Marco Lotano MD

Complications with Continuous Catheter Nerve Blocks

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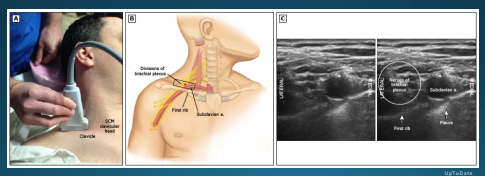
Nondisclosure

I have no conflicts of interest in relation to this presentation.



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Regional Anesthesia in OPSC

- Regional anesthesia is beneficial for outpatient surgery
  - Improved postoperative analgesia, minimizing opioid use
  - Decreased complications / adverse side-effects (e.g. respiratory depression, PONV)
  - Shorter average recovery room times / improved quality of recovery
  - Lower hospital readmission rates
  - Relatively few contraindications
- Use of continuous peripheral nerve block (PNB) techniques and extended release local anesthetic delivery systems have extended these benefits beyond the limited duration of single-injection PNBs.

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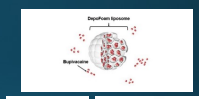
Prolonged Peripheral Nerve Blocks

LA adjuvants
- Vasoconstrictors (Epi 1:200k – 1:400k)
- Dexamethasone
- Alpha 2 Agonists

Liposomal Bupivacaine LPB (Exparel)



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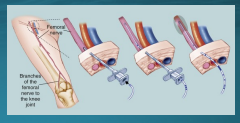
Continuous Nerve Catheter

Continuous infusion of LA (local anesthetic) through percutaneously-placed catheter adjacent to peripheral nerve

Prolonged duration of anesthesia/analgesia

Planning and patience
- Patient selection/education
- Prolonged time to place catheter - sterile technique
- Increased costs and follow-up
- Associated complications



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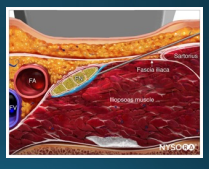
Complications with ssPNBs

- Bleeding/hematoma
- Infection
- Allergic reaction
- Nerve injury
- Local Anesthetic Systemic Toxicity (LAST)



- Secondary injury: motor block related falls
  tissue injury in blocked extremity

Major complications resulting in permanent (>6 mo) nerve damage 0.015-0.09%

Sites BD, Taenzer AH, Herrick MD, et al. Incidence of local anesthetic systemic toxicity and postoperative neurologic symptoms associated with 12,668 ultrasound-guided nerve blocks: an analysis from a prospective clinical registry. Reg Anesth Pain Med. 2012;37:478-82.

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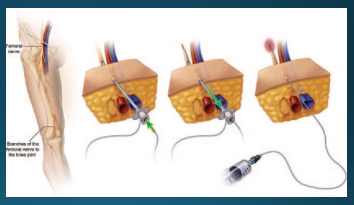
Risks of Continuous Nerve Catheters

Failure of Catheter
- Primary (placement)
- Secondary
- Removal

Needle-induced injuries
- Bleeding / hematoma
- Nerve Injury

Infection

Local anesthetic induced complications
- Local Anesthetic Systemic Toxicity/LAST



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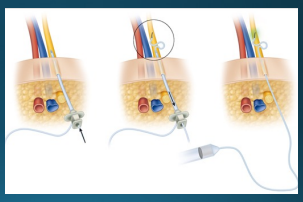
Continuous Nerve Catheter Failure

- Primary
  - Improper placement
  - Technically challenging
  - Additional training
- Secondary
  - Catheter displacement
  - Cather migration
  - Disconnection
  - Leakage of local anesthetic
  - Pump failure



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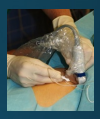
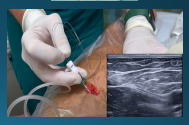
Primary Catheter Failure: Improper Insertion

- Published failure rates range from **0.5 to 26%**
- Studies support **ultrasound-guidance improves continuous catheter success**





Ilfeld BM. Continuous Peripheral Nerve Blocks: An Update of the Published Evidence and Comparison With Novel, Alternative Analgesic Modalities. Anesth Analg. 2017 Jan;124(1):308-335.

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Primary Catheter Failure: Improper Insertion

- Case Report:
- Patient demise after nerve catheter placed under GA
- Catheter inserted 7 cm beyond the needle tip
- Bolus administered post-operatively without prolonged observation of patient
- "Interscalene" catheter was actually *intrathecal*

- ***Imperative to:*** **Confirm catheter placement**
  Monitor patient after bolus

Yanovski B, Gaitini L, Volodarski N, Ben-David N. Catastrophic complication of an interscalene catheter for continuous peripheral nerve block analgesia. Anaesthesia 2012, 67, 1166–1169

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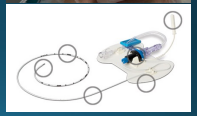
Secondary Catheter Failure

- Leakage at site
- Dislodgement
- Catheter obstruction
- Difficulty removing
  - Catheter retention during withdrawal
  - Loop, knot, kink (case reports)
  - Shearing
- *Stimulating catheters* more commonly retained



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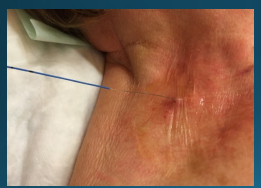
Secondary Catheter Failure

Stimulating catheters more commonly retained



Yanovski B, Gaitini L, Volodarski D, Ben-David B. Catastrophic complication of an interscalene catheter for continuous peripheral nerve block analgesia. Anesthesiology. 2012. 67;10. 1166-1169

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Secondary Catheter Failure

- 1458 patients with Interscalene catheter
- **Tubing obstruction**
- **Pump/catheter disconn**ection
- **Persistent alarming** from the electronic pump

Medical advice sought at home	174 (12%)
Pump or tubing technical issues	29 (2%)
Catheter leakage	111 (8%)

- Pump-related issues were higher for the electronic device compared with the elastomeric pump

- **12%** patients seeking medical advice, usually by telephone

Fredrickson MJ, Leightley P, Wong A, Chaddock M, Abeysekera A, Frampton C. An analysis of 1505 consecutive patients receiving continuous interscalene analgesia at home: a multicentre prospective safety study. Anaesthesia. 2016 Apr;71(4):373-9. doi: 10.1111/anae.13383. Epub 2016 Feb 5. PMID: 26843272.

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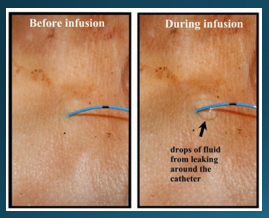
Secondary Catheter Failure: Variability between types of block



Number of adverse events and additional interventions by catheter type

	IC (N = 374)	IB (N = 185)	SC (N = 42)
Adverse event			
Residual blockade	18	11	3
Leakage	21	3	1
Numbness	22	10	1
Dislodgement	14	8	2
Breathing difficulty	0	0	0
Additional health care intervention			
Clinic	0	1	0
ER	34	11	4
Phone care	44	25	6
Readmission	1	2	0

King R, Mariano ER, Yajnik M, Kou A, Kim TE, Hunter OO, Howard SK, Mudumbai SC. Outcomes of Ambulatory Upper Extremity Surgery Patients Discharged Home with Perineural Catheters from a Veterans Health Administration Medical Center. Pain Med. 2019 Nov 1;20(11):2256-2262. doi: 10.1093/pm/pnz023. PMID: 30859216

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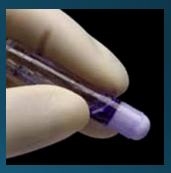
Secondary Catheter Failure: Leakage

- 1644 patients, 748 without and 896 with Dermabond©
- 2-Octyl Cyanoacrylate glue
  - *Decreased leakage* problem by a factor of 10
  - *Decreased dislodged* catheters



- Peri-catheter leakage at 24 h was 0% (Dermabond©) versus 93% (sterile strips)
- Displacement at 24 hours 6.7% versus 93.3%

Gurnaney H, Kraemer FW, Carroll A. Dermabond dressing over pericatheter lateral anesthetic leakage after continuous perineural infusions. Anesth Analg. 2011;113:206.

Chalacheewa et al. Decreasing leakage during continuous femoral catheter fixation using locally applied glue: Dermabond® a randomized controlled trial. BMC Anesthesiology (2021) 21:169

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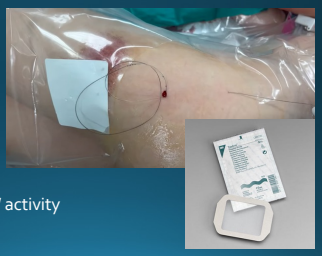
Mitigating Catheter Migration or Dislodgement

- Insertion technique
  ? tunnel catheter



- Securing carefully
  Dermabond®, Tegaderm

- Patient education: postop care
  positioning / activity

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Bleeding and / or Hematoma

- Considerations for diagnosing bleeding complications at home
  - Patient education
  - Post-operative communication

- Anti-coagulation pre-operatively and/or post-operatively

- Sight of injection - deep blocks higher risk
  Psoas catheter causing retroperitoneal hematoma

Warner NS, Duncan CM, Kopp SL. Acute retroperitoneal hematoma after psoas catheter placement in a patient with myeloproliferative thrombocytosis and aspirin therapy. A A Case Rep. 2016;6:2830

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Postoperative Neurologic Symptoms (PONS) Peripheral Nerve Injury (PNI)

- Potential catheter-associated risks:
  - ? Increased concentration of local anesthetics
  - ? Prolonged exposure

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Risk of Nerve Injury after ssPNB

1-2 / 5,000

0.02-0.04%

> 6 months

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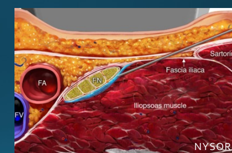
Postoperative Neurologic Symptoms (PONS) Peripheral Nerve Injury (PNI)

- Prospective study 1010 ssPNBs
  - 8.2% day 10
  - 3.7% at 1 month
  - 0.6% at 6 months



Fredrickson MJ, Kilfoyle DH. Neurological complication analysis of 1000 ultrasound guided peripheral nerve blocks for elective orthopaedic surgery: a prospective study. Anaesthesia. 2009 Aug;64(8):836-44. doi: 10.1111/j.1365-2044.2009.05938.x. PMID: 19604186.

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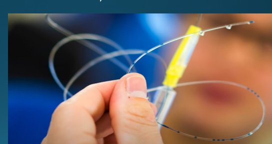
Postoperative Neurologic Symptoms (PONS) Peripheral Nerve Injury (PNI)

- Prospective study 1505 **interscalene catheters**
  - 7.3% patients reported tingling, weakness or pain >1 month
  - 3.2% > 3 months
  - 1.8% > 6 months
  - 0.7% > 12 months



Fredrickson MJ, Leightley P, Wong A, Chaddock M, Abeysekera A, Frampton C. An analysis of 1505 consecutive patients receiving continuous interscalene analgesia at home: a multicentre prospective safety study. Anaesthesia. 2016;71:373379.

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Infection

- Site of catheter
- Duration of catheter
- Patient risks factors

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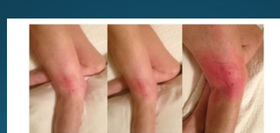
Infection

- Rates of inflammation (3%–4%) and catheter colonization (6%–57%)
- Clinically relevant infection rare (0%–3%)



Dott D, Canlas C, Sobey C, Obremskey W, Thomson AB. Necrotizing Fasciitis as a Complication of a Continuous Sciatic Nerve Catheter Using the Lateral Popliteal Approach. Reg Anesth Pain Med. 2016 Nov/Dec;41(6):728-730. doi: 10.1097/AAP.0000000000000482. PMID: 27662064.

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Infection

Capdevila X, Jaber S, Pesonen P, et al. Acute neck cellulitis and mediastinitis complicating a continuous interscalene block Anesth Analg 2008;107:1419-1421

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Infection

Table 4. Results of Catheter Culture for Each CPNB Group

	Interscalene (n = 256)	Axillary (n = 126)	PCB (n = 20)	Femoral (n = 683)	Fascia I (n = 94)	Sciatic (n = 32)	Popliteal (n = 167)	Distal (n = 38)
Catheters with culture, (n) %	(n = 166) 64.9	(n = 77) 61.1	(n = 15) 76.9	(n = 485) 71.1	(n = 65) 69.3	(n = 25) 77.4	(n = 112) 67.5	(n = 24) 63.3
Colonized catheters, % [95% CI]	25.6 [19–32]	36.5 [25.5–47.4]	20 [2.4–37.5]	28.6 [14.9–52.2]	28.6 [14.9–42.2]	30.4 [11.6–49.2]	18.9 [11.6–26.2]	35.5 [24–47.4]
Organisms, %								
Coagulase-negative staphylococcus	83	56.7	66.7	52.3	35.7	75	77.3	69.6
SA	4.3	6.7	0	4.6	7.1	0	0	8.7
Enterococcus	2.1	3.3	0	9.9	14.3	12.5	0	0
Other gram-positive cocci	6.4	3.3	0	1.3	0	0	0	0
Gram-negative bacillus	0	26.7	33.3	27.1	42.7	12.5	18.1	21.7
Others	4.2	6.6	0	4.8	0.2	0	4.6	0

Axillary = axillary catheter; CI = confidence interval; CPNB = continuous peripheral nerve block; Distal = distal nerve block catheter (cubital or median nerve); Fascia I = fascia iliaca compartment block catheter; Femoral = femoral catheter; Interscalene = catheter of the brachial plexus through interscalene approach; PCB = catheter in the lumbar plexus through a posterior approach; Popliteal = popliteal catheter; SA = *Staphylococcus aureus*; Sciatic = sciatic catheter through a parasacral approach.

Capdevila X, Pirat P, Bringuier S, Gaertner E, Singelyn F, Bernard N, Choquet O, Bouaziz H, Bonnet F; French Study Group on Continuous Peripheral Nerve Blocks. Continuous peripheral nerve blocks in hospital wards after orthopedic surgery: a multicenter prospective analysis of the quality of postoperative analgesia and complications in 1,416 patients. Anesthesiology. 2005 Nov;103(5):1035-45. doi: 10.1097/00000542-200511000-00018. PMID: 16249678.

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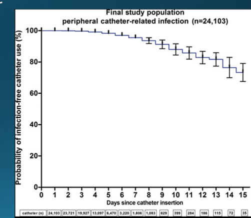
Infection and Duration of Catheter

- Prospective multi-center study showing probability of infection-free indwelling peripheral nerve catheter
  - 99% day 4 (1%)
  - 96% day 7 (4%)
  - 73% day 15 (27%)



Bomberg H, Bayer I, Wagenpfeil S, Kessler P, Wulf H, Standl T, Gottschalk A, Döffert J, Hering W, Birnbaum J, Spies C, Kutter B, Winckelmann J, Liebl-Biereige S, Meissner W, Vicent O, Koch T, Sessler DI, Volk T, Raddatz A. Prolonged Catheter Use and Infection in Regional Anesthesia: A Retrospective Registry Analysis. Anesthesiology. 2018 Apr;128(4):764-773. doi: 10.1097/ALN.0000000000002105. PMID: 29420315.

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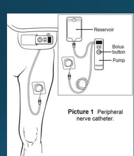
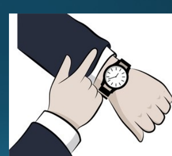
Infection and Duration of Catheter

Up to 88 days in literature





Pacenta HL, Kaddoum RN, Pereiras LA, Chidiac EJ, Burgoyne LL. Continuous tunneled femoral nerve block for palliative care of a patient with metastatic osteosarcoma. Anaesth Intensive Care. 2010;38:563565.

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Infection

- Risk Factors
  - Increased age
  - Male
  - Multiple comorbidities: Diabetes, Obesity
- Additional risk factors for infection
  - Postoperative ICU
  - Catheter duration longer than 48 h
  - Absence of prophylactic use of antibiotics

Bomberg H, Bayer I, Wagenpfeil S, Kessler P, Wulf H, Standl T, Gottschalk A, Döffert J, Hering W, Birnbaum J, Spies C, Kutter B,Winckelmann J, Liebl-Biereige S, Meissner W, Vicent O, Koch T, Sessler DI, Volk T, Raddatz A. Prolonged Catheter Use and Infection in Regional Anesthesia: A Retrospective Registry Analysis. Anesthesiology. 2018 Apr;128(4):764-773. doi: 10.1097/ALN.0000000000002105. PMID: 29420315
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Bomberg H, Albert N, Schmitt K, et al. Obesity in regional anesthesia--a risk factor for peripheral catheter-related infections. Acta Anaesthesiol Scand. 2015;59(8):1038-1048. doi:10.1111/aas.12548

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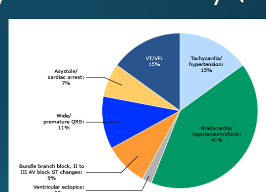
Local Anesthetic Systemic Toxicity (LAST)

- Accumulation of local anesthetic
- LA conc peak days 1 – 4 of infusion
- Patient risk factors contributory:
  - Extremes of age
  - Cardiac disease
  - Renal insufficiency
  - Hepatic disease
  - Pregnancy



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Neal JM, Barrington MJ, Fettiplace MR, et al. The Third American Society of Regional Anesthesia and Pain Medicine Practice Advisory on Local Anesthetic Systemic Toxicity: Executive Summary 2017. Reg Anesth Pain Med. 2018;43(2):113-123. doi:10.1097/AAP.0000000000000720
Neal JM. Ultrasound-guided regional anesthesia and patient safety: update of an evidence-based analysis. Reg Anesth Pain Med. 2016;41:195–204

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Time and Expense

- Retrospective Cohort Study – ssLB ISB to cc ISB for TSR
- Improved pain scores POD0 – POD1, equivalent pain scores POD2-POD3
- Equivalent narcotic consumption for duration of hospitalization
- Cost for anesthesia professional fees, equipment, medication
  - Average cc PNB $805
  - Average long-acting LA ssPNB $375

Budge M, Orvets N, Shields E. Single-shot liposomal bupivacaine interscalene nerve block in total shoulder arthroplasty. Seminars in Arthroplasty: JSES. 2020/10/10/2020; 30(4): 285-290

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Time and Expense

- Extensive time commitment for placement, confirmation, securing catheter compared to ss PNB
- Requires more technical skill / training for catheter
- Management of catheter requires support service/acute pain team to educate, manage, trouble-shoot catheter

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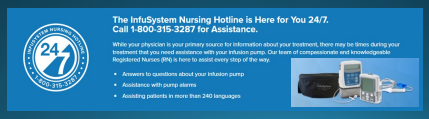
Patient Satisfaction/Support

Table III Perioperative patient complications

Complications	ISC (N = 33)	LB (N = 28)	P value
Anesthetic site complications			
Discomfort	12 (36.4%)	2 (7.1%)	.007
Leakage	10 (30.3%)	2 (7.1%)	.023
Irritation	3 (9.1%)	1 (3.6%)	.385
Other complications	7 (21.2%)	1 (3.6%)	.042
Facial flushing/rash	2 (6.1%)	0	
Ptosis	3 (9.1%)	0	
Hand swelling	1 (3.0%)	1 (3.6%)	
Hemoptysis	1 (3.0%)	0	
Nausea	15 (45.5%)	8 (28.6%)	.175
Dyspnea	12 (36.4%)	8 (28.6%)	.518
Overall complication rate	59 (29.8%)	22 (13.1%)	<.001

ISC, Interscalene catheter; LB, liposomal bupivacaine brachial plexus nerve block.



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How to avoid complications?

Provider Education
- Ultrasound-guidance training
- PNB selection / Technique
- Patient Selection
- LA selection
- Monitoring

Patient education

Acknowledgements: Ashley Shilling MD, Hanae Tokita MD, Sakura Kinjo MD

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