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Can we ever eliminate neurologic complications associated with regional anesthesia?

Joseph M Neal, MD*

* Virginia Mason Medical Center Seattle, WA.

Regional anesthesia and analgesia are safe in part because associated neurologic complications are exceedingly rare. Yet when neurologic complications occur in this setting they are often life altering, especially when involving the neuraxis. Since August Bier's first spinal anesthetic in 1898, anesthesiologists have sought to minimize neurologic complications.

This presentation aims to take a circumspect look at neurologic complications associated with regional anesthesia and to critically appraise our success in eliminating them. During the course of this analysis, I intend to made several key points:

- Regional anesthesia has experience cyclical approval or condemnation as specific neurologic complications have been identified and addressed.
- Overall, it is difficult to see meaningful reduction in many neurologic complications. This occurs in part because as we demonstrate safety with a procedure, we tend to extend its use to patients who are at higher risk for complications.
- Our ability to obtain good incidence data has improved vastly. A secondary advantage of this is improved understanding of previously unrecognized etiologic factors and associations.
- Our attempts to reduce neurologic complications have been both successful and unsuccessful over the years.
- Several emerging complications will be discussed and placed into perspective.

CONSIDER THIS

- Obstetric epidurals - 1980 to 1996
  - Use increases 10 fold
  - Stable rate of hematoma 1:200,000
- Total joint replacement
  - Exponential growth
  - Rate of hematoma 1:3,800
- Ambulatory orthopedics - 1996 to 2006
  - Shoulder arthroscopy increases by 350%
  - PNB increases from 11.5 to 24%

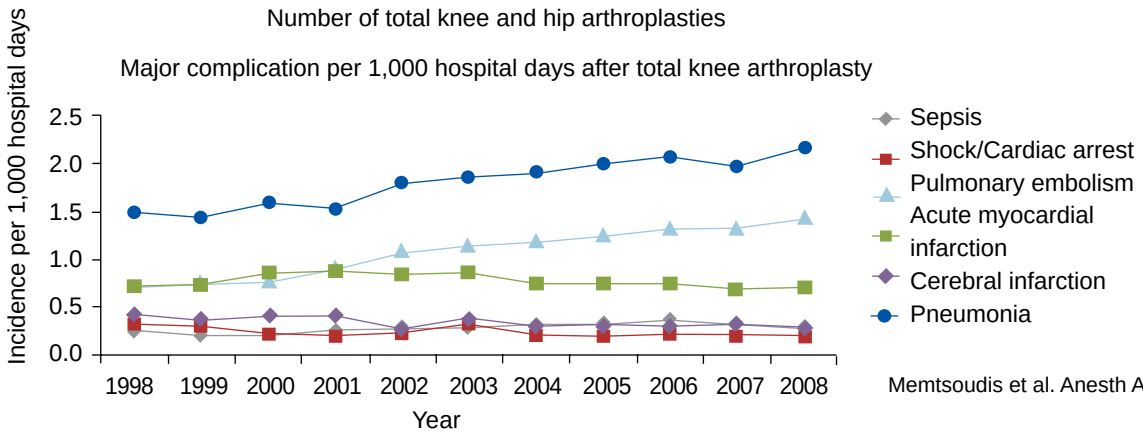
Moen et al. Anesthesiology. 2004.
Memtsoudis et al. Reg Anesth Pain Med. 2011.

- Long-term nerve injury
  0-16/10,000
- Local anesthetic systemic toxicity
  3/10,000
- Epidural hematoma
  0-4/10,000

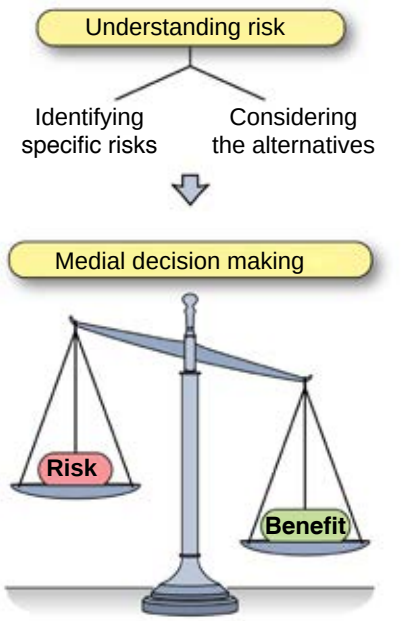
A Six Sigma/High Reliability Organization
3.4/1,000,000

- Extend the risk to another facet of care
- Overall Risk Remains Unchanged
- Decrease risk in one aspect of safety

ARTHROPLASTY AND MAJOR COMPLICATIONS
Both are increasing

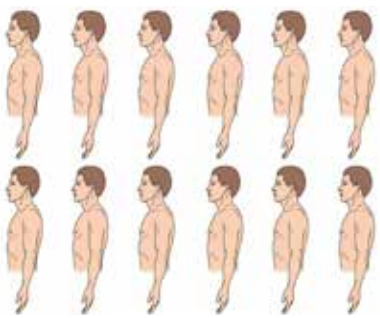


Memtsoudis et al. Anesth Analg. 2012.



Neal & Rathmell. 2013.

«NO COMPLICATIONS IN 12 PATIENTS»
(0/12 (0%) complications with 95% confidence interval 0-25%)



What does «No complications» really mean?
The 3/n Rule
The upper limit of the 95% CI

Neal & Rathmell. 2013.

«PROVING» SAFETY

Assume 3% early, transient injury
Alpha 0.05, beta 0.8
> 3,000 patients per group to reduce by 50 to 1.5%
Long-term injury
4 → 2/10,000
> 70,000 patients/group!

ORIGINAL ARTICLE

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
Brian Daniels Sites, MD, Andreas H. Taenzer, MS, MD, Michael D. Herrick, MD, Constance Gilloon, MD, John Antonakakis, MD, Janeen Richins, MD, and Michael L. Beach, MD, PhD

- Postoperative neurologic symptoms > 6 months:
  — 0.9/1,000 (95% CI, 0.5-1.7)
- Compared with Brull et al (> 12 months):
  — 0.04/1,000
  — 22 fold less than Sites et al.

Reg Anesth Pain Med. 2012.

BIG NUMBERS = INSIGHTS INTO CAUSALITY

Pain and regional anesthesia

Anesthesiology 2004;101:950-959.

Severe neurological complications after Central Neuraxial Blockades in Sweden 1990-1999

Vibeke Moen, MD,* Nils Dahigren, MD., PhD,† Lars Irestedt, MD, PhD‡

- 1.7 million neuraxial anesthetics
- Signal for associated spinal stenosis
- Epidural hematoma rates differ
  - — 1:200,000 young women in labor
  - — 1:3,600 older women having TKR
- 32 cauda equina syndrome
- 13 epidural abscess

BIG NUMBERS AND GRANULARITY THE GOLD STANDARD

Reg Anesth Pain Med. 2009.

ORIGINAL ARTICLE

Preliminary results of the Australasian Regional Anaesthesia Collaboration

A prospective audit of more than 7,000 peripheral nerve and plexus blocks for neurologic and other complications

Michael J. Barrington, MB, BS, FANZCA,* Steve A. Watts, MB, ChB, FANZCA,† Samuel R. Gledhill, MMedStat,* Rowan D. Thomas, MB, BS, FANZCA, MPH,* Simone A. Said, PGDipEpi,* Gabriel L. Snyder, MB, BS,* Valerie S. Tay, MB, BS, FRACP,‡ and Konrad Jamrozik, DPhil, FAFPHM§

GUIDELINES THAT WORK

Impact of ASRA Anticoagulation Guidelines

March 1993	FDA approves enoxaparin
October 1993	1st report of epidural hematoma
January 1996	11 hematomas reported
March 1997	1st ASRA advisory published
April 1998	40 + 20 hematomas reported to MedWatch Vandermeulen had reported only 64 in previous 100 years
2002	Only 13 additional MedWatch cases

Ultrasound guidance reduces the risk of local anesthetic systemic toxicity following peripheral nerve blockade

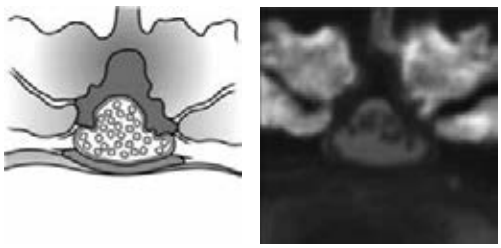
Michael J. Barrington, PhD, MBBS, FANZCA and Roman Kluger, MBBS, FANZCA PGDDipBiostat

- Australia & New Zealand Registry of Regional Anaesthesia
- 2007-2012 → 25,336 PNB
- US (vs no US) reduced LAST > 65%

Reg Anesth Pain Med. 2013.

SPINAL STENOSIS AND NEURAXIAL COMPLICATIONS

- Epidural hematoma
- Epidural abscess
- CES
- New or exacerbated deficit



Moen, Hebl, Horlocker.

CLINICAL RECOMMENDATION IN PERSPECTIVE

- Very common condition
- Dx often unknown
- Degree of (severe) spinal stenosis
- Can be indication for therapy
- Nevertheless…

RETHINKING LLA

- LLA probably higher than 50 mmHg
- Hypotension and perioperative stroke
  - — MAP ↓ > 30% from baseline
  - — Time dependent
- LLA during CPB
  - — LLA of MAP = 66 mmHg (43 to 90)
  - — Unpredictable based on Hx or PreOp MAP

JC Drummond

Bijker et al. Anesthesiology. 2012.

Joshi et al. Anesth Analg. 2012.

CLINICAL RECOMMENDATIONS IN PERSPECTIVE

- Consider LLA MAPs closer to 60-70 mmHg, rather than 50 mmHg
- Beware of MAPs < 30% of baseline
- Avoid prolonged BP < 30% MAP baseline
- Few compelling reasons for low MAPs

CAUDA EQUINA SYNDROME

- Swedish observations

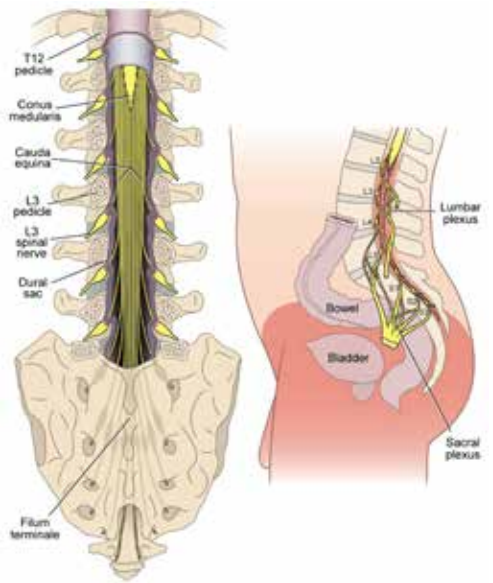
- 32 CES/1,710,000 neuraxial blocks
- 9/32: (unknown) spinal stenosis
- 23/32: believed related to LA toxicity or pressure

- French observations
  - 3-5 CES/~ 58,000 neuraxial blocks
  - 2 received 75-100 mg lidocaine, 1 rec'd 350 mg

Moen et al. Anesthesiology. 2004.
Auroy et al. Anesthesiology 1997. 2002.

CAUDA EQUINA SYNDROME

- Supernormal doses
- Maldistribution
- BUT, most are «normal»
  - Local anesthetic toxicity?
  - Inflammatory?



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- Neal JM, Barrington MJ, Brull R, et al. The second ASRA practice advisory on neurologic complications associated with regional anesthesia and pain medicine: Executive summary, 2015. Reg Anesth Pain Med 2015;40:401-430.