

AVANOS

CLINICAL COMPENDIUM

LOCAL ANESTHETIC DELIVERY MODE:
INTERMITTENT BOLUS VS CONTINUOUS
PERIPHERAL NERVE BLOCK

ON-Q^{*}
PAIN RELIEF SYSTEM

STUDIES

1 Effective analgesia with ultrasound-guided interscalene brachial plexus block for postoperative pain control after arthroscopic rotator cuff repair

2 Infusion methods for continuous interscalene brachial plexus block for postoperative pain control after arthroscopic rotator cuff repair

3 Patient-initiated mandatory boluses for ambulatory continuous interscalene analgesia: an effective strategy for optimizing analgesia and minimizing side-effects

4 Ultrasound-guided continuous Interscalene block: the influence of local anesthetic background delivery method on postoperative analgesia after shoulder surgery: a randomized trial

5 Continuous suprascapular nerve block with a perineural catheter for reverse shoulder arthroplasty rescue analgesia in a patient with severe chronic obstructive pulmonary disease

6 A randomized prospective study of analgesic quality after thoracotomy: paravertebral block with bolus versus continuous infusion with an elastomeric pump

7 Continuous transversus abdominis plane nerve blocks: does varying local anesthetic delivery method - automatic repeated bolus versus continuous basal infusion - influence the extent of sensation to cold: a randomized, triple-masked, crossover study in volunteers

8 Randomised comparison of three types of continuous anterior abdominal wall block after mid-line laparotomy for gynecological oncology surgery

9 Continuous adductor canal blocks: does varying local anesthetic delivery method (automatic repeated bolus doses versus continuous basal infusion) influence cutaneous analgesia and quadriceps femoris strength? a randomized, double-masked, controlled, split-body volunteer study

10 Post-operative analgesia using intermittent vs. continuous adductor canal block technique: a randomized controlled trial

11 The efficacy comparison of on-demand boluses with and without basal infusion of 0.1 % bupivacaine via perineural femoral catheter after arthroscopic ACL reconstruction

12 Patient controlled analgesia reduces the consumption of bupivacaine in femoral nerve block for the treatment of postoperative pain after reconstruction of anterior cruciate ligament of the knee

13 Continuous femoral nerve blocks: varying local anesthetic delivery method (bolus versus basal) to minimize quadriceps motor block while maintaining sensory block

14 Intermittent versus continuous sciatic block combined with femoral block for patients undergoing knee arthroplasty. A randomized controlled trial

15 A "new" automated bolus technique for continuous popliteal block: a prospective, randomized comparison with a continuous infusion technique

16 Comparison of continuous infusion versus automated bolus for postoperative patient-controlled analgesia with popliteal sciatic nerve catheters

17 Programmed intermittent peripheral nerve local anesthetic bolus compared with continuous infusions for post-operative analgesia: a systematic review and meta-analysis

Summary

#	STUDY/AUTHOR	SURGICAL PROCEDURE	CATHETER LOCATION	DRUG	TREATMENT GROUPS					PRIMARY FINDINGS	AUTHOR'S CONCLUSION
					N	BASAL (ML/HR)	AUTOMATED BOLUS (ML)	ON-DEMAND BOLUS (ML)	LOCKOUT (MIN)		
1	Effective analgesia with ultrasound-guided interscalene brachial plexus block for postoperative pain control after arthroscopic rotator cuff repair Shin S.W., et al J Anes. 2014; 28:64-69 https://pubmed.ncbi.nlm.nih.gov/23903900	Arthroscopic Rotator Cuff Repair	Interscalene <ul style="list-style-type: none"> • Ultrasound, in-plane • Nonstimulating needle • Nonstimulating catheter 	Ropivacaine 0.2%	33	4	N/A	0	N/A	No differences between the basal and bolus treatment groups. Ropivacaine groups had lower pain scores and consumed less supplemental analgesics than the control group.	POSITIVE - For CPNB and Bolus delivery compared to IV-PCA.
					33	0	N/A	4	60		
					33	N/A	N/A	N/A	N/A		
2	Infusion methods for continuous interscalene brachial plexus block for postoperative pain control after arthroscopic rotator cuff repair Byeon G.J., et al Korean J Pain. 2015; 28:210-216 https://pubmed.ncbi.nlm.nih.gov/26175882	Arthroscopic Rotator Cuff Repair	Interscalene <ul style="list-style-type: none"> • Ultrasound, in-plane • Stimulating needle • Stimulating catheter 	Ropivacaine 0.2%	32	4	N/A	4	60	Total consumed dose of local anesthetic was significantly lower in the Bolus group compared to the CPNB group. No other differences between the basal and the bolus treatment groups.	POSITIVE - Bolus delivery may exert similar post-op analgesic effect and result in less motor weakness compared to CPNB.
					32	0	N/A	4	30		
3	Patient-initiated mandatory boluses for ambulatory continuous interscalene analgesia: an effective strategy for optimizing analgesia and minimizing side-effects Fredrickson M.J., et al British J of Anaes. 2010; 1-7 https://pubmed.ncbi.nlm.nih.gov/21112881	Arthroscopic or Open Rotator Cuff Repair	Interscalene <ul style="list-style-type: none"> • Ultrasound, out-of-plane • Nonstimulating needle • Nonstimulating catheter 	Ropivacaine 0.2%	38	2	N/A	5mL bolus every 6 hr	60	Analgesia was similar between groups. Patients who received the higher basal rate experienced more side effects.	NEUTRAL - The lower infusion regimen was associated with less side effects and has the additional advantage of longer infusion duration for a given reservoir volume.
					43	5	5mL bolus every 6 hr	5mL bolus every 6 hr	60		
4	Ultrasound-guided continuous Interscalene block: the influence of local anesthetic background delivery method on postoperative analgesia after shoulder surgery: a randomized trial Hamdani, M., et al RAPM. 2014; 39 387-393 https://pubmed.ncbi.nlm.nih.gov/24942849	Major Shoulder Surgery	Interscalene <ul style="list-style-type: none"> • Ultrasound, out-of-plane • Stimulating needle • Nonstimulating catheter 	Ropivacaine 0.2%	50	4	N/A	5	30	No differences detected between groups.	NEUTRAL - Optimal positioning of the catheter tip may play a more important role than the mode of local anesthetic administration.
					51	0	4mL bolus every 1 hr	5	30		

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5	Continuous suprascapular nerve block with a perineural catheter for reverse shoulder arthroplasty rescue analgesia in a patient with severe chronic obstructive pulmonary disease Careskey, M. & Naidu, R. A&A 2016; 7(2) 37-40 https://pubmed.ncbi.nlm.nih.gov/27258178	Humeral Fx Repair with Reverse Shoulder Arthroplasty	Suprascapular <ul style="list-style-type: none"> • Ultrasound, in-plane • Nonstimulating needle • Nonstimulating catheter 	Ropivacaine 0.2%	1	N/A	4	N/A	60	Analgesia was achieved and maintained during infusion.	POSITIVE – Analgesia was achieved for the duration of therapy.
6	A randomized prospective study of analgesic quality after thoracotomy: paravertebral block with bolus versus continuous infusion with an elastomeric pump Fibla, J., et al Eur J Cardiothac Surg 2015; 47(4) 631-5 https://pubmed.ncbi.nlm.nih.gov/24966147	Thoracotomy	Paravertebral <ul style="list-style-type: none"> • Surgeon placed under direct visualization • Nonstimulating catheter 	Bupivacaine 0.5%	40	0	15mL bolus every 6 hr	N/A	N/A	No differences between groups. Pain scores were statistically significantly lower in bolus group only at 48 and 72 hours. Higher total volume of local anesthetic consumed by the basal group.	NEUTRAL – Both modes of delivery were safe and effective.
				Bupivacaine 0.25%	40	5	0	0	N/A		
7	Continuous transversus abdominis plane nerve blocks: does varying local anesthetic delivery method automatic repeated bolus versus continuous basal infusion – influence the extent of sensation to cold: a randomized, triple-masked, crossover study in volunteers Khatibi, B., et al Anesthesia & Analgesia 2017; 124(4) 1298-303 https://pubmed.ncbi.nlm.nih.gov/28319550	Bilateral TAP Catheters	CTAP <ul style="list-style-type: none"> • Ultrasound, in-plane • Nonstimulating needle • Nonstimulating catheter 	Ropivacaine 0.2%	12	8	N/A	N/A	N/A	No difference between groups. Primary endpoint was extent of sensory deficit at 6 hours post initial injection.	NEUTRAL
					12	N/A	24mL bolus every 3 hr	N/A	N/A		
8	Randomised comparison of three types of continuous anterior abdominal wall block after mid-line laparotomy for gynecological oncology surgery Cowlshaw P.J., et al Anesthesia Intensive Care 2017 Jul; 45(4) 453-458 https://pubmed.ncbi.nlm.nih.gov/28673214	Mid-line laparotomy for GYN ONC	Abdominal Wall Infusion <ul style="list-style-type: none"> • Ultrasound (TAP) (PRS as needed) • Direct visualization (SQ) • Nonstimulating needle • Nonstimulating catheter 	Ropivacaine 0.5%	29 subcutaneous delivery (SQ)	N/A	18ml bolus every 4 hr	N/A	N/A	Programmed intermittent boluses of ropivacaine can be provided safely to patients undergoing mid-line laparotomy surgery. Initially TAP catheters appear superior, reducing early opioid and antiemetic requirements, and severe pain.	NEUTRAL – No differences in morphine consumption were noted between groups.
					29 posterior rectus sheath delivery (PRS)	N/A	18ml bolus every 4 hr	N/A	N/A		
					30 - TAP delivery	N/A	18ml bolus every 4 hr	N/A	N/A		

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9	Continuous adductor canal blocks: does varying local anesthetic delivery method (automatic repeated bolus doses versus continuous basal infusion) influence cutaneous analgesia and quadriceps femoris strength? a randomized, double-masked, controlled, split-body volunteer study Monahan, A.M., et al A&A 2016; 122(5) 1681-88 https://pubmed.ncbi.nlm.nih.gov/26863502	Adductor Perineural Catheter	Adductor Canal <ul style="list-style-type: none"> • Ultrasound, in-plane • Nonstimulating needle • Nonstimulating catheter 	Ropivacaine 0.2%	24	8	N/A	N/A	N/A	No difference between groups.	NEUTRAL
					24	N/A	8mL every 1 hr	N/A	N/A		
10	Post-operative analgesia using intermittent vs. continuous adductor canal block technique: a randomized controlled trial Thapa, D., et al Acta Anaesthesiol Scand 2016: 60 1379-85 https://pubmed.ncbi.nlm.nih.gov/27592690	ACL	Adductor Canal <ul style="list-style-type: none"> • Ultrasound, in-plane • Nonstimulating needle • Nonstimulating catheter 	Ropivacaine 0.5%	25	2.5	N/A	N/A	N/A	Mean 24-hr total morphine consumption, mean VAS at rest and on knee flexion was significantly reduced in the intermittent bolus group @ 4, 6, 8 and 12 hr compared to continuous group.	POSITIVE - Intermittent adductor canal bolus reduced morphine consumption and pain for 0-24 hours post-operatively.
					25	N/A	15 mL every 6 hr	N/A	N/A		
11	The efficacy comparison of on-demand boluses with and without basal infusion of 0.1 % bupivacaine via perineural femoral catheter after arthroscopic ACL reconstruction Svediene, S., et al Knee Surg Sports Traumatol Arthrosc 2013: 21:641-645 https://pubmed.ncbi.nlm.nih.gov/22527409	ACL	Femoral <ul style="list-style-type: none"> • Stimulating needle • Nonstimulating catheter 	Bupivacaine 0.1%	16	5	N/A	5	30	Analgesia was superior in Basal + Bolus Group at rest and during mobilization DOS and POD #1. No significant difference in patient satisfaction between groups at the end of the trial. Opioid consumption was similar in both groups.	POSITIVE - Basal + bolus delivery mode was more efficient than on-demand regimen alone.
					19	N/A	N/A	5	15		
12	Patient controlled analgesia reduces the consumption of bupivacaine in femoral nerve block for the treatment of postoperative pain after reconstruction of anterior cruciate ligament of the knee Contreras-Dominguez, V.A., et al Rev Bras Anestesiol 2007 Aug: 57 (4) 356-65 https://pubmed.ncbi.nlm.nih.gov/19462111	ACL	Femoral	Bupivacaine 0.125% + Clonidine 1mcg/ml	30	10	N/A	N/A	N/A	No differences in VAS between 2 and 48 hours; morphine consumption was similar between groups.	NEUTRAL - Continuous femoral nerve block is a useful technique to manage pain following ACL repair.
					30	5	2.5mL every 30 min	N/A	N/A		
					30		5mL every 30 min	N/A	N/A		

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13	Continuous femoral nerve blocks: varying local anesthetic delivery method (bolus versus basal) to minimize quadriceps motor block while maintaining sensory block Charous, M.T., et al Anesthesiology 2011; 115(4): 774-81 https://pubmed.ncbi.nlm.nih.gov/21394001	Volunteer study	Femoral	Ropivacaine 0.1%	N/A	5	N/A	N/A	N/A	No difference in maximum voluntary isometric contraction or cutaneous sensation deficit in both groups.	NEUTRAL
					N/A	N/A	5mL every 1 hr	N/A	N/A		
14	Intermittent versus continuous sciatic block combined with femoral block for patients undergoing knee arthroplasty. A randomized controlled trial Soltesz, S., et al International Orthopaedics 2016; 40: 1861-1867 https://pubmed.ncbi.nlm.nih.gov/26810904	TKA	Sciatic + Continuous Femoral Nerve Block <ul style="list-style-type: none"> • Neurostimulation • Stimulating needle • Non-stimulating catheter 	Ropivacaine 0.2%	70	6	N/A	10ml NRS >3 rest/ >4 mobilization	N/A	No differences in pain scores were observed. Groups did not differ with regard to functional outcome and opioid consumption.	NEUTRAL - Failed to show superiority for one delivery mode over another when combined with a continuous femoral nerve block.
				Ropivacaine 0.75% - Single Injection	70	N/A	20 x 1	10ml Ropi 0.2% NRS >3 rest/ >4 mobilization	N/A		
15	A "new" automated bolus technique for continuous popliteal block: a prospective, randomized comparison with a continuous infusion technique Taboada, M., et al Anesthesia & Analgesia 2008; 107(4):1433-37 https://pubmed.ncbi.nlm.nih.gov/18806065	Hallux Valgus Repair	Popliteal <ul style="list-style-type: none"> • Neurostimulation • Stimulating needle • Non-stimulating catheter 	Levobupivacaine 0.125%	22	5	N/A	N/A	N/A	Reduction of pain scores @ 6, 8 and 12 hrs post-op in the automated bolus group.	POSITIVE - Automated intermittent boluses provided superior pain control compared to continuous infusion technique.
					22	0.1 (to ensure patency)	5mL every 1 hr	N/A	N/A		
16	Comparison of continuous infusion versus automated bolus for postoperative patient-controlled analgesia with popliteal sciatic nerve catheters Taboada, M., et al Anesthesiology 2009; 110(1): 150-4 https://pubmed.ncbi.nlm.nih.gov/19104182	Hallux Valgus Repair with Osteotomy	Popliteal <ul style="list-style-type: none"> • Neurostimulation • Stimulating needle • Non-stimulating catheter 	Levobupivacaine 0.125%	25	5	N/A	3	15 min; max 2 doses per hr	Similar pain relief between groups. Bolus group used less PCA and overall consumption of local anesthetic.	POSITIVE
					25	N/A	5mL every 1 hr	N/A	15 min; max 2 doses per hr		

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17	Programmed intermittent peripheral nerve local anesthetic bolus compared with continuous infusions for post-operative analgesia: a systematic review and meta-analysis Chong, M.A., et al J Clinical Anesth 2017; 142: 69-76 https://pubmed.ncbi.nlm.nih.gov/28830037	Systematic Review and Meta-analysis of 9 RCTs automated intermittent bolus vs basal only	Upper or Lower Limbs	N/A	448	N/A	N/A	0	N/A	Intermittent bolus modestly reduced VAS pain scores at 6 hr and 12 hr. No other meaningful differences in other outcomes: opioid and LA consumption, patient satisfaction, rescue analgesic requirements, side effects and block related complications.	NEUTRAL - Programmed intermittent bolus does not meaningfully reduce VAS scores in CPNB. Overall small sample size and underpowered. Clinical differences between studies present in studies.

SUMMARY

- There are conflicting results and inconsistent data with regard to added benefits of either automated or intermittent bolus therapy compared to continuous infusion for post-operative pain
- Some studies suggest superior analgesia, while others demonstrated no difference
- Authors report there are many reasons for the discrepancies, namely, variations in the protocols, including but not limited to:
 - drug concentrations used in the studies. Two studies (Fibla and Soltesz) used a different concentration for each group
 - bolus volume and timed interval of delivery
 - the use of nerve stimulation vs. ultrasound and potential effect on block effectiveness, specifically, needle proximity to the target nerve, accuracy of catheter insertion, distribution of local anesthetic
- Two studies were completed using voluntary subjects. Results may not be applicable to patients who experience surgical pain
- Authors did not address issues related to electronic pumps, specifically known nuances with regard to alarms
- Authors did not address continuation of therapy after discharge and the feasibility of discharging patients home with electronic pumps for intermittent or automated delivery modes
- ON-Q* was used for both groups in one study (Fredrickson), No differences in overall satisfaction or dissatisfaction with the device was noted between groups
- Authors of meta-analysis note that given the premium cost of pumps capable of programmed-intermittent bolus delivery and lack of meaningful benefit in existing literature serves as word of caution for widespread adoption of programmed intermittent bolus delivery technique.

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