

CONTINUOUS PERIPHERAL NERVE BLOCKS AT HOME

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OUTLINE

- History
- Why do it?
- The naysayers and what to tell them
- Catheter techniques
- Drug selection
- Block pitfalls
- Stimulators
- Catheter types and pitfalls
- Pump types and pitfalls
- Tricks for success

HISTORY

- Single shot brachial plexus block– 1911
- Continuous with a needle – 1946
- Continuous with a catheter – 1977
- Continuous at home - 1998 (Bulky pumps became smaller. Improved needles and catheters.)
- 2000 - A shift from general/spinal/epidural anesthetic to peripheral regional.

HISTORY

- Hindered by lack of familiarity, rapid turnover, and logistical impediments.
- Only 50.8% of anesthesiologists rated their training in peripheral nerve blocks as adequate.
- Most commonly performed: IV regional, axillary, ankle > 70% of respondents.
- Least commonly performed: popliteal, infraclavicular, supraclavicular, sciatic < 30% of respondents.
- No regional variability.

Hadzic A, Vloka JD, Kuroda MM, Koorn R, Birnback DJ. The use of peripheral nerve blocks in anesthesia practice. A national survey. Reg Anesth Pain Med, 1998; 23: 241-246.

WHY DO IT?

- ↑ Patient satisfaction
- ↓ Opioids - New Mandate: "the fifth vital sign"
- ↑ Quality of sleep
- Better surgical outcome/facilitates rehab. process
- Facilitates long term physical therapy
- ↓ Hospital costs

WHY DO IT?

#1: ↑ Patient satisfaction:

- 35 patients, all with initial interscalene block with either IV PCA or PCIA for 48 hours.
- PONV 5.5% PCIA, versus 60% in IV PCA group.
- Patient satisfaction double in PCIA group.

Borgeat A, Perschak H, Bird P, Hodler J, Gerber C. Patient-controlled interscalene analgesia with ropivacaine 0.2% versus patient-controlled intravenous analgesia after major shoulder surgery. Anesthesiology, 2000; 92: 102-108.

WHY DO IT?

#2: ↓ Opioids: (↓ PONV, ↓ constipation, ↓ drowsiness)

- 369 outpatient ACL reconstructions.
- GA vs. GA/RA vs. RA.
- Incidence of pain: 63% vs. 23% vs. 14%.
- Incidence of PONV: 39% vs. 34% vs. 9%.

Williams BA, Kentor ML, Williams JP, Figallo CM, Sigl JC, Anders JW, Bear TC, Tullock WC, Bennett CH, Harner CD, Fu FH. Process analysis in outpatient knee surgery. Effects of regional and general anesthesia on anesthesia-controlled time. Anesthesiology, 2000; 93: 529-538.

WHY DO IT?

#3: ↑ Quality of sleep

- Insomnia:
 - 70% in saline group.
 - 30% in ropivacaine group.
- Number of awakenings:
 - 4 in saline group.
 - 0.5 in ropivacaine group.

Ilfeld BM, Morey TE, Wright TW, Chidgey LK, Enneking FK. Continuous interscalene brachial plexus block for postoperative pain control at home: A randomized, double-blinded, placebo-controlled study. Anesth Analg, 2003; 96: 1089-1095.

WHY DO IT?

#4: Better surgical outcome/facilitates rehabilitation process.

- 45 patients, all general anesthesia, all unilateral TKA.
- Group A: IV PCA morphine.
- Group B: continuous 3-in-1 block.
- Group C: epidural.

WHY DO IT?

#4: Better surgical outcome/facilitates rehabilitation process.(continued)

Results:

- Group A: Highest VAS pain. Highest PONV.
- Group B: Pain at 4 Hrs. postop, but lower afterwards.
- Group C: Lowest pain. But hypotension, urinary retention.
- Knee flexion angles highest in B and C.

Singelyn FJ, Deyaert M, Jorist D, Penderville E, Gouverneur JM. Effects of intravenous patient-controlled analgesia with morphine, continuous epidural analgesia, and continuous three-in-one block on postoperative pain and knee rehabilitation after unilateral total knee arthroplasty. Anesth Analg, 1998; 87: 88-92.

WHY DO IT?

#5: Facilitates long term physical therapy

- 93 patients (100 catheters), stiff shoulder resistant to conservative therapy and intermittent regional anesthesia.
- Indwelling catheters for 3 days, worked in 87 patients. All had manipulation, minor surgery and physical therapy.

WHY DO IT?

#5: Facilitates long term physical therapy (continued)

- After 3 years, average gains in motion were 44 ° elevation (from 115 ° to 159 °), 31 ° external rotation (from 22 ° to 53 °), and 5 spine segments internal rotation (L4 to T11).

Cohen NP, Levine WN, Marra G, Pollock RG, Flatow EL, Brown AR, Bigliani LU. Indwelling interscalene catheter anesthesia in the surgical management of stiff shoulder: a report of 100 consecutive cases. J Shoulder Elbow Surg, 2000; 9: 268-274.

WHY DO IT?

#6: ↓ Hospital costs:

- 53 rotator cuff repairs. General vs. interscalene.
- Shortened these times:
 - from arrival into O.R. till incision.
 - from end of surgery till out of O.R.
- Shortened PACU stay by 40%.
- Decreased overnight admission rate by 64%.

Chelly JE, Greger J, Al Samsam T, Gebhart R, Masson M, Matuszczak M, Sciard D. Reduction of operating and recovery room times and overnight hospital stays with interscalene blocks as sole anesthetic technique for rotator cuff surgery. *Minerva Anesthesiol*, 2001; 67: 613-619.

WHY DO IT?

#6: ↓ Hospital costs:

- 369 consecutive ACL reconstruction.
- GA vs. GA/RA vs. RA alone.
- Anesthesia-controlled time vs. Total turnover time (ACT vs. TOT).
- 1995-1996: 84% GA, 16% RA.
- 1996-1997: 21% GA, 43% GA/RA, 36% RA.
- 1997-1998: 1% GA, 25% GA/RA, 74% RA.
- ACT: 20.3 min GA, 15.7 min GA/RA, 11.4 min RA.

Williams BA et al. *Anesthesiology*, 2000; 93: 529-538.

THE NAYSAYERS AND WHAT TO TELL THEM

- Surgeons
- Nurses
- Administrators
- Anesthesia providers
- Patients

THE NAYSAYERS AND WHAT TO TELL THEM

Orthopedic surgeons:

- I can still help with pain control, even with anticoagulation.
- Patients that called your office with postop. pain will no longer have pain.
- Surgeries you did as inpatients can now go home as outpatients.

THE NAYSAYERS AND WHAT TO TELL THEM

Orthopedic surgeons: National survey in Canada. Surgeons said regional anesthesia is safer, gives better pain control and less postoperative sedation.

When they direct their patients' choice, 84% recommend regional.

Regional anesthesia delays O.R. start and has unpredictable success.

Oldman M, McCartney CJL, Leung A, Rawson R, Perlas A, Gadsden J, Chan VWS. A survey of orthopedic surgeons' attitudes and knowledge regarding regional anesthesia. *Anesth Analg*, 2004; 98: 1486-1490.

THE NAYSAYERS AND WHAT TO TELL THEM

Orthopedic surgeons:

- They won't start to hurt right after discharge and have unplanned readmissions.
- It's OK to go home with a numb arm/leg.
- What's best, go home groggy (from opioids) with an immobilized painful leg, or go home alert with a numb leg w/o weight-bearing?

LA can have multi benefited action against. Stephen Amann

THE NAYSAYERS AND WHAT TO TELL THEM

Orthopedic surgeons:

- 120 patients, all arthroscopic acromioplasty.

	VAS	PACU morphine	PONV
interscalene	0.7-3	0.5 mg	2/30
intraarticular	3-6.1	4 mg	7/30
suprascapular	1.1-5.4	4 mg	4/30
control group	2.5-7.7	5 mg	10/30

Singelyn FJ, Lhotel L, Fabre B. Pain relief after arthroscopic shoulder surgery: A comparison of intraarticular analgesia, suprascapular nerve block, and interscalene brachial plexus block. *Anesth Analg*, 2004; 99: 589-592.

THE NAYSAYERS AND WHAT TO TELL THEM

Nurses:

- Less postop pain/PONV means less nursing labor intensity and less potential patient backlog.
- Lower PACU staffing requirement
- Less forced overtime
- Less paperwork, fewer unplanned admissions

THE NAYSAYERS AND WHAT TO TELL THEM

Administrators:

- Retrospective observational study over 4 years, 948 ACL reconstructions.
- 4 groups: GA, GA+block, SP/EPI, Block only.
- 608 received blocks: 135 stayed in PACU, 473 bypassed PACU.
- 81% of unplanned admissions were for pain or PONV or both.
- Only 4% of block cases were unplanned admissions.

THE NAYSAYERS AND WHAT TO TELL THEM

Administrators (continued):

- PACU bypass associated with 12% cost reduction.
- Total savings \$ 98,600 for ACL reconstructions.
- If all procedures at their site, savings \$ 1.2 million/yr.

Williams BA, Kentor ML, Vogt MT, Vogt WB, Coley KC, Williams JP, Roberts MS, Chelly JE, Harner CD, Fu FH. Economics of nerve block pain management after anterior cruciate ligament reconstruction. *Anesthesiology*, 2004; 100: 697-706.

THE NAYSAYERS AND WHAT TO TELL THEM

Anesthesia providers:

- Anywhere you can do a single-shot block, you can place a catheter.
- A single-shot might give you 6-20 hours, but a catheter can be there for many days.
- The time you invest in preop. holding, you save in PACU and Phase 2 recovery.

THE NAYSAYERS AND WHAT TO TELL THEM

Anesthesiologists:

- Incidence of phrenic nerve paralysis is 20%, so lower than if injecting through the needle.
- 120 patients, group 1 single shot w/o a PNS, group 2 single shot w/ PNS, group 3 catheter.
 - Incidence of phrenic nerve paralysis: Group 1: 85%. Group 2: 35%. Group 3: 20%.

Boezaart AP, deBeer JF, duToit C, vanRooyen K. A new technique of continuous interscalene nerve block. *Can J Anaesth*. 1999; 46: 275-281.

THE NAYSAYERS AND WHAT TO TELL THEM

Patients:

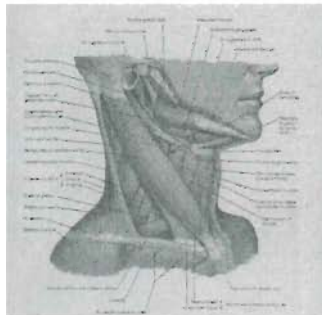
- You'll have less pain, less PONV.
- You'll be more lucid when you go home, and you'll go home sooner.
- This will actually improve blood supply to your arm/leg.
- Unlike an epidural, you won't need a Foley, and the other leg won't be numb.
- Yes, I can give you drugs to decrease the chance of recall.

CATHETER TECHNIQUES

- Interscalene
- Popliteal
- Femoral 3-in-1
- Sciatic
- Psoas compartment
- Infraclavicular
- Paravertebral
- Axillary

Interscalene

- Indicated Procedures
 - Shoulder joint surgery
 - Upper extremity surgery
 - Unreliable for elbow and below



Securing the catheter



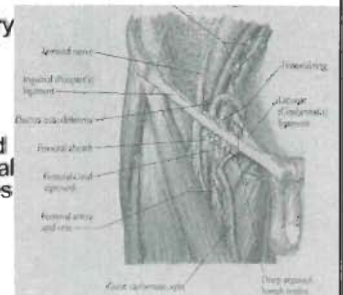
Interscalene catheter insertion, 7-8-04, at MIOSH

Popliteal



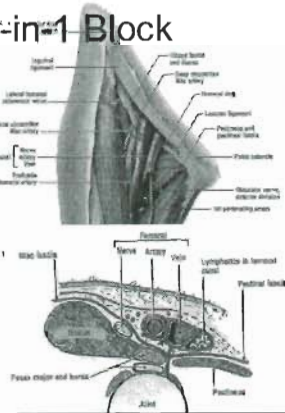
Femoral 3-in-1 Block

- Indicated Procedures
 - Upper leg surgery
 - Knee surgery
 - Travel up the lumbar plexus sheath to catch the obturator and the lateral femoral cutaneous nerves



Femoral 3-in-1 Block

- Needle approach/technique
 - Bevel up
 - Hold needle at 30-45 degree angle
 - Feel for “double pop” through fascia lata and then fascia iliaca
 - Looking for patellar movement



DRUG SELECTION

- Lidocaine – 2% bolus.
- Mepivacaine – 1.5% bolus.
- Bupivacaine – 0.5% bolus, and 0.125-0.25% drip.
- Levobupivacaine
- Ropivacaine – 0.5% bolus, and 0.2% drip.

DRUG SELECTION

- Adjuvants:
 - Epinephrine – initial block, not for the drip.
 - Clonidine – 1 mcg/ml.
 - Sodium Bicarbonate – initial block only.
 - Fentanyl – 1 mcg/ml.
 - Sufentanil – 0.1 mcg/ml.
 - Morphine – 30 mcg/ml.
 - Tramadol

DRUG SELECTION

- Drugs with increasing amounts until cardiac arrest (dogs), then resuscitation attempted.
- Ropivacaine tolerated at 2.5-3 times levobupivacaine and bupivacaine concentrations, and 80% resuscitation success (versus 60% with bupivacaine and levobupivacaine).

Groban A, Deal D, Vernon J, James R, Butterworth J. Ventricular arrhythmias with or without programmed electrical stimulation after incremental overdosage with lidocaine, bupivacaine, levobupivacaine, and ropivacaine. *Anesth Analg.* 2000; 91: 1103-1111.

DRUG SELECTION

- Compared 0.2% ropivacaine and 0.15% bupivacaine. Looked at hand grip strength.
- 5cc/hr plus 4cc bolus with 20 minute lockout.
- Both had pain relief but “ropivacaine is associated with better preservation of strength in the hand and less paresthesia in the fingers.”

Borgeat A, Kalberer F, Jacob H, Ruetsch YA, Gerber C. Patient-controlled interscalene analgesia with ropivacaine 0.2% versus bupivacaine 0.15% after major open shoulder surgery: the effects on hand motor function. *Anesth Analg.* 2001; 92: 218-223.

DRUG SELECTION

- Femoral nerve catheters in minipigs.
 - 0.5% then 0.25% Bupivacaine.
 - 0.75% then 0.375% Ropivacaine.
 - Bupivacaine: severe tissue damage, muscle apoptosis.
 - Ropivacaine: damage was significantly less severe.

Zink W, Sef C, Bohl JRE, Hacke N, Braun PM, Sinner B, Martin E, Fink RHA, Graf BM. The acute myotoxic effects of bupivacaine and ropivacaine after continuous peripheral nerve blockades. *Anesth Analg.* 2003; 97: 1173-1179.

DRUG SELECTION

- 50 patients, open shoulder surgery.
- 30 ml 0.5% levobupivacaine then 0.125%.
- 30 ml 0.5% ropivacaine then 0.2%.
- Onset, failure, rescue medications all same.
- Degree of motor block deeper with levobupivacaine.

Casati A, Borghi B, Fanelli G, Montone N, Rotini R, Fraschini G, Vinciguerra F, Torri G, Chelly J. Interscalene brachial plexus anesthesia and analgesia for open shoulder surgery: A randomized, double-blinded comparison between levobupivacaine and ropivacaine. *Anesth Analg*. 2003; 96: 253-259.

DRUG SELECTION

- Low pKa and high lipid solubility associated with preferential blockade of A fibers.
- High pKa and low lipid solubility associated with preferential blockade of C fibers.
- Compared with bupivacaine, ropivacaine produces a faster block of lightly myelinated (sensory) fibers, and a weaker blockade of heavily myelinated fibers.

Bader AM, Datta S, Flanagan H, Covino BG. Comparison of bupivacaine and ropivacaine-induced conduction blockade in the isolated rabbit vagus nerve. *Anesth Analg*. 1989; 68: 724-727.

DRUG SELECTION

- 0.5% Ropivacaine costs \$10 per 30cc vial.
- 0.5% Bupivacaine costs \$1.40 per 30cc vial.

BLOCK PITFALLS

INTERSCALENE

- Intraneural injection – Benumof article and subsequent comments, trying to answer the question: Is general anesthesia a relative or absolute contraindication to performing an interscalene block???

Benumof JL. Permanent loss of cervical spinal cord function associated with interscalene block performed under general anesthesia. *Anesthesiology*. 2000; 93: 1541-1544.

Are anyone aware of potential block pitfalls

BLOCK PITFALLS

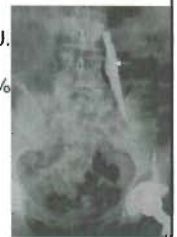
INTERSCALENE

- Phrenic nerve paralysis (absolute contraindication if contralateral pneumonectomy or preexisting contralateral hemidiaphragmatic paresis).
- Horner's syndrome.
- Pneumothorax.
- Bezold-Jarisch reflex.

BLOCK PITFALLS

FEMORAL 3-in-1 BLOCK

- 62 TKA. All femoral 3-in-1 blocks in PACU.
- 0.2% bupiv – 0.1% bupiv – Placebo
- Success: 73% in 0.2% group; 45% in 0.1% group.
- Morphine consumption lowest in 0.2% group.
- Increased R.O.M in 0.2% group.
- 20 had CT scan with dye – only 8 ideally located (between sacral promontory and L4-L5).



Ganapathy S, Wasserman RA, Watson JT, Bennett J, Armstrong KP, Stockall CA, Chess DG, MacDonald C. Modified continuous femoral three-in-one block for postoperative pain after total knee arthroplasty. *Anesth Analg*. 1999; 89: 1197-1202.

BLOCK PITFALLS

FEMORAL 3-in-1 BLOCK

100 patients, all TKA. 7/100 failed block. Catheter in postop., inject dye, classify by tip location, then do the block.

- 23/100 reached ideal location-91% blocked.
- 33/100 medial under psoas-52% blocked.
- 37/100 lateral-27% blocked.

BLOCK PITFALLS

FEMORAL 3-in-1 BLOCK (continued)

- Catheter course totally unpredictable.
- Comparison studies cannot be reliable if catheter tip position is not verified.
- VAS scores lowest in group 1.
- Now the good news: VAS 0-3 in group 1, VAS 0-5 in group 2, VAS 0-5 in group 3.

Capdevila X, Biboulet P, Morau D, Bernard N, Deschodt J, Lopez S, d'Athis F. Continuous three-in-one block for postoperative pain after lower limb orthopedic surgery: Where do the catheters go? Anesth Analg. 2002; 94: 1001-1006.

BLOCK PITFALLS

FEMORAL 3-in-1 BLOCK

- Catheter threaded 24cm at the skin.
- Had epidural anesthesia.

Singelyn FJ, Contreras V, Gouverneur JM. Epidural anesthesia complicating continuous 3-in-1 lumbar plexus blockade. Anesthesiology. 1995; 83: 217-220.

BLOCK PITFALLS

POPLITEAL SCIATIC BLOCK

- Posterior approach, 24 patients, 1/2 with saline, 1/2 with 0.25% bupivacaine @ 5 cc/hr via a C-Bloc.
- 4/24 catheters dislodged.
- Bupivacaine group used 70% less PCA morphine in hospital and 40% less p.o. opioids at home.
- No leg weakness, but 80% had tingling.

White PF, Issioui T, Skrivaneck GD, Early JS, Wakefield C. The use of a continuous popliteal sciatic nerve block after surgery involving the foot and ankle: Does it improve the quality of recovery? Anesth Analg. 2003; 97: 1303-1309.

BLOCK PITFALLS

- **To decrease or not to decrease?**
 - 60 patients.
 - Supraclavicular blocks at 0.9 mA versus dial down to 0.5 mA.
 - 100% success with both.

Franco CD, Domashevich V, Voronov G, Rafizad AB, Jeleu TJ. The supraclavicular block with a nerve stimulator: to decrease or not to decrease, that is the question. Anesth Analg. 2004; 98: 1167-1171.

BLOCK PITFALLS

Single injection with an immobile needle vs. multiple injection technique?

- Controversial. Nerve injury not increased in this article (3996 blocks, not continuous)
- May get a higher success rate with less drug volume.

Fanelli G, Casati A, Garancini P, Torri G. Nerve stimulator and multiple injection technique for upper and lower limb blockade: Failure rate, patient acceptance, and neurologic complications. Anesth Analg. 1999; 847-852.

STIMULATORS

- Audible and visual warning Re. circuit status.
- Function-specific electrode connectors.
- Pulse width usually 100 microseconds.
- Current 1.5 mA to 0.5 mA in 0.05 mA increments.
- Frequency 1-2 Hz.



STIMULATORS

- Ten healthy volunteers, femoral/interscalene.
- Cutaneous (grounding, or return) electrode can be anywhere on the body.
- Do not switch polarity (3-fold increase in amperage).
- Increasing pulse duration causes discomfort, so stick with 0.1 milliseconds.

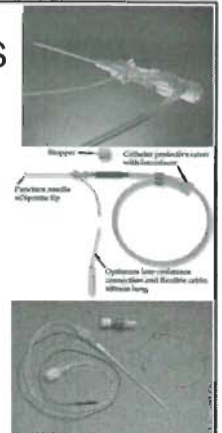
Hadzic A, Vloka JD, Claudio RE, Hadzic N, Thys D, Santos AC. Electrical nerve stimulation. Effects of cutaneous electrode placement and duration of the stimulus on motor response. *Anesthesiology*, 2004; 100: 1526-1530.

CATHETER TYPES

- **NON-STIMULATING**
- **STIMULATING**
- **Needle bevels:**
 - B-bevel vs. Tuohy vs. Sprotte.

CATHETER TYPES

- **NON-STIMULATING:**
 - B.Braun's Contiplex – epidural catheter, no stylet.
 - Pajunk's Plexolong – stylet. Comes in a plastic sheath.
 - Life-Tech's ProLong – catheter, no stylet.

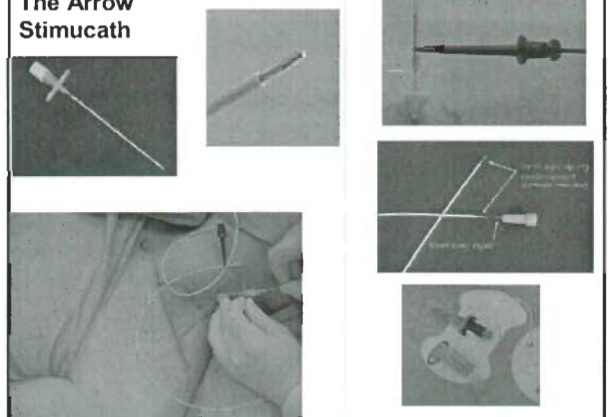


CATHETER TYPES

- **STIMULATING:**
 - Arrow's Stimucath – stylet for stimulation, plus metal in the catheter.
 - HDC's Pandin – stylet must be removed to thread while stimulating. Few catheter markings.



The Arrow Stimucath



CATHETER TYPES

- 20 volunteers, bilat. femoral catheters. One side: stimulation through the **needle and the catheter**. Other side: stimulation **through the needle only**.

	Ice/pinprick	TENS @ 4 Hrs.	Quadriceps strength @ 4 Hrs.
Stimulation-catheter	100%	49 mA	6±16% of baseline
Stimulation-needle	85%	25 mA	33±41% of baseline
P value	0.07	0.0004	0.009

Salinas FV, Neal JM, Sueda LA, Kopacz DJ, Liu SS. Prospective comparison of continuous femoral nerve block with nonstimulating catheter placement versus stimulating catheter-guided perineural placement in volunteers. Reg Anesth Pain Med. 2004; 29: 212-220.

CATHETER PITFALLS

- Unable to thread – 8%
- Misplaced – epidural, subcutaneous, ...
- Dislodged (4/24 White; 2/30 Ilfeld; 6/24 Tuominen; 9/68 Capdevila) – biggest problem; must find a better way to secure catheters !!!
- Obstructed

CATHETER PITFALLS

(continued)

- Leaking (around 10%; 50% in the Ilfeld popliteal study !!)
- Disconnected
- Bleeding
- Knotted – if threaded too far
- Excessive numbness

CATHETER PITFALLS

(continued)

- Local anesthetic toxicity – initial block only, no migration
- No increase in plasma concentration [Klein]
- Increase in plasma concentration [Tuominen]

CATHETER PITFALLS

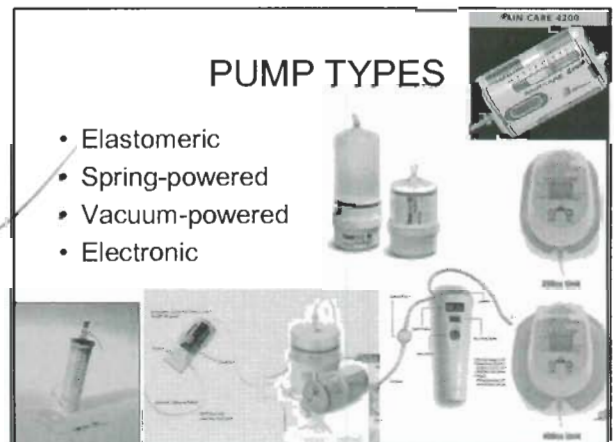
(continued)

- Infection – local erythema only. No case reports of true catheter infections. But incidence of bacterial colonization is high (57%).

Cuvillon P, Ripart J, Lalourcey L et al. The continuous femoral nerve block catheter for postoperative analgesia: Bacterial colonization, infectious rate and adverse effects. Anesth Analg. 2001; 93: 1045-1049.

PUMP TYPES

- Elastomeric
- Spring-powered
- Vacuum-powered
- Electronic



PUMP TYPES

- The ideal infusion pump:
 - Large reservoir (400 cc or more).
 - Infusion rate unaffected by extremes in temperature or pressure.
 - Uncomplicated infusion setting that is tamper proof.
 - Light weight, transportable, inexpensive.
 - Capable of supporting a patient controlled bolus function.
 - Simple mechanism for infusion termination.

Klein SM, Buckenmaier C. Ambulatory surgery with long acting regional anesthesia. Minerva Anesth, 2002; 68: 1-15.

PUMP PITFALLS

- Compared 3 pumps: Graseby, Microject, Infusor LV5.
- No infections. No local anesthetic toxicity.
- 9 catheters came out earlier than planned.
- Highest satisfaction with the non-electronic (elastomeric) Infusor LV5.
- Numerous technical problems with the Microject (11 out of 23) - now off the market.
- "Electronic pumps may be reassuring to the physician..... Unfortunately, their use is not always straightforward for the patient."

Capdevila X, Macaire P, Aknin P, Dadure G, Bernard N, Lopez S. Patient-controlled perineural analgesia after ambulatory orthopedic surgery: A comparison of electronic versus elastomeric pumps. Anesth Analg. 2003; 96: 414-417.

PUMP PITFALLS

- Compared 6 pumps at room temperature and 4°C higher.
- Looked at consistency, accuracy, flow profile, and temperature effects.
- All had minor issues [faster than stated rate then slower].

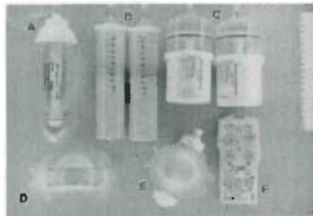
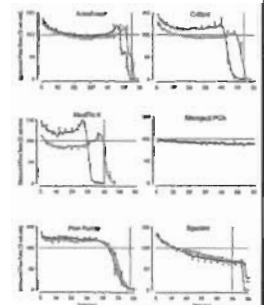


Figure 1. Portable infusion pump configurations as investigated: Accufuser (A), Sgarato (B), Pain Pump (C), MedFlo II (D), C-Block (E), and Microject PCA (F). Manufacturer information is included in Table 1.

PUMP PITFALLS

- "...when choosing an optimal pump ...convenience, reliability, cost, ease of use, ..."



Ilfeld BM, Morey TE, Enneking FK. The delivery rate accuracy of portable infusion pumps used for continuous regional analgesia. Anesth Analg. 2002; 95: 1331-1336.

PUMP PITFALLS

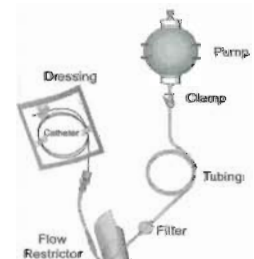
- Phone survey of 131 patients who had catheters at home.
- 14% accidental premature catheter dislodgement.
 - 31% incidence of clear fluid leakage.
 - 98% "felt comfortable" removing catheter at home.
 - 98% "felt safe" with an infusion at home.
 - All felt that one phone call per day was optimal.
 - Only 35% "felt comfortable" changing the pump basal infusion rate.

Ilfeld BM, Esener DE, Morey TE, Enneking FK. Ambulatory perineural infusion: The patient's perspective. Reg Anesth Pain Med, 2003; 28: 418-423.

PUMP PITFALLS

ELASTOMERIC PUMPS:

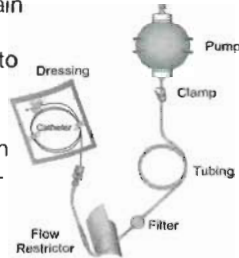
- Less phone calls for high-pressure or occlusion alarms.
- Simpler.
- No programming errors.



PUMP PITFALLS

ELASTOMERIC PUMPS:

- The pressure that pumps the fluid is generated by the strain energy of the elastomeric membranes that are forced to expand when the pump is filled.
- Flow control is achieved with a flow restrictor, a precision-bored glass orifice (0.002 inches).



PUMP PITFALLS

ASRA Journal, July-August 2004 issue:

- Compared 6 NEW pumps at room temperature and 5°C higher.
- Looked at consistency, accuracy, flow profile, and temperature effects.
- All had minor issues.
- If 500ml in a 400ml I-Flow On-Q C-Bloc with OnDemand, get 4ml/hr instead of 5 ml/hr.

Ilfeld BM, Morey TE, Enneking FK. New portable infusion pumps: Real advantages or just more of the same in a different package? Reg Anesth Pain Med, 2004; 29: 371-376.

PUMP PITFALLS

Who pays for the pump?

- The hospital buys it and bills the patient.
- The pump company consigns it to the institution.
- Should you get the combination: pump and catheter from a single vendor?



TRICKS FOR SUCCESS

- Patient selection/exclusion criteria.
- Surgeons and their office staff on board [preop. screening, lobbying].
- PAT, preop. education.
- Preemptive analgesia.
- Arrival time.
- A "Block room". A helper (RN, LPN, PA,...)
- A dedicated team of anesthesia 'regionalists'.
- Timing the block.
- Supplementing/repeating the block.

TRICKS FOR SUCCESS

- Minimize IV narcotics.
- PACU care. Ice pack.
- When to do block (pre-op vs. post-op)
- Identify patients at risk for abuse/misunderstanding.
- Train both patient and family to recognize side effects.
- Tell them what to expect. Tell them complications (weight-bearing, contact with hot/cold, loss of proprioception to avoid dislocation).

TRICKS FOR SUCCESS

- **Instruct** Re. catheter removal.
- **Daily phone** calls at home: pain, numbness, fever, swelling, redness, pus/drainage, tinnitus, nausea, grogginess, metallic taste, fluid leak around catheter site, any pump problems.
A way for them to reach you.
- Cryotherapy, limb elevation, NSAIDs, opioids, stool softener, drug for PONV.

CONCLUSION

- “These are exciting times for regional anesthesia enthusiasts”. Discusses 3 issues:
 - Optimizing and extending peripheral nerve blockade. [*?multiple nerve stimulation; continuous catheters; sustained-release microspheres or liposomal preparations*]
 - Defining best clinical practice. [*review articles; guidelines re. anticoagulants; consensus re. infection*]
 - Enhancing nerve localization. [*needle design and proximity to nerve; stimulators; ultrasound*]

Neal JM. Regional anesthesia: Progress through the growing pains. ASA Newsletter, July 2004; 68: 42-43.

- “...similar difficulties, resistance, and observations accompanied the transition of spinal anesthesia into mainstream acceptance...”
- “Developing this area of anesthesia is essential to increasing the scale and scope of surgery that is compassionately performed on an outpatient basis.”
- “...beyond the operating room... a technique that promises to improve the overall perioperative experience.”

Klein SM. Beyond the hospital: Continuous peripheral nerve blocks at home. Anesthesiology, 2002; 96: 1283-1285.



You gotta be kidding me!
Your back *still* hurts?!

THANK YOU
FOR YOUR
ATTENTION!

WAYNE STATE
UNIVERSITY
SCHOOL OF MEDICINE

CONTINUOUS PERIPHERAL NERVE BLOCKS AT HOME- Elie Joseph Chidiac, M.D.

HISTORY

- Single shot brachial plexus block– 1911; Continuous at home - 1998
- 2000 - A shift from general/spinal/epidural anesthetic to peripheral regional.
- Hindered by lack of familiarity, rapid turnover, and logistical impediments. Only 50.8% of anesthesiologists rated their training in peripheral nerve blocks as adequate (1).

WHY DO IT?

#1: ↑ Patient satisfaction:

–35 patients, all with initial interscalene block with either IV PCA or PCIA for 48 hours. PONV 11-fold in IV PCA group. Patient satisfaction double in PCIA group (2).

#2: ↓ Opioids: (↓ PONV, ↓ constipation, ↓ drowsiness)

–369 outpatient ACL reconstructions. GA vs. GA/RA vs. RA. Incidence of pain: 63% vs. 23% vs. 14%. Incidence of PONV: 39% vs. 34% vs. 9% (3).

#3: ↑ Quality of sleep

– Insomnia: 70% in saline group. 30% in ropivacaine group. Number of awakenings: 4 in saline group. 0.5 in ropivacaine group (4).

#4: Better surgical outcome/facilitates rehabilitation process.

–45 patients, all general anesthesia, all unilateral TKA. Three groups: IV PCA morphine group had the highest VAS scores and highest PONV rate. Continuous femoral block group had pain at 4 Hrs. postop, but lower afterwards. Epidural group had the lowest pain, but had hypotension and urinary retention. Knee flexion angles were best and equal in the femoral and epidural groups (5).

#5: Facilitates long term physical therapy

–93 patients (100 catheters), stiff shoulder resistant to conservative therapy. Indwelling catheters for 3 days. All had manipulation, minor surgery and physical therapy. After 3 years, very high gains in motion (elevation, external rotation, internal rotation) (6).

#6: ↓ Hospital costs:

–53 rotator cuff repairs. General vs. interscalene. Shortened anesthesia-related turnover time (from arrival into O.R. till incision, and from end of surgery till out of O.R.). Also shortened PACU stay by 40%, and decreased overnight admission rate by 64% (7).

–369 consecutive ACL reconstruction. GA vs. GA/RA vs. RA alone. Looked at anesthesia-controlled turnover time (ACT). As they went from 84% GA and 16% RA (1995-96) to 1% GA, 25% GA/RA, 74% RA (1997-98), their ACT decreased from 20.3 min with GA, to 11.4 min with RA (3).

THE NAYSAYERS AND WHAT TO TELL THEM

Orthopedic surgeons:

- I can still help with pain control, even with anticoagulation. Patients that called your office with postop. pain will no longer have pain. Surgeries you did as inpatients can now go home as outpatients. They won't start to hurt right after discharge and have unplanned readmissions. It's OK to go home with a numb arm/leg. What's best, go home groggy (from opioids) with an immobilized painful leg, or go home alert with a numb leg w/o weight-bearing?
- National survey in Canada: Surgeons said regional anesthesia is safer, gives better pain control and less postoperative sedation. When they direct their patients' choice, 84%

recommend regional. Regional anesthesia delays O.R. start and has unpredictable success (8).

- 120 patients, all arthroscopic acromioplasty. Compared intraarticular vs. interscalene injections. VAS 0.7-3 in IS group, 3-6.1 in IA group; Morphine average 0.5mg in IS group, 4mg in IA group; PONV in 2 patients in IS group, 7 patients in IA group (30 patients per group) (9).

Nurses:

- Less postop pain/PONV means less nursing labor intensity and less potential patient backlog. Lower PACU staffing requirement. Less forced overtime. Less paperwork. Fewer unplanned admissions.

Administrators:

- Retrospective observational study over 4 years, 948 ACL reconstructions. 4 groups: GA, GA+block, SP/EPI, Block only. 608 received blocks: 135 stayed in PACU, 473 bypassed PACU. 81% of unplanned admissions were for pain or PONV or both. Only 4% of block cases were unplanned admissions. Since PACU bypass associated with 12% cost reduction, total savings \$ 98,600 for ACL reconstructions per year. If all procedures at their site had been studied, savings \$ 1.2 million/yr (10).

Anesthesiologists:

- Anywhere you can do a single-shot block, you can place a catheter. A single-shot might give you 6-20 hours, but a catheter can be there for many days. The time you invest in preop. holding, you save in PACU and Phase 2 recovery.
- Incidence of phrenic nerve paralysis is 20%, so lower than if injecting through the needle (11).

Patients:

- You'll have less pain, less PONV. You'll be more lucid when you go home, and you'll go home sooner. This will actually improve blood supply to your arm/leg. Unlike an epidural, you won't need a Foley, and the other leg won't be numb. Yes, I can give you drugs to decrease the chance of recall.

DRUG SELECTION

- Ropivacaine till cardiac arrest in dogs, tolerated higher concentration and were easier to resuscitate (12).
- With interscalene catheters, ropivacaine 0.2% compared to bupivacaine 0.15%, had better preservation of strength in the hand and less paresthesia in the fingers (13).
- Femoral nerve catheters in minipigs. Severe tissue damage and muscle apoptosis with bupivacaine, less with ropivacaine (14).
- 50 patients, open shoulder surgery, compared continuous levobupivacaine 0.125% to ropivacaine 0.2%. Degree of motor block deeper with levobupivacaine (15).
- Compared with bupivacaine, ropivacaine produces a faster block of lightly myelinated (sensory) fibers, and a weaker blockade of heavily myelinated fibers. This is because low pKa and high lipid solubility are associated with preferential blockade of A fibers, whereas high pKa and low lipid solubility are associated with preferential blockade of C fibers (16).

BLOCK PITFALLS

Interscalene:

- Intraneural injection – Benumof article and subsequent comments, trying to answer the question: Is general anesthesia a relative or absolute contraindication to performing an interscalene block??? (17).

- Phrenic nerve paralysis (absolute contraindication if contralateral pneumonectomy or preexisting contralateral hemidiaphragmatic paresis).

- Horner's syndrome. Pneumothorax. Bezold-Jarisch reflex.

Femoral Block:

- 62 TKA. All femoral 3-in-1 blocks in PACU. 0.2% bupiv – 0.1% bupiv – Placebo. Success: 73% in 0.2% group; 45% in 0.1% group. Morphine consumption lowest in 0.2% group. Increased R.O.M in 0.2% group. 20 had CT scan with dye – only 8 ideally located (between sacral promontory and L4-L5). (18).

- 100 patients, all TKA. 7/100 failed block. Catheter in postop., inject dye, classify by tip location, then do the block. Catheter course totally unpredictable. VAS scores lowest in group 1. Now the good news: VAS 0-3 in group1, VAS 0-5 in group 2, VAS 0-5 in group 3 (19).

- One case report, catheter threaded 24cm at the skin. Had epidural anesthesia (20).

Popliteal Block:

- Posterior approach, 24 patients, ½ with saline, ½ with 0.25% bupivacaine @ 5 cc/hr via a C-Bloc. Bupivacaine group used 70% less PCA morphine in hospital and 40% less p.o. opioids at home. No leg weakness, but 80% had tingling (21).

To decrease or not to decrease?

- 60 patients, supraclavicular blocks at 0.9 mA versus dial down to 0.5 mA. Had 100% success with both (22).

Single injection with an immobile needle vs. multiple injection technique?

- Controversial. Nerve injury not increased in this article (3996 blocks, not continuous). May get a higher success rate with less drug volume (23).

STIMULATORS

- Audible and visual warning Re. circuit status. Function-specific electrode connectors. Pulse width usually 100 microseconds. Current 1.5 mA to 0.5 mA in 0.05 mA increments. Frequency 1-2 Hz.

- Ten healthy volunteers, femoral/interscalene. Cutaneous (grounding, or return) electrode can be anywhere on the body. Do not switch polarity (3-fold increase in amperage). Increasing pulse duration causes discomfort, so stick with 0.1 milliseconds (24).

CATHETER TYPES

- NON-STIMULATING: B.Braun's Contiplex; Pajunk's Plexolong; Life-Tech's ProLong.

- STIMULATING: Arrow's Stimucath; HDC's Pandin.

- 20 volunteers, bilat. femoral catheters. One side: stimulation through the needle and the catheter. Other side: stimulation through the needle only. Precisely placed catheters had weaker quadriceps muscles and tolerated higher TENS amperage (25).

CATHETER PITFALLS

- Unable to thread; Misplaced; Dislodged (Biggest problem: 4/24 White; 2/30 Ilfeld; 6/24 Tuominen; 9/68 Capdevila); Obstructed; Leaking (around 10%; 50% in the Ilfeld popliteal study !!); Disconnected; Bleeding; Knotted (if threaded too far); Excessive numbness; Local anesthetic toxicity (Initial block only, no migration)

PUMP TYPES

- The ideal infusion pump: Large reservoir (400 cc or more); Infusion rate unaffected by extremes in temperature or pressure; Uncomplicated infusion setting that is tamper proof;

Light weight, transportable, inexpensive; Capable of supporting a patient controlled bolus function; Simple mechanism for infusion termination (26).

PUMP PITFALLS

- Compared 3 pumps: Graseby, Microject, Infusor LV5. No infections. No local anesthetic toxicity. 9 catheters came out earlier than planned. Highest satisfaction with the non-electronic (elastomeric) Infusor LV5. Numerous technical problems with the Microject (11 out of 23) - now off the market. "Electronic pumps may be reassuring to the physician..... Unfortunately, their use is not always straightforward for the patient." (27).
- Compared 6 pumps at room temperature and 4°C higher. Looked at consistency, accuracy, flow profile, and temperature effects. All had minor issues [faster than stated rate then slower]. "When choosing an optimal pump ...convenience, reliability, cost, ease of use, ..." (28).
- Phone survey of 131 patients who had catheters at home. 14% accidental premature catheter dislodgement. 31% incidence of clear fluid leakage. 98% "felt comfortable" removing catheter at home. 98% "felt safe" with an infusion at home. All felt that one phone call per day was optimal. Only 35% "felt comfortable" changing the pump basal infusion rate (29).

Elastomeric pumps:

Less phone calls for high-pressure or occlusion alarms. Simpler. No programming errors. The pressure that pumps the fluid is generated by the strain energy of the elastomeric membranes that are forced to expand when the pump is filled. Flow control is achieved with a flow restrictor, a precision-bored glass orifice (0.002 inches).

- ASRA Journal, July-August 2004 issue: Compared 6 NEW pumps at room temperature and 5°C higher. Looked at consistency, accuracy, flow profile, and temperature effects. All had minor issues. If 500ml in a 400ml I-Flow On-Q C-Bloc with OnDemand, get 4ml/hr instead of 5 ml/hr (30).

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TRICKS FOR SUCCESS

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