A One-Step Catheter Over Needle System Compared to a Single Shot Nerve Block for Shoulder Surgery

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Background

- Continuous peripheral nerve blockade (CPNB):
  - Single shot technique (SSNB)
    - Fast, but repeats may be necessary
  - Catheters:
    - Prolonged analgesia, lower doses
    - Additional time slows surgery start → limited use
- Catheters: Through-the-needle (CTN), Over-the-needle (CON).
  - CTN: Common, slower, leak, dislodge
  - CON: Newer, faster, don't require needle movement to fix, less leak.
- A one-step catheter over needle system potentially reduces catheter placement procedural time and therefore could expand access to continuous peripheral nerve blockade.
- Comparison: SSNB vs CON placement

Methods

- Elective shoulder surgeries with interscalene peripheral nerve blocks
- Comparison: SSNB vs. CON placement time
- Single trainee (JL) PGY 4-5 level under direct supervision of multiple regional anesthesiologists. Time keeper AS.
- 20 patients CTN, 20 patients SSNB
  - CTN system: Solo-DEX, 70 mm 20 gauge needle with a 4 French multi-orifice catheter + lidocaine 1mL 2% via gauge BD TB needle
  - SSNB: 80mm 20 gauge Stimuplex 360 block needle
- Time In: Needle to skin
- Time Out: Needle withdrawal
- 20mL 0.5% Bupivicaine
- Ultrasound guided and confirmed placement: Sonosite SII linear transducer. 13-6MHz

- Statistical Analysis: JMP Pro 14 software
  - Chi square analysis for categorical variables
  - Welch's t test for continuous variables
  - Linear mixed model to determine the association between procedure time while controlling for variability due to sex and block type (catheter or single shot), block order, patient BMI, and age.
  - Considered a two-tailed p-value less than 0.05 to be statistically significant
  - CLINICAL SIGNIFICANCE SET POINT:
    - Considered as doubling of block time

Results

SSNB and CON Groups comparable, except pulmonary circulation disease difference statistically significant.

	SSNB (n =20)	CPNB (n =20)	Total (n = 40)
Demographics			
Age	59.0 ± 13.1	51.5 ± 15.3	55.2 ± 14.6
BMI	27.0 ± 5.3	29.3 ± 4.3	28.1 ± 4.9
Female	8/20 (40%)	9/20 (45%)	17/40 (43%)
Rural	1/20 (5%)	3/20 (15%)	4/40 (10%)
Surgery			
Shoulder Arthroplasty or Joint Repair	7/20 (35%)	9/20 (45%)	16/40 (40%)
Rotator Cuff Repair	3/20 (15%)	5/20 (25%)	8/40 (20%)
Other Shoulder Repair	11/20 (55%)	7/20 (35%)	18/40 (45%)
Arthroscopic	9/20 (45%)	8/20 (40%)	17/40 (43%)
Open	11/20 (55%)	12/20 (60%)	23/40 (58%)
Healthcare Resource Use			
Hospitalizations in Last Year	6/20 (30%)	7/20 (35%)	13/40 (33%)
Emergency Department Visit in Last Year	2/20 (10%)	5/20 (25%)	7/40 (18%)
Comorbidities			
ASA < 3	17/20 (85%)	14/20 (70%)	31/40 (78%)
Cerebrovascular Disease	0/20 (0%)	1/20 (5%)	1/40 (3%)
Chronic Renal Disease	1/20 (5%)	3/20 (15%)	4/40 (10%)
Dialysis	0/20 (0%)	0/20 (0%)	0/40 (0%)
Dementia	0/20 (0%)	0/20 (0%)	0/40 (0%)
Primary Malignancy	4/20 (20%)	2/20 (10%)	6/40 (15%)
Metastatic Solid Tumor	0/20 (0%)	0/20 (0%)	0/40 (0%)
Peripheral Vascular Disease	0/20 (0%)	0/20 (0%)	0/40 (0%)
History of Peptic Ulcer Disease	0/20 (0%)	1/20 (5%)	1/40 (3%)
Liver Disease	2/20 (10%)	1/20 (5%)	3/40 (8%)
Rheumatologic Disorder	4/20 (20%)	3/20 (15%)	7/40 (18%)
Hemiplegia or paraplegia	0/20 (0%)	0/20 (0%)	0/40 (0%)
Atrial Arrhythmia	1/20 (5%)	2/20 (10%)	3/40 (8%)
History of Venous Thromboembolism	1/20 (5%)	3/20 (15%)	4/40 (10%)
History of Heart Failure	1/20 (5%)	1/20 (5%)	2/40 (5%)
History of Hypertension	11/20 (55%)	10/20 (50%)	21/40 (53%)
History of Diabetes Mellitus	2/20 (10%)	3/20 (15%)	5/40 (13%)
Chronic Obstructive Pulmonary Disease	0/20 (0%)	1/20 (5%)	1/40 (3%)
Asthma	2/20 (10%)	4/20 (20%)	6/40 (15%)
History of Myocardial Infarction	0/20 (0%)	1/20 (5%)	1/40 (3%)
Chronic Valvular Disease	0/20 (0%)	1/20 (5%)	1/40 (3%)
Disease of Pulmonary Circulation*	0/20 (0%)	4/20 (20%)	4/40 (10%)
Coagulopathy	2/20 (10%)	3/20 (15%)	5/40 (13%)
Obesity	5/20 (25%)	11/20 (55%)	16/40 (40%)
Weight Loss	0/20 (0%)	0/20 (0%)	0/40 (0%)
Blood Loss Anemia	2/20 (10%)	3/20 (15%)	5/40 (13%)
Iron Deficiency Anemia	2/20 (10%)	3/20 (15%)	5/40 (13%)
Alcohol Abuse	1/20 (5%)	1/20 (5%)	2/40 (5%)
Drug Abuse	1/20 (5%)	0/20 (0%)	1/40 (3%)
Psychosis	1/20 (5%)	0/20 (0%)	1/40 (3%)
Depression	4/20 (20%)	5/20 (25%)	9/40 (23%)

Table 1. Patient characteristics. Data are presented for all patients and by group with continuous variables listed as the mean (SD) and categorical variables as the ratio (%). Statistically significant differences between the groups are indicated with an *.

- Block time statistically significantly longer in CON group vs SSNB (2.1 ± 0.6 minutes versus 1.4 ± 0.4 minutes, p <0.001, figure 1).
- Longer time not clinically significant as did not double procedure time
- Catheter identified via ultrasound, echogenicity similar for both techniques (figure 2)
- A linear mixed model demonstrated a significant association between procedure time and block type while controlling for variability due to sex and considering block order, patient BMI, and patient age (table 2).
- Efficacy of blocks was comparable between groups

	Estimate	95% CI	Wald p-value
Random Effect			
Sex (Female)	86.4	-359.9 – 532.7	0.70
			Prob>|t|
Fixed Effects			
Intercept	39.2	-44.4 – 122.8	0.35
Block type (Catheter)	35.1	14.6 – 55.7	0.0014
Block order	1.11	-0.75 – 2.98	0.23
BMI	0.26	-2.08– 2.61	0.82
Age	0.67	-0.40 – 1.74	0.21

Table 2. Results of a linear mixed model estimating the block placement time in seconds and modeling the effect of random variation due to sex and a within model estimation of the effect of block type, block order, BMI, and age.

Figure 3: Catheter Graphic

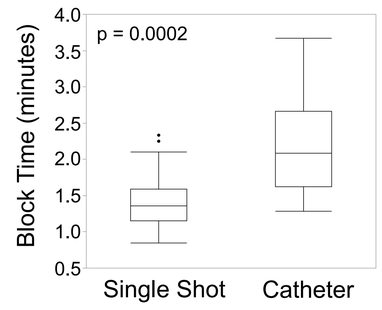

Figure 1: Box plots of the block time by group in minutes (Catheter: 2.1 ± 0.6 minutes versus Single Shot: 1.4 ± 0.4 minutes, p <0.001, figure 1)

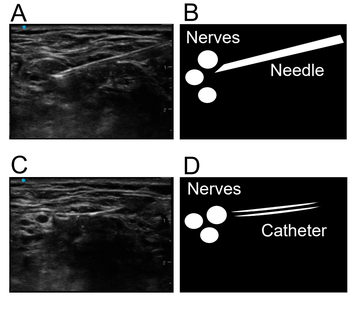

Figure 2: Representative ultrasonography images for each group with schematic representations of notable structures in the image.

Conclusions

- CON vs SSNB comparable time to place, can expand access to CPNB without disrupting workflow
- CON requires a statistically significant increase in procedure time compared to a SSNB; however, the increased time was below our proposed threshold for a clinically significant difference.
- CON carries further intra- and post-op benefits that may outweigh the slight increase in placement time over SSNB

Implications/Limitations

- CON placement may be faster over the course of practiced placement
- Pain management intra- and post-op is possible with CPNB, with lower doses than SSNB.
- First case start times may not be impacted with clinical significance, but more varied trainee placement may be needed to further assess

Disclosures

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