Has Dual Guidance Been A Success?

Review of Evidence…

Dr Azrin Mohd Azidin
MBBS M Med (Anaes), A M
Dept of Anaesthesia and Intensive Care
Hospital Kuala Lumpur

Content

- Dual Guidance
- Review of Evidence
- Issues on use of nerve stimulator
- Conclusion

Background

- Greenblatt and Denson in 1960's – portable transistorized nerve stimulator.

- 'Gold standard' of peripheral nerve blocks for > half a century
- Ultrasound guided (USG) era about 25 years ago – Ting & Sivagnanaratnam

Comparison US v NS

Author	Approach	Nerve Stimulation Success Rate	Ultrasound Success Rate	Statistical Significant Difference
Marhofer et al. 1997	Femoral N = 40	85%	95%	NO
Williams et al. 2003	Supraclavicular N = 80	78%	85%	NO
Liu et al. 2005	Axillary N = 90	90%	90%	NO
Chan et al. 2007	Axillary N = 188	63%	81%	YES
Casati et al. 2007	Axillary N = 60	100%	100%	NO
Perlas et al. 2008	Lateral popliteal sciatic N = 74	61%	89%	YES
Guerkan et al. 2008	Infraclavicular N = 60	93%	95%	NO
Kapral et al 2008	Interscalene N = 160	91%	99%	YES
Sauer et al 2008	Infraclavicular N = 80	85%	95%	NO
Macaire et al. 2008	Median and Ulnar nerve at the wrist N = 60	93%	93%	NO

Table 2: Nerve Stimulation vs. Ultrasound – Nerve Block Success Rate in Randomized Clinical Trials

Steps of Nerve Block Performance	Ultrasound	Nerve Stimulation	Ultrasound Combined with Nerve Stimulati
Multi-Dimensional Method	+ +	+ + +	
Nerve Localization	+ +		
Needle Guidance to Target			+ + +
Avoidan		-	+ +
	+	+ +	+ + +
surance of Adequate Local Anesthetic Delivery	+	+	+ +

Dual Guidance

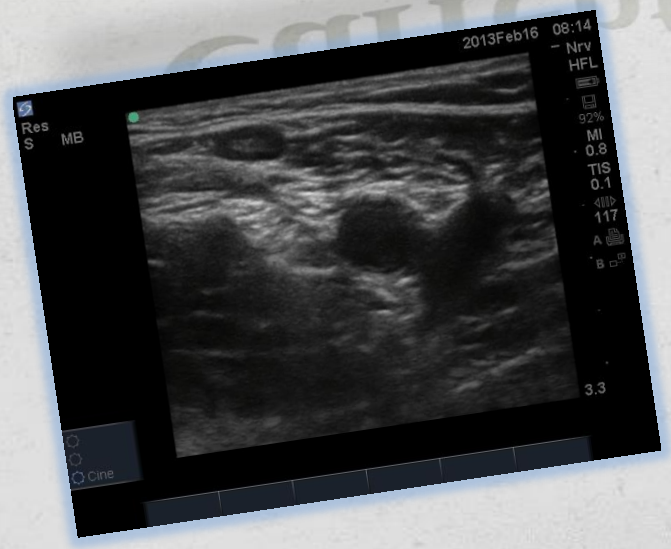
Table 3: Synergy between Ultrasound and Nerve Stimulation during Nerve Block Performance

Dual Guidance

Definition

- Technique of using the synergistic properties of two modalities i.e US and NS (anatomical and functional)
- Real time optimal nerve localization and injection patterns
- avoiding perineural structures and maximizing success and minimalizing complications.

Current Recommendations...



ESRA and ASRA Recommendations 2009…

Consider a secondary confirmation technique, such as nerve stimulation
Regional Anesthesia and Pain Medicine

SFAR Recommendations 2011

Additional means are recommended for doing a block: nerve stimulation and/or hydro-localization and/or hydro-dissection and/or removal of tissue, with the needle's movements

German Society of Anaesthesiology Recommendations 2014

The sole use of electrical nerve stimulation or ultrasound for nerve localization is still a suitable option as well as their combined use

In RAPM 2012..

- Orebaugh SL. Adverse outcomes associated with nerve stimulator-guided and ultrasound-guided peripheral nerve blocks by supervised trainees. Update of a single-site database.
- Schoenmakers KPW. Effect of local anesthetic volume (15 v 40ml) on the duration of ultrasound –guided single-shot axillary brachial plexus block. A prospective, randomized observer- blinded trial.
- Hara K. Incidence and effects of unintentional intraneural injection of ultrasound-guided subgluteal sciatic nerve block.
- Fournier R. Perineural clonidine does not prolong levobupivacaine 0.5% after sciatic nerve block using the Labat approach in foot and ankle surgery.
- Fredrickson MJ. Randomized study of the effect of local anesthetic volume and concentration on the duration of peripheral nerve blockade.
- Laur JJ. Triple-blind randomized clinical trial of time until sensory change using 1.5% mepivacaine with epinephrine, 0.5% bupivacaine, or an equal mixture of both for infraclavicular block
- Manassero A. Ultrasound –guided obturator nerve block. Interfascial injection versus neurostimulation-assisted technique

Only 3 in 2013 RAPM…

Systematic Ultrasound Identification of the Dorsal Scapular and Long Thoracic Nerves During Interscalene Block

Neil A. Hanson, MD and David B. Auyong, MD

The Effects of Ultrasound-Guided Adductor Canal Block Versus Femoral Nerve Block on Quadriceps Strength and Fall Risk

A Blinded, Randomized Trial of Volunteers

M. Kwesi Kwofie, MD, FRCPC, Uma D. Shastri, MD, FRCPC,†*
Jeff C. Gadsden, MD, FRCPC, FANZCA,‡ Sanjay K. Sinha, MBBS,§ Jonathan H. Abrams, MD,§
Daquan Xu, MB, MPH,‡ and Emine A. Salviz, MD‡

Ultrasound-Guided Root/Trunk (Interscalene) Block for Hand and Forearm Anesthesia

Sarah J. Madison, MD, Julie Humsi, MD,* Vanessa J. Loland, MD,† Preetham J. Suresh, MD,**
NavParkash S. Sandhu, MD, Michael J. Bishop, MD,* Michael C. Donohue, PhD,* Dong Nie, MS,**
Eliza J. Ferguson, BS, Anya C. Morgan, MA, CCRC,* and Brian M. Ilfeld, MD, MS**

Only 2 in 2014 RAPM...

A Dose-Ranging Study of 0.5% Bupivacaine or Ropivacaine on the Success and Duration of the Ultrasound-Guided, Nerve-Stimulator–Assisted Sciatic Nerve Block

A Double-Blind, Randomized Clinical Trial

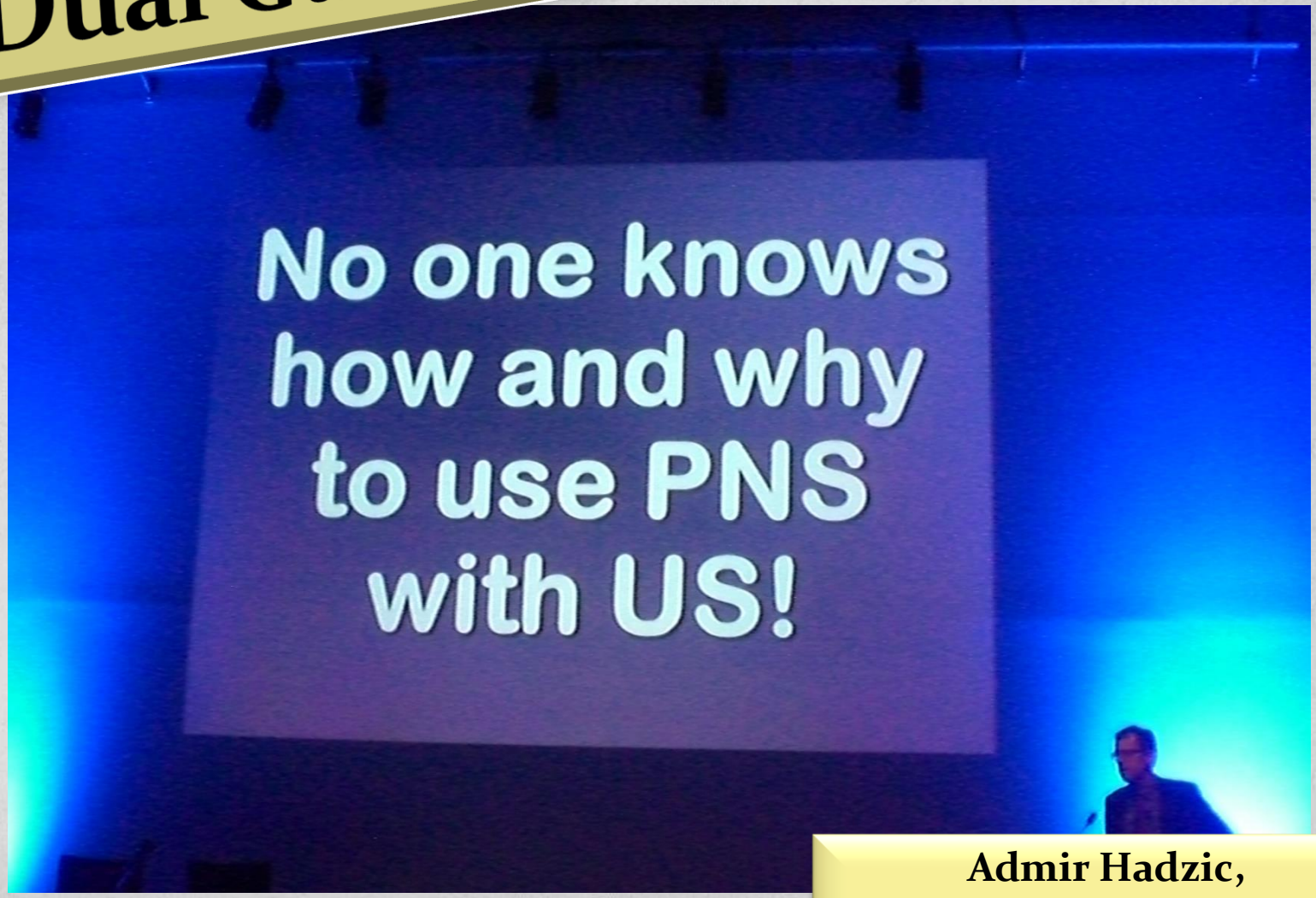
Antoun Nader, MD, Mark C. Kendall, MD,* Gildasio S. De Oliveira, Jr, MD, MSCI,* Lalit Puri, MD,† Luminita Tureanu, MD,* Alina Brodskaia, MD,* Yogen Asher, MD,* Vamsi Parimi, MD, MPH,‡ and Robert J. McCarthy, PharmD**

Subparaneural Versus Circumferential Extraneural Injection at the Bifurcation Level in Ultrasound-Guided Popliteal Sciatic Nerve Blocks

A Prospective, Randomized, Double-Blind Study

Olivier Choquet, MD, Guillaume Brault Noble, MD, MSc,* Bertrand Abbal, MD,* Didier Morau, MD, MSc,* Sophie Bringuier, PharmD, PhD,†‡ and Xavier Capdevila, MD, PhD*§*

Dual Guidance



Admir Hadzic,
Bordeaux ESRA 2012

Is Dual Guidance superior?...

- **Block efficacy**
  - Success rate
  - Performance time
  - Needle pass
- **Safety**
  - Role of NS in detection of intra neural injection

On block efficacy….

- Several single centre studies with small sample sizes (largest was n=188)
- No systematic review or meta-analysis
- Heterogenous population sample, multiple block types
- Multiple definitions of ‘block success’; different quantification of success rates, performance time

Block efficacy..

- Beach ML. **Use of a nerve stimulator does not improve the efficacy of ultrasound-guided supraclavicular blocks.** *Journal of Clinical Anesthesia 2006*
- Chan V. **Ultrasound Guidance improves success rates of axillary brachial plexus block.** *Can J Anaesth. 2007*
- Dingemans E. **Neurostimulation in ultrasound guided infraclavicular block: a prospective randomized trial.** *Anesth Analg 2007*
- Sites BD. **A comparison of sensory and motor loss after a femoral nerve block conducted with ultrasound versus ultrasound and nerve stimulation.** *Reg Anesth Pain Med 2009*
- Gurkan Y. **Is nerve stimulation needed in ultrasound guided lateral sagittal infraclavicular block.** *Acta Anesth Scandinavica 2010*

- **Block efficacy**
  - Success rate
  - Performance time
  - Needle pass
- **Safety**
  - Role of NS in detection of intraneural injection
  - Peripheral neuropathy

Use of a nerve stimulator does not improve the efficacy of ultrasound-guided supraclavicular nerve blocks

Michael L. Beach MD, PhD (Associate Professor of Anesthesiology)*,
Brian D. Sites MD (Assistant Professor of Anesthesiology and Orthopedics),
John D. Gallagher MD (Professor of Anesthesiology)

Abstract

Objective: To evaluate the efficacy of nerve stimulation as an adjunct to ultrasound-guided supraclavicular nerve blocks.

Design: Prospective database review.

Setting: Tertiary-care medical center.

Measurements: The records of 94 consecutive adult patients requiring surgery below the elbow and consenting to receive regional anesthesia were studied. The focus of this study was on supraclavicular nerve block using ultrasound guidance for nerve identification and needle localization. A nerve stimulator with a motor response lower than 0.5 mA was used for confirmation of findings. An ultrasound image was considered adequate if two trunks of the brachial plexus were visualized and if the needle was completely seen on the long axis. A successful block was defined as one that sufficed as the sole anesthetic without conversion to general anesthesia. Motor and sensory examination findings on the upper extremity were also evaluated.

Results: 74 patients had an adequate ultrasound image. Of the 64 patients with a positive motor response, 88% had a successful block, as compared with 90% of the 10 patients without a motor response (relative risk, 1.09; 95% confidence interval, 0.79-1.51; $P = 0.52$). Neither multivariate correction for baseline characteristics nor inclusion of the 20 patients with inadequate ultrasound images changed the results.

Conclusion: For adequately imaged ultrasound-guided supraclavicular nerve blocks, a positive motor response to nerve stimulation does not increase the success rate of the block. In addition, the high false-negative rate suggests that these blocks are usually effective, even in the absence of a motor response. Nerve stimulation as an adjunct to ultrasound guidance may have a limited role.

Use of a nerve stimulator does not improve the efficacy of ultrasound-guided supraclavicular nerve blocks

Michael L. Beach MD, PhD (Associate Professor of Anesthesiology)*,
Brian D. Sites MD (Assistant Professor of Anesthesiology and Orthopedics),
John D. Gallagher MD (Professor of Anesthesiology)

ultrasound-guided block with well-defined anatomy and needle position, the twitch monitor does not appear to add any useful information with respect to the ultimate success of the block.

Perhaps nerve stimulation does have a role with respect to both positive and negative predictive values for ultrasound images in which visualization of either the nerve plexus or the needle is not ideal. This issue is not directly

Conclusion: For adequately imaged ultrasound-guided supraclavicular nerve blocks, a positive motor response to nerve stimulation does not increase the success rate of the block. In addition, the high false-negative rate suggests that these blocks are usually effective, even in the absence of a motor response. Nerve stimulation as an adjunct to ultrasound guidance may have a limited role.

Ultrasound guidance improves success rate of axillary brachial plexus block

[L'échoguidage améliore le taux de succès du bloc axillaire du plexus brachial]

Vincent W.S. Chan MD FRCPC,*† Anahi Perlas MD FRCPC,*† Colin J.L. McCartney MBChB FRCA FFARCSI FRCPC,*† Richard Brull MD FRCPC,*† Daquan Xu MB MSc,† Sherif Abbas MD†

Purpose: The purpose of this study is to determine if real time ultrasound guidance improves the success rate of axillary brachial plexus blockade.

Methods: Patients undergoing elective hand surgery were randomly assigned to one of three groups. Axillary blocks were performed using three motor response endpoints in the nerve stimulator (NS) Group, real-time ultrasound guidance in the ultrasound (US) Group and combined ultrasound and nerve stimulation in the USNS Group. Following administration of a standardized solution containing 2% lidocaine with 1:200,000 epinephrine and 0.5% bupivacaine (total 42 mL), sensory and motor functions were assessed by a blinded observer every five minutes for 30 min. A successful block was defined as complete sensory loss in the median, radial and ulnar nerve distribution by 30 min. The need for local and general anesthesia supplementation and post-block adverse events were documented.

Results: One hundred and eighty-eight patients completed the study. Block success rate was higher in Groups US and USNS (82.8% and 80.7%) than Group NS (62.9%) ($P = 0.01$ and 0.03 respectively). Fewer patients in Groups US and USNS required supplemental nerve blocks and/or general anesthesia. Postoperatively, axillary bruising and pain were reported more frequently in Group NS.

CAN J ANESTH 2007 / 54: 3 / pp 176–182

Contrary to our expectations, we failed to demonstrate a higher block success rate when nerve stimulation was added to ultrasound as a confirmatory tool.

Conclusion: This study demonstrates that ultrasound guidance, with or without concomitant nerve stimulation, significantly improves the success rate of axillary brachial plexus block.

CAN J ANESTH 2007 / 54: 3 / pp 176–182

Neurostimulation in Ultrasound-Guided Infraclavicular Block: A Prospective Randomized Trial

Emmanuel Dingemans, MD*
Stephan R. Williams, MD, PhD*
Geneviève Arcand, MD, FRCPC*
Philippe Chouinard, MD, FRCPC*
Patrick Harris, MD, FRCSC†
Monique Ruel, RN*
François Girard, MD, FRCPC*

Ultrasound guidance (USG) for infraclavicular blocks provides real time visualization of the advancing needle and local anesthetic distribution. Whether visualization of local anesthetic spread can supplant neurostimulation as the end point for local anesthetic injection during USG block has never been formally evaluated. Therefore, for this prospective randomized study, we recruited 72 patients scheduled for hand or forearm surgery and compared the speed of execution and quality of USG infraclavicular block with either USG alone (Group U) or USG combined with neurostimulation (Group S). In Group U, local anesthetic was deposited in a U-shaped distribution posterior and to each side of the axillary artery using as few injections as possible (1, 2, and 3 injections in 29, 6, and 3 patients, respectively). In Group S, a single injection was made after obtaining a distal motor response with a stimulating current between 0.3 and 0.6 mA. The anesthetic solution consisted of 0.5 mL/kg of lidocaine 1.5%, bupivacaine 0.125%, and epinephrine 1:200 000 (final concentrations). Procedure times were significantly shorter in Group U compared with Group S (3.1 ± 1.6 min and 5.2 ± 4.7 min, respectively; $P = 0.006$). In Group S, anesthetic spread was mainly anterior to the axillary artery in 37% of patients and mainly posterior in 63% of patients. Thirty minutes after the injection, 86% of patients in Group U had complete sensory block in the musculocutaneous, median, radial, and ulnar nerve territories compared with 57% in Group S ($P = 0.007$). Patients blocked in Group U with a single injection had the same rate of complete block (86%) as those blocked with more than one injection (86%). Block supplementation rates were 8% in Group U versus 26% in Group S ($P = 0.049$). Block failure occurred in one patient in Group S because of an inability to obtain a distal stimulation after 20 min. We conclude that USG infraclavicular block is more rapidly performed and yields a higher success rate when visualization of local anesthetic spread is used as the end point for injection. Posterolateral spread of local anesthetic around the axillary artery predicts successful block, circumventing the need for direct nerve visualization.

stimulation after 20 min. We conclude that USG infraclavicular block is more rapidly performed and yields a higher success rate when visualization of local anesthetic spread is used as the end point for injection. Posterolateral spread of local anesthetic around the axillary artery predicts successful block, circumventing the need for direct nerve visualization.

A Comparison of Sensory and Motor Loss After a Femoral Nerve Block Conducted With Ultrasound Versus Ultrasound and Nerve Stimulation

Brian D. Sites, MD, Michael L. Beach, MD, PhD, Christopher D. Chinn, MD, MPH, Kirsten E. Redborg, MD, and John D. Gallagher, MD

Background: Controversy exists regarding the need for nerve stimulation when performing an ultrasound (US)-guided peripheral nerve block. We tested the hypothesis that the quality of a femoral nerve block (FNB) performed with US is equivalent to an FNB performed with US and nerve stimulation.

Methods: One hundred seven patients undergoing unilateral total knee arthroplasty were randomized to receive either a US-guided FNB (group US) or a US-guided FNB with nerve stimulation (group USNS). Thirty milliliters of bupivacaine 0.5% was injected in both groups. At 10, 20, 30, and 40 mins after block placement, blinded motor and sensory examinations were conducted. Secondary outcomes included time to perform the block, the number of needle redirections, and 24-hrs intra-

Conclusion: The addition of nerve stimulation to a US-guided FNB did not change preoperative block efficacy.

nerve (complete in 71.7% and partial in 24%) compared with 88.1% of US subjects (complete in 69% and partial in 19.1%; odds ratio, 2.97; $P = 0.19$). There were more needle redirections in group USNS (4.1 vs 1.1, $P < 0.001$), with a higher percentage of patients requiring 2 or more needle attempts (44.2% vs 18.9%, $P < 0.01$). The time to perform the block in group USNS was longer (188 vs 148 secs, $P = 0.01$).

Conclusion: The addition of nerve stimulation to a US-guided FNB did not change preoperative block efficacy.

(*Reg Anesth Pain Med* 2009;34: 508–513)

Is nerve stimulation needed during an ultrasound-guided lateral sagittal infraclavicular block?

Y. GÜRKAN, M. TEKIN, S. ACAR, M. SOLAK and K. TOKER
Department of Anesthesiology, Kocaeli University Hospital, Kocaeli, Turkey

Background: The objective of the study was to evaluate the influence of ultrasound (US) guidance alone vs. neurostimulation (NS) and US (NSUS) guidance techniques on block performance time and block success rate for the lateral sagittal infraclavicular block (LSIB).

30 min. Successful block was defined as analgesia or anesthesia of all five nerves distal to the elbow.

Results: Block success rate was 94.5% in both groups. Block performance time was significantly shorter in the US than the NSUS group (157 ± 50 vs. 230 ± 104 s)

alone group. Conclusion of Dingemans and colleagues is in accordance with our results that NS during US-guided infraclavicular block does not add additional benefit to block success rate. Sauter

20 ml of lidocaine 20 mg/ml) was administered in both groups. Sensory block was tested at 10 min intervals for

Conclusions: During LSIB performance US guidance alone produces block success rate identical to both US and NS guidance yet with a shorter block performance time.

Author	'Block Success'	Block Time	Needle pass	Complication
Beach 2006 (Supraclvicular) n=94	Overall 89% With twitch 89% Without twitch 92%	Not significant	Not as end point	No complications
Vincent 2007 (Axillary) n=188	US USNS PNS 82.2%* 80.7%* 62.9% Surgical anaesthesia 95%* 92%* 85.5%	US USNS PNS 9.3* 12.4* 11.2	Not as end point	No major complications
Dingemans 2007 (Infraclavicular) n=72	'Block quality' Complete blocks US USNS 86% 57%* Surgical anaesthesia 92% 72%* Supplement rate	3.1 v 5.2*	Not as end point	Vascular puncture 2 v 1 Paraesthesia>1/52 1 v 0 Shoulder pain <3/7 0 v 1
Sites 2009 (Femoral) n=107	Complete and partial at 40 mins US USNS 88.1%(69%+19.1%) 95.7%(71.7%+24%) 90.2% 89.1% (motor)	147.8s v 188.2s*	1.1 v 4.2*	No complications
Gurkan 2010 (Infraclavicular) n=110	US USNS 94.5% 94.5%	157s v 230s*	Not statistically significant	Vascular puncture in 2 (USNS)

Despite the conclusions…

- Vincent did not directly compare USG v US-NS . Significance testing was done between US techniques v NS
- Only Dingemans used NS as end-point for US-NS group
- Gurkan, Vincent, Sites used NS, BUT LOOKED AT ADEQUATE DRUG SPREAD as end-point.
- Gurkan study was only powered to detect a difference in performance time

- Block efficacy
  - Success rate
  - Performance time
  - Needle pass
- **Safety**
  - Role of NS in detection of intraneural injection

Is Nerve Stimulation sensitive in detecting intraneural injections....

Nerve Injury Complicating Ultrasound/Electrostimulation–Guided Supraclavicular Brachial Plexus Block

Wojciech Reiss, MD, Sushmitha Kurapati, MD, MPH, Ali Shariat, MD, and Admir Hadzic, MD

Background and Objectives: Neurologic complications after peripheral nerve blocks (PNBs) are relatively uncommon. It has been postulated that real-time, needle-nerve visualization during ultrasound-guided PNBs might further reduce the risk of neurologic or vascular complications.

Case Report: In this report, we describe the occurrence of a severe brachial plexus injury after combined ultrasound and nerve stimulator

Moreover, reliance on nerve stimulation to rule out an intraneural injection may be further diminished in the setting of multiple injections of local anesthetic.[11]

(*Reg Anesth Pain Med* 2010;35: 400–401)

Anaesthesist. 2013 Mar; 62(3):183-88, 190-2. doi: 10.1007/s00101-013-2150-5. Epub 2013 Mar 16.

Distal sciatic nerve blocks: randomized comparison of nerve stimulation and ultrasound guided intraepineural block.

[Article in German]

Seidel R[1], Natge U, Schulz J.

BACKGROUND AND OBJECTIVES:

The design of this study is related to an important current issue: should local anesthetics be intentionally injected into peripheral nerves? Answering this question is not possible without better knowledge regarding classical methods of nerve localization (e.g. cause of paresthesias and nerve stimulation technique). Have intraneural injections ever been avoided? This prospective, randomized comparison of distal sciatic nerve block with ultrasound guidance tested the hypothesis that intraneural injection of local anesthetics using the nerve stimulation technique is common and associated with a higher success rate.

CONCLUSIONS:

For distal sciatic nerve blocks using the nerve stimulation technique, intraepineural injection of local anesthetics is common and associated with significant and clinically important higher success rates as well as shorter times until readiness for surgery. In both groups no block-related nerve damage

methods of nerve localization (cause of paresthesias and nerve stimulation technique). Additional nerve stimulation with an ultrasound-guided distal sciatic nerve block cannot make any additional contribution to the safety or success of the block. New insights concerning the architecture of the

contribution to the safety or success of the block. New insights concerning the architecture of the sciatic nerve are discussed and associated implications for the performance of distal ultrasound-guided sciatic nerve block are addressed.

Intraneural Injection with Low-Current Stimulation During Popliteal Sciatic Nerve Block

Christopher Robards, MD*

Admir Hadzic, MD†

Lakshmanasamy Somasundaram, MD*

Takashige Iwata, MD*

Jeff Gadsden, MD*

Daquan Xu, MD*

Xavier Sala-Blanch, MD‡

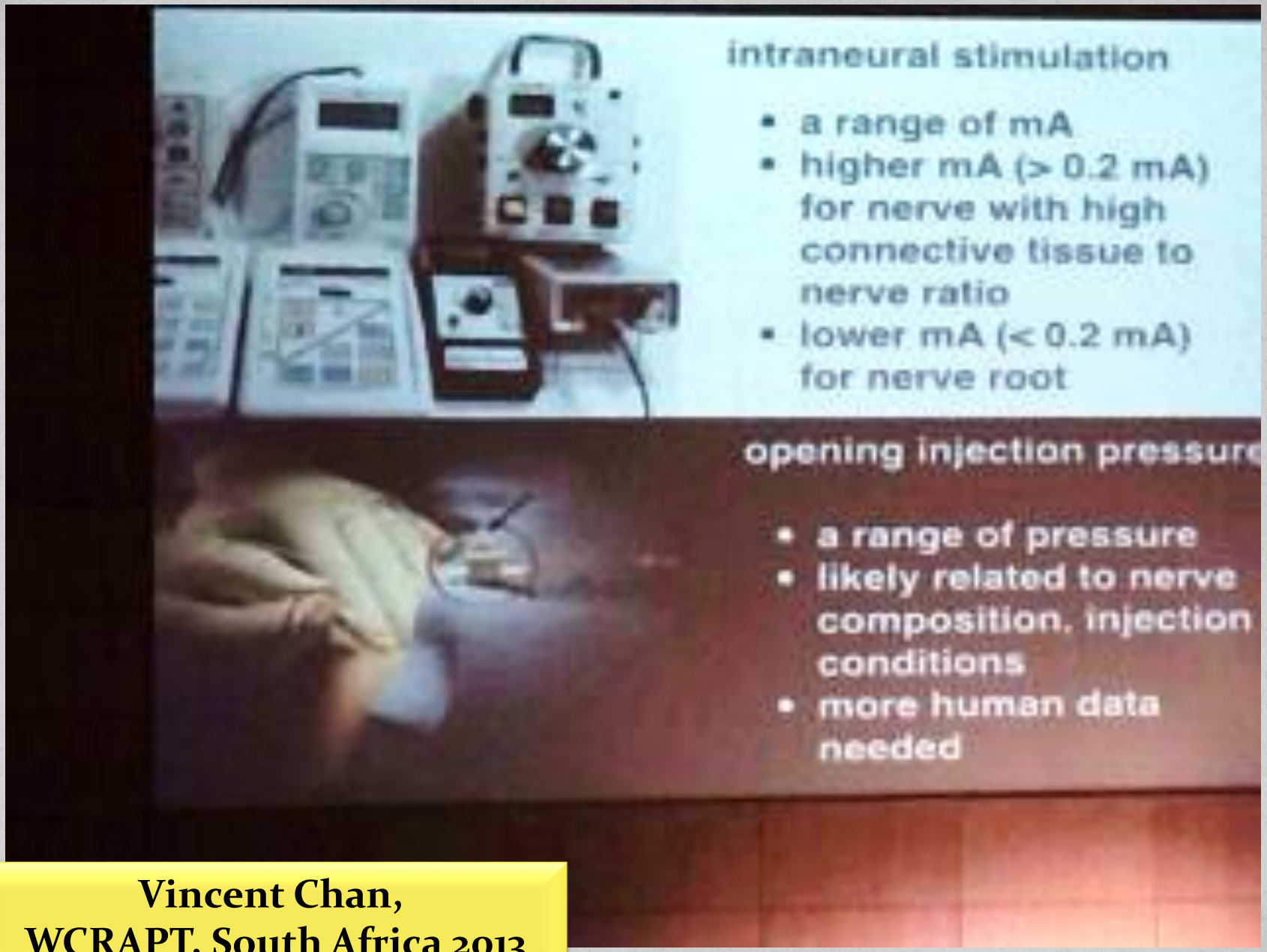
BACKGROUND: Prevention of an intraneural injection of a local anesthetic during peripheral nerve blockade is considered important to avoid neurologic injury. However, the needle-nerve relationship during low-current electrical nerve localization is not well understood.

METHODS: We postulated that intraneural needletip location is common during low-current stimulation popliteal sciatic nerve blockade. Twenty-four consecutive ASA class I-III patients scheduled for foot or ankle surgery under popliteal sciatic nerve block using a combined ultrasound and nerve stimulator-guided technique were prospectively studied. The end point for needle advancement was predetermined to be either an elicited motor response between 0.2 and 0.5 mA (100 μs/2 Hz) or an apparent intraneural location of the needletip as seen on ultrasound, whichever came first. The injection occurred at either end points provided the injection pressure was <20 psi. The injection was considered intraneural when injectate resulted in both the swelling and compartmentalization of the nerve within the epineurium.

RESULTS: Elicited motor response could be obtained only upon entry of the needle into the intraneural space in 20 patients (83.3%). In the remaining four patients (16.7%), a motor response with a stimulating current of 1.5 mA could not be obtained even after the needle entry into the intraneural space. An injection in the intraneural space occurred in all patients who had motor-evoked response at current 0.2–0.4 mA. All 24 blocks resulted in adequate anesthesia for foot surgery. No patient developed postoperative neurologic dysfunction.

CONCLUSION: The absence of motor response to nerve stimulation during popliteal sciatic nerve block does not exclude intraneural needle placement and may lead to additional unnecessary attempts at nerve localization. Additionally, low-current stimulation was associated with a high frequency of intraneural needle placement.

(Anesth Analg 2009;109:673–7)



Vincent Chan,
WCRAPT, South Africa 2013

Possible reasons…

- Different ratio of neural: non-neural composition of different nerves and also within the same nerve at different locations.

  Moayeri N. **Differences in quantitative architecture of sciatic nerve may explain differences in potential vulnerability to nerve injury, onset time and minimum effective anesthetic volume.** *Anesthesiology 2009; 111: 1128-1134*

- More central location, less non-neural component, potentially lower current required as minimum stimulation threshold.

Possible reasons…

- Difference in extra-neural/intra-neural tissue impedance even of same nerve at different sites.
  - Sauter AR. **Current threshold for nerve stimulation depends on electrical impedance of the tissue: A study of ultrasound guided electrical nerve stimulation of the median nerve.** *Anesth Analg 2009; 108: 1338-1143*
- Probably similar concept with opening pressure.

Conclusion… Is NS helpful?

- Not all needle-nerve contact results in stimulation and motor response or paraesthesia
- Different approaches/block locations for the same nerve may have different stimulating thresholds

Relationship between Impedance v Current Tresholds

Sauter 2009

- 29 volunteers; measure impedance and threshold current of median nerve at axilla v elbow at 0.1 and 0.3 msec pulse duration.
- Results;
  - Threshold Current lower at elbow v axilla
  - threshold lower with 0.3 v 0.1
  - Impedance lower in muscle v fat
  - Impedance lower in axilla v elbow
  - Inverse relationship between Impedance and Threshold

Current setting may require adjustment based on tissue type and Impedance

Conclusion… Is NS helpful?

- **Current understanding <0.2 mA IS intra-neural, BUT no response OR other stimulating current up to 1.7 mA MAY be intra-neural - depending on US image (operator –observer dependent)**

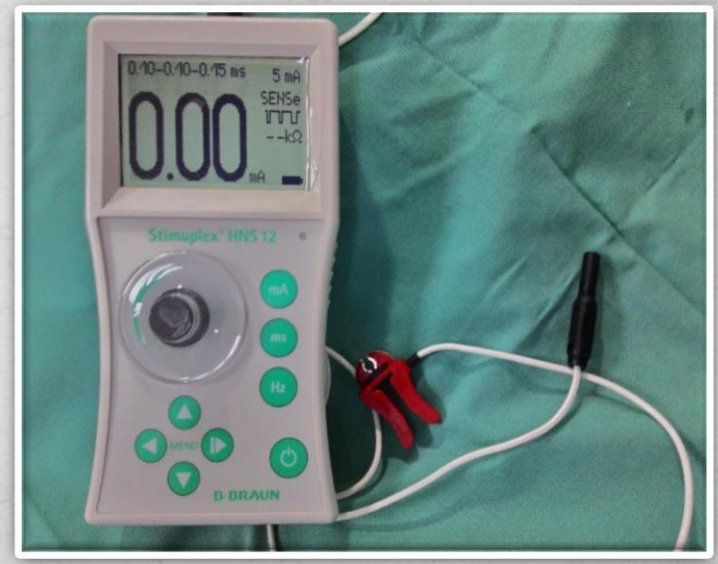
Conclusion… Is NS helpful?

- Our application and clinical use of nerve stimulation principles based on ABSOLUTE VALUES may be wrong!!!
- Only reflects nerve-needle distance but NOT intra-neural

Conclusion

- Literature is poor
- Current evidence - Conventional NS adds no value
- No evidence on the use of SENS with USG
- NS with USG in deep/difficult blocks or where images of nerves or needles are degraded

Thank You



Dr Azrin Mohd Azidin
Hospital Kuala Lumpur, Malaysia
azrinmohdazidin@yahoo.com

Reference Journals

- *Regional Anesthesia and Pain Medicine*
- *Anesthesia Analgesia*
- *Pediatric Anesthesia*
- *Journal of Clinical Anesthesia*
- *Canadian Journal of Anesthesiology*
- *Acta Anaesthesiologica Scandinavica*
- *Minerva Anesthesiologica*
- *Das Anesthesis*
- *Lecture- Admir Hadzic ESRA Bordeaux 2012*
- *Lecture- Vincent Chan WCRAPT South Africa 2013*
- *Lecture- Luc Mercadal ESRA Seville 2014*