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Bupivacaine dosing and complications for paravertebral and transversus abdominis catheters: a systematic review

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Introduction

Since the introduction of paravertebral (PVB) catheters in 1988, practitioners have utilized continuous truncal plane blocks including PVB and transversus abdominis plane (TAP) catheters for pain management. To date, a summary has yet to be published of the bupivacaine dosing parameters for PVB and TAP catheters along with the resulting complications.

Materials and Methods

A systematic review was performed with exemption approval from the Mass General Brigham Institutional Review Board (protocol# 2021P003709). PROSPERO registration was completed on 12/7/2021. Medline via PubMed and Europe PMC repositories was queried for published manuscripts through 11/30/2021 using the following search: "peripheral nerve catheters" in the "paravertebral" or "transversus abdominis" space dosed with "bupivacaine" or "ropivacaine". Inclusion was confirmed by two authors; extracted data was confirmed by two authors. Disagreements on inclusion or extraction was mediated by the third author. Papers were included if catheter groups were dosed, or intended to be dosed, for greater than 24 hours and excluded if an alternative local anesthetic to bupivacaine was used for the infusion, the catheter was utilized for a location other than the PVB space or TAP, or dosing was unavailable. The extracted data included author, year, study type, infusion type, surgical service, catheter dermatomal level, laterality, bolus concentration and volume, infusion concentration and volume or rate, breakthrough boluses, incidence of local anesthetic systemic toxicity, toxic blood levels if available and other complications. Data for adult ropivacaine catheters and pediatric catheters were analyzed separately.

Results/Case Report

A total of 1,480 publications (548 from PubMed and 932 from Europe PMC) with 227 duplicates were identified. From the PubMed data, 336 publications were excluded while data was extracted from 212 publications, 86 of which (63 PVB and 23 TAP) included adult bupivacaine data. The articles consisted of 48 randomized controlled trials, 12 case reports, 11 case series, 8 observational and 4 retrospective cohort studies, and 3 methods papers published since 1988 and 2008 for PVB and TAP catheters, respectively. Participant demographic data along with bupivacaine PVB and TAP catheter dosing parameters and associated complications are presented in Tables 1-3. Figure 1 shows the distribution of

the initial 24-hour bupivacaine doses for the data in Table 2. Of note, 61% of PVB catheter treatment groups, or 58% of total PVB participants, received a 24-hour dose for a 70 kg participant that is greater than 400 mg, while 28% of the TAP catheters, or 24% of total TAP participants, received greater than 400 mg. Authors reported 4 cases of definite LAST representing 1 in 504 cases and 3 cases when excluding case reports representing 1 in 647 cases. Symptoms of LAST included hypotension, convulsions, agitation, and death. Of the reported toxic levels, 1 paper reported 5.1 microg/mL with associated confusion and dizziness, but was not classified as systemic toxicity[1]. A second paper reported 10 patients with levels greater than 2.2 microg/mL and a max of 7.48 microg/mL with a mean of 4.92 microg/mL but denied signs of symptoms of toxicity[2]. A third paper reported 4 patients with levels greater than 2.6 microg/mL[3] above the maximum tolerated plasma concentrations previously published[4]. Fourteen of these 15 patients received greater than 700mg of bupivacaine per day to reach such high levels.

Discussion

Herein, we presented dosing and complications associated with bupivacaine truncal catheters in the PVB and TAP spaces. Overall dosing in the PVB group was higher than the TAP group driven by a higher average concentration of bolus (approximately 0.5% and 0.25% respectively) and infusion (0.25% and 0.125% respectively). The higher concentrations were associated with higher 24-hour doses and a higher rate of complications with 4 cases of LAST and 15 cases of toxic blood levels in the PVB groups but zero cases or toxic concentrations in the TAP groups. When considering the recommended total bupivacaine dose per day of 400 mg[5], over half of the PVB and more than a quarter of the TAP catheter treatment group parameters exceeded 400 mg. One consideration for the higher 24-hour doses in the PVB catheter data is that these papers date back to 1988 while the earliest publication of TAP catheters included in this study is 2008. The differentiation between “toxic blood levels” and LAST was also curious. Specifically, Perttunen and colleagues[1] reported a toxic serum concentration (5.1 microg/mL) with associated confusion and dizziness but did not report LAST with a justification that Berrisford and colleagues[2] had seen even higher serum levels without symptoms. The 15 cases of toxic blood concentrations were all reported before 1995 whereas the four cases of LAST were all published after 2009. Between these two dates was the advent of lipid rescue which may have changed the perception of practitioners in the field. In conclusion, catheter dosing is varied with no standard dosing metric, and is based on clinically-available bupivacaine formulations (e.g. 0.25% and 0.5%). While total dosing has decreased over time, practitioners continue to report toxic events.

References

1. Perttunen, K., et al. Extradural, paravertebral and intercostal nerve blocks for post-thoracotomy pain. British Journal of Anaesthesia 75, 541-547 (1995).
2. Berrisford, R.G., Sabanathan S Fau - Mearns, A.J., Mearns Aj Fau - Clarke, B.J., Clarke Bj Fau - Hamdi, A. & Hamdi, A. Plasma concentrations of bupivacaine and its enantiomers during continuous extrapleural intercostal nerve block. British Journal of Anaesthesia 70, 201-204 (1993).
3. Theissen, O., et al. Analgésie après thoracotomie par administration extrapleurale de bupivacaïne à débit continu. Annales Françaises d'Anesthésie et de Réanimation 12, 265-272 (1993).
4. Knudsen, K., Beckman Suurküla, M., Blomberg, S., Sjövall, J. & Edvardsson, N. Central nervous and cardiovascular effects of i.v. infusions of ropivacaine, bupivacaine and placebo in volunteers. Br J Anaesth 78, 507-514 (1997).
5. Marcaine Bupivacaine Hydrochloride injection. 1-14 (Hospira, Inc., 2011).

Disclosures

No

Tables / Images

Figure 1. Initial 24-Hour Bupivacaine Dose in 70 kg Participant

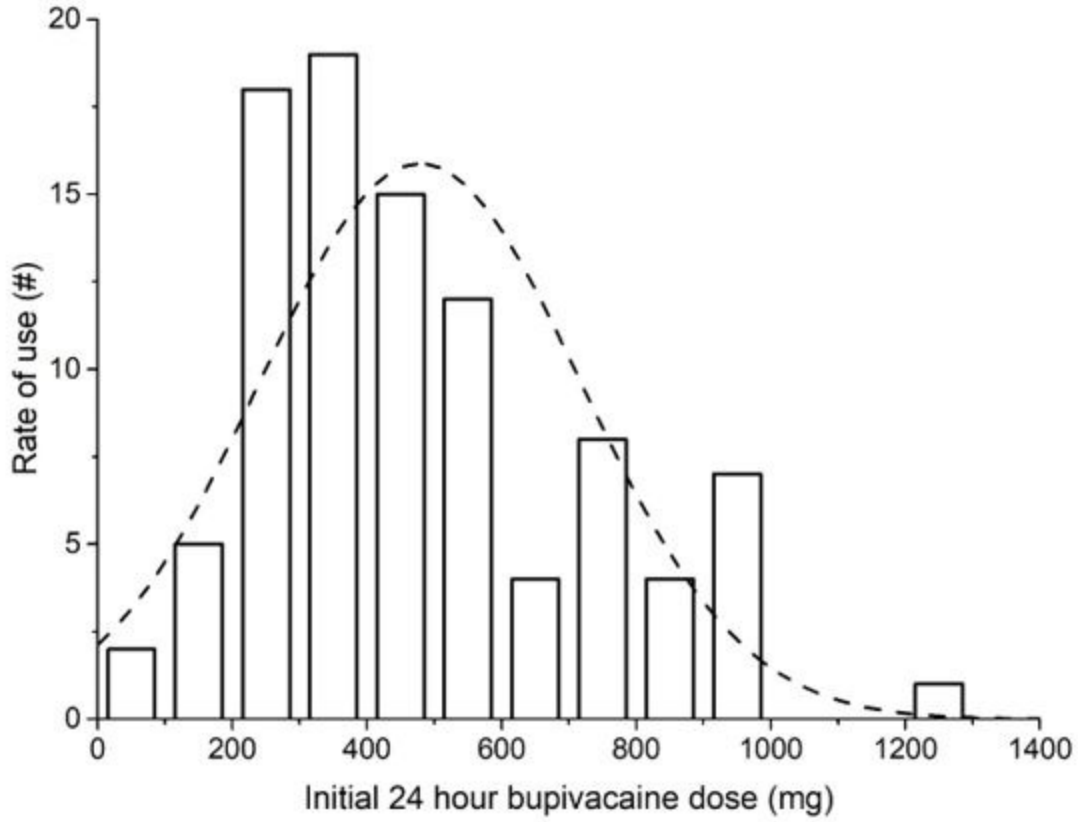

Table 1. Participant Demographics

		PVB	TAP
Participants (#)		1532	487
Age (yr)		58.4 (17 – 95)	50.4 (15 – 88)
Weight (kg)		69.2 (28.0 – 114.3)	71.1 (36.7 – 183.8)
Surgical service	Thoracic	998	0
	General	29	291
	Plastic	30	129
	Other (neurosurg, ortho, cardiac, urology, OB/gyn, pain, palliative)	242	67

**Data represented as weighted average (range)*

Table 2. Bupivacaine Catheter Dosing Parameters

	Block	Bolus	Continuous infusion	Intermittent bolus	Initial 24 hours
Concentration (%)	PVB	0.44 (0.125 – 0.5) (n=62)	0.25 (0.1 – 0.5) (n=63)	0.5 (0.25 – 0.5) (n=8)	-
	TAP	0.25 (0.125 – 0.5) (n=24)	0.125 (0.125 – 0.25) (n=9)	0.25 (0.125 – 0.5) (n=15)	-
Volume (mL) or rate (mL/hr)	PVB	19 (4 – 40) (n=52)	7 (3 – 20) (n=39)	15 (10 – 20) (n=7)	-
	TAP	30 (5 – 40) (n=17)	9 (2 – 16) (n=8)	35 (20 – 40) (n=10)	-
Weight-based volume (mL/kg) or rate (mL/kg/hr)	PVB	0.3 (0.1 – 1.6) (n=10)	0.1 (0.05 – 0.4) (n=24)	0.3 (n=1)	-
	TAP	0.4 (0.4 – 0.8) (n=8)	0.2 (n=1)	0.4 (0.4 – 0.53) (n=5)	-
Dose (mg/kg) or rate (mg/kg/hr)	PVB	1.0 (0.14 – 2.9) (n=62)	0.25 (0.07 – 1) (n=63)	1.1 (0.4 – 1.5) (n=8)	6.6 (1.1 – 17.6) (n=71)
	TAP	1.1 (0.14 – 2.8) (n=24)	0.2 (0.06 – 0.3) (n=9)	1.1 (0.7 – 2.0) (n=15)	4.2 (1.5 – 10) (n=24)
Interval (hr)	-	-	-	PVB: 6 (1 – 48) (n=8) TAP: 9 (8 – 12) (n=15)	-

**Data represented as median (range) of treatment groups; n = number of treatment groups included in calculation*

Table 3. Reported Bupivacaine Catheter Complications

	PVB	TAP
LAST	4 cases	0
Toxic blood levels	15 cases	0
Other (# of cases)	Catheter dislodgement (46), hypotension (19), block failure (10), urinary retention (6), parietal pleura breech (6), Horner's syndrome (2), Anaphylaxis (1)	Pulmonary edema (1), hypoxemia (1)