



The Impact of Patient and Provider Variables on Peak Serum Lidocaine Levels Following Catheter Placement for Rib Fracture Pain

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Introduction

At our institution, pain management for patients presenting with multiple rib fractures often involves the placement of peripheral nerve catheters. Lidocaine is frequently infused through these catheters for its efficacy and monitoring of serum levels. Numerous patient factors such as liver and renal function, body mass index, and comorbid illness can lead to variability in plasma lidocaine concentrations¹. Lesser known is to what degree patient-independent variables such as block type², catheter type, or provider training or experience influence peak lidocaine levels in this population.

Methods

- Data were sourced from the STAnford Research Repository (STARR) under IRB 32044.
- Statistical analysis was performed using R version 4.4.2.
- Generalized linear models were applied for univariate and multivariate regression.
- The R package "Comorbidity" v1.1 was used to calculate Elixhauser comorbidity scores.
- Standardized lidocaine dosing: 10ml of 0.5% lidocaine every 2 hours via catheter auto-bolus.
- Attendings performing >median number of blocks were classified as "high block volume."

Results

- **Participants:** 113 rib fracture patients (24-89 years, 64.6% aged 65+)
- **Peak lidocaine levels:** Ranged from 0-5.3µg/mL (median 1.63µg/mL)
- **Time to peak lidocaine:** <1-110 hours (median 17.5 hours)
- **Catheter types:** Serratus anterior plane (SAP) catheters (n=43), Erector spinae plane (ESP) catheters (n=70)
- **Techniques:** Catheter-over-needle (n=19), Catheter-through-needle (n=94)
- **Provider factors:** 18 different attendings supervised block placements

Table 1. Univariate Linear Regression

Variable	Count* or <u>Mean</u>	Estimate	95% C.I.	<i>p</i> -value
Bilateral catheters	n = 12	1.08	0.44 — 1.68	<0.001 [†]
Block (serratus anterior plane)	n = 43	0.15	-0.20 — 0.58	0.47
Age (years)	68.90	0.02	1.73E-04 — 0.02	0.03 [†]
Catheter-over-needle technique	n = 19	0.42	-0.08 — 0.87	0.12 [†]
Weight (kg)	76.7	-0.01	-0.02 — 3.34E-03	0.01 [†]
Height (cm)	168.00	-0.02	-0.03 — 4.12E-03	0.09 [†]
Albumin (g/dL)	3.89	-0.35	-0.65 — 0.05	0.09 [†]
Comorbidity score	14.91	0.03	9.47E-03 — 0.04	<0.001 [†]
Resident (vs fellow/attending) block placement	n = 59	-0.13	-0.51 — 0.25	0.50
Supervising attending (fellowship trained)	n = 99	-0.10	-0.48 — 0.27	0.63
Supervising attending (high block volume)	n = 50	0.56	0.13 — 0.87	0.01 [†]

[†]Covariates with *p*<0.2 included in multivariate analysis

*Total number of cases, n = 113

Table 2. Multivariate Linear Regression

Variable	Count or <u>Mean</u>	Estimate	95% C.I.	<i>p</i> -value
Bilateral catheters	n = 12	0.96	0.34 — 1.56	0.002*
Age (years)	68.90	4.70E-03	-0.01 — 0.01	0.53
Catheter-over-needle technique	n = 19	0.12	-0.35 — 0.59	0.66
Weight (kg)	76.7	-5.00E-04	-0.01 — 0.01	0.93
Height (cm)	168.00	-0.01	-0.03 — 0.01	0.20
Albumin (g/dL)	3.89	-0.07	-0.49 — 0.23	0.72
Comorbidity score	14.91	0.02	4.20E-03 — 0.03	0.01*
Supervising attending (high block volume)	n = 50	0.58	0.11 — 0.86	0.003*

* *p* < 0.05

Discussion

- **Patient and provider factors** influenced peak serum lidocaine levels.
- **Bilateral catheters** significantly increased peak lidocaine levels (*p*=0.002).
- **Higher comorbidity score** correlated with higher lidocaine levels (*p*=0.01), although likely clinically insignificant.
- **Attending experience** (high block volume) was associated with increased lidocaine levels (*p*=0.003), suggesting experience may play a role in block efficacy.
- **Future research** is needed to validate these findings and explore their clinical significance.

References

1. Williamson ES, Hollis NM, King KK, Williamson A. Retrospective Analysis of Comorbidities in Patients Receiving Erector Spinae Plane Catheters with Lidocaine Infusions. Ann Anesth Pain Med. 2023; 6(1): 1032.
2. Chen, Jeffrey S. et al. Systemic Absorption of Lidocaine From Intermittent Bolus Serratus Anterior Plane Catheters: A Single-Institution Experience. Journal of Cardiothoracic and Vascular Anesthesia, Volume 37, Issue 7, 1335 – 1336.