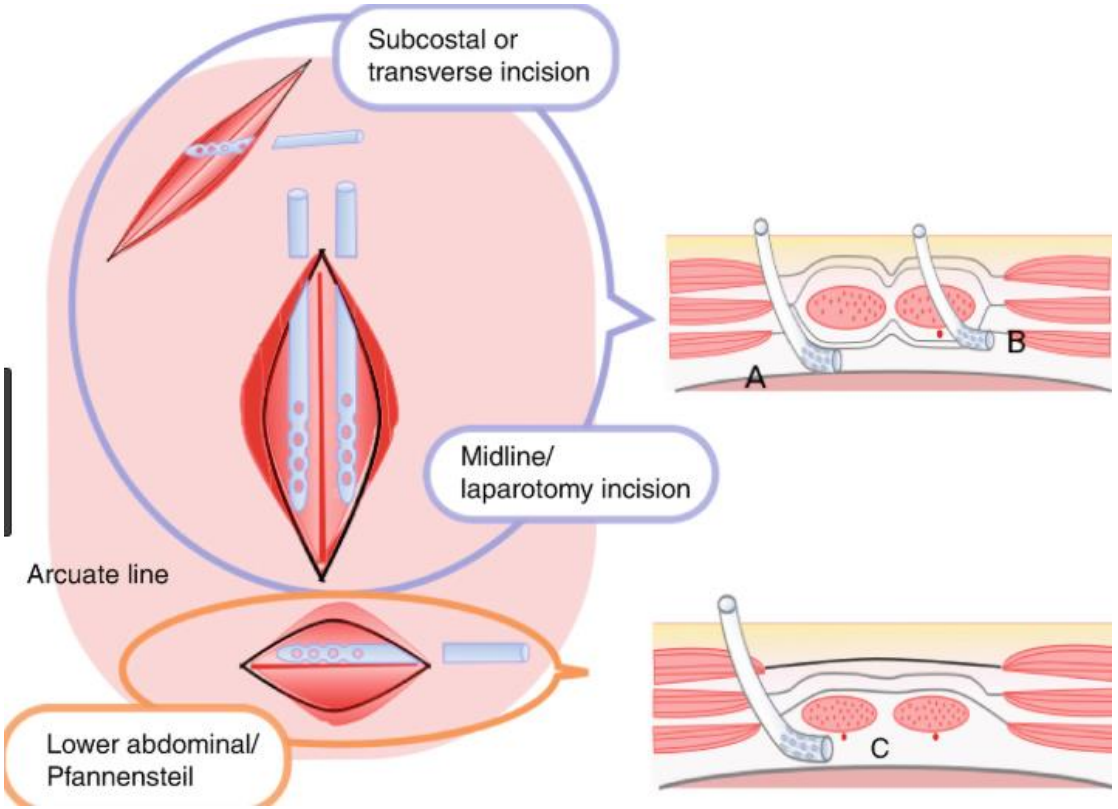
Hypotension

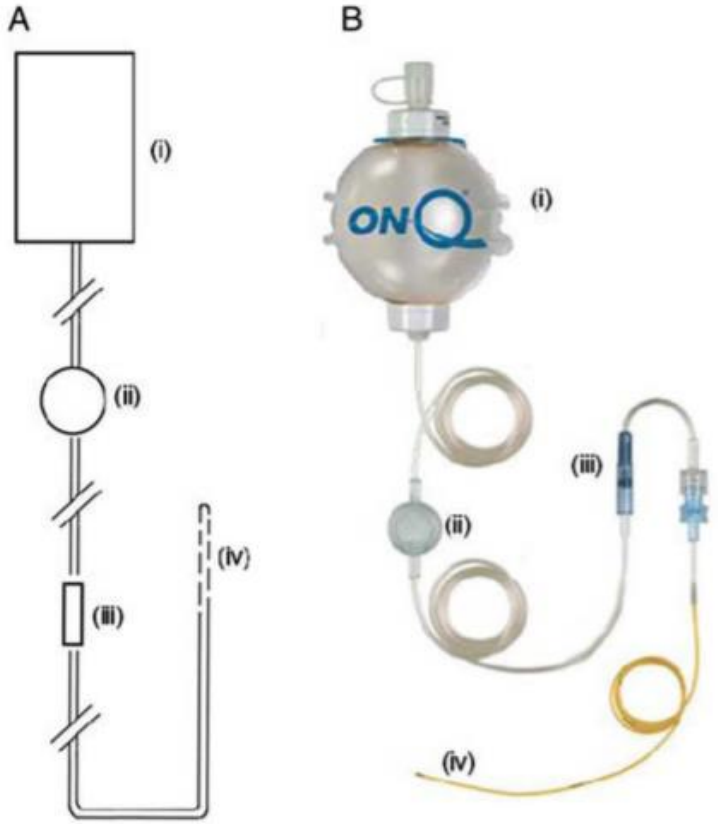
Intercostal nerve blocks



- Pre-emptive > Postop injection
- Short half-life
- Repeated percutaneous blocks are usually required.

Continuous wound infiltration





Transcutaneous electrical nerve stimulation (TENS)

- Non invasive, electroanalgesia
- Modulation of nociceptive input signals via peripheral stimulation
- Release of endogenous opioids

Transcutaneous electrical nerve stimulation (TENS)

Transcutaneous electrical nerve stimulation after thoracic surgery: systematic review and meta-analysis of randomized trials

Rev Bras Cir Cardiovasc 2012;27):75-87

Best evidence topic - Thoracic non-oncologic

Is transcutaneous electrical nerve stimulation effective in relieving postoperative pain after thoracotomy?

Anne Freynet[a], Pierre-Emmanuel Falcoz[b,*]

Interact Cardiovasc Thorac Surg. 2010;10:283-8

Systemic multimodal analgesia

- Regional analgesia; may not be sufficient.
- Circulating humoral inflammatory factors induce central sensitization and neuropathic pain.
- Maximize pain relief and minimize side effects.

Systemic multimodal analgesia

- **Systemic opioid** (IV PCA)

  sedation, suppression of ventilation, coughing and sighing

- **Nonsteroidal anti-inflammatory drugs (NSAIDs)**

  reduces opioid requirement, opioid-related side effects

- **COX-2 inhibitor** (Celecoxib)
- **Acetaminophen** (PO or IV)
- **Gabapentinoids** (Gabapentin/Pregabalin)

  reduce neurotransmitter release associated with neural sensitization

  multiple neuropathic pain conditions

- **NMDA Antagonists** (Ketamine)

Take home message

- **Thoracotomy induces severe postoperative pain, which can cause respiratory complications, such as hypoxia, atelectasis, and pulmonary infections.**
- **Appropriate analgesia is important both for humanitarian reasons and to allow early mobilization and pulmonary rehabilitation.**
- **Pain after thoracic surgery is generated from multiple structures and is transmitted via a number of afferent pathways.**

Take home message

- **Various procedures** have been introduced to reduce postoperative pain.
- **Less invasive surgery** should be considered to reduce postoperative pain.
- **Pre-emptive analgesia** to prevent the establishment of altered central processing of sensory input that amplifies postoperative pain.
- **Multidisciplinary management** of thoracotomy pain incorporating surgical, anesthetic, and analgesic techniques is mandatory.

Thank you for your attention !!