

A systematic review of local anesthetic systemic absorption after regional anesthesia: Truncal blocks

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INTRODUCTION

- Truncal blocks often employ large volumes of local anesthetic (LA) to establish and maintain analgesia
- We performed a systematic review of plasma local anesthetic levels following peripheral nerve and interfascial plane blocks and are reporting here on the plasma pharmacokinetic profile and safety of local anesthetics following truncal blocks

METHODS

- Literature searches were performed in OVID MEDLINE and Embase, PubMed, DARE, CDSR and library, and all the databases and indices of Web of Science
- Primary articles measuring systemic concentrations of LA after single-shot truncal blocks were included.
- Time to maximum (Tmax) and maximum concentrations (Cmax) in arterial and venous samples and the proportion of patients who breached safe margin of plasma levels of LA were collected.
- Data was pooled using Der-Simonian Laird inverse variance method of random effects model using OpenMeta Analyst.

RESULTS

- A total of 4752 references were screened and after various exclusions, 35 studies met the inclusion criteria.
- Pooled data show a great variability in Cmax and Tmax between individual truncal blocks. (Table 1)
- The block with the highest mean Cmax in our review was the intercostal block followed by TAP and PVB.
- Most of the blocks exhibited a safe profile following single shot blocks with peak plasma levels within a safe margin.
- The proportion of patients breaching the acceptable range of plasma LA levels is around 4% following single shot truncal blocks (Figure 1).
- Tmax varies greatly between different blocks with PVB demonstrating the fastest Tmax at a range of 18-21 min while most blocks average around 30 to 44 (Figure 2).
- Adding epinephrine delayed Tmax in most blocks except in PVB and lowered Cmax levels.

Single shot truncal blocks while relatively safe regarding LA systemic toxicity can still lead to variable systemic concentrations.

While most blocks do not breach safe plasma levels, some blocks have a higher propensity to breach safe levels

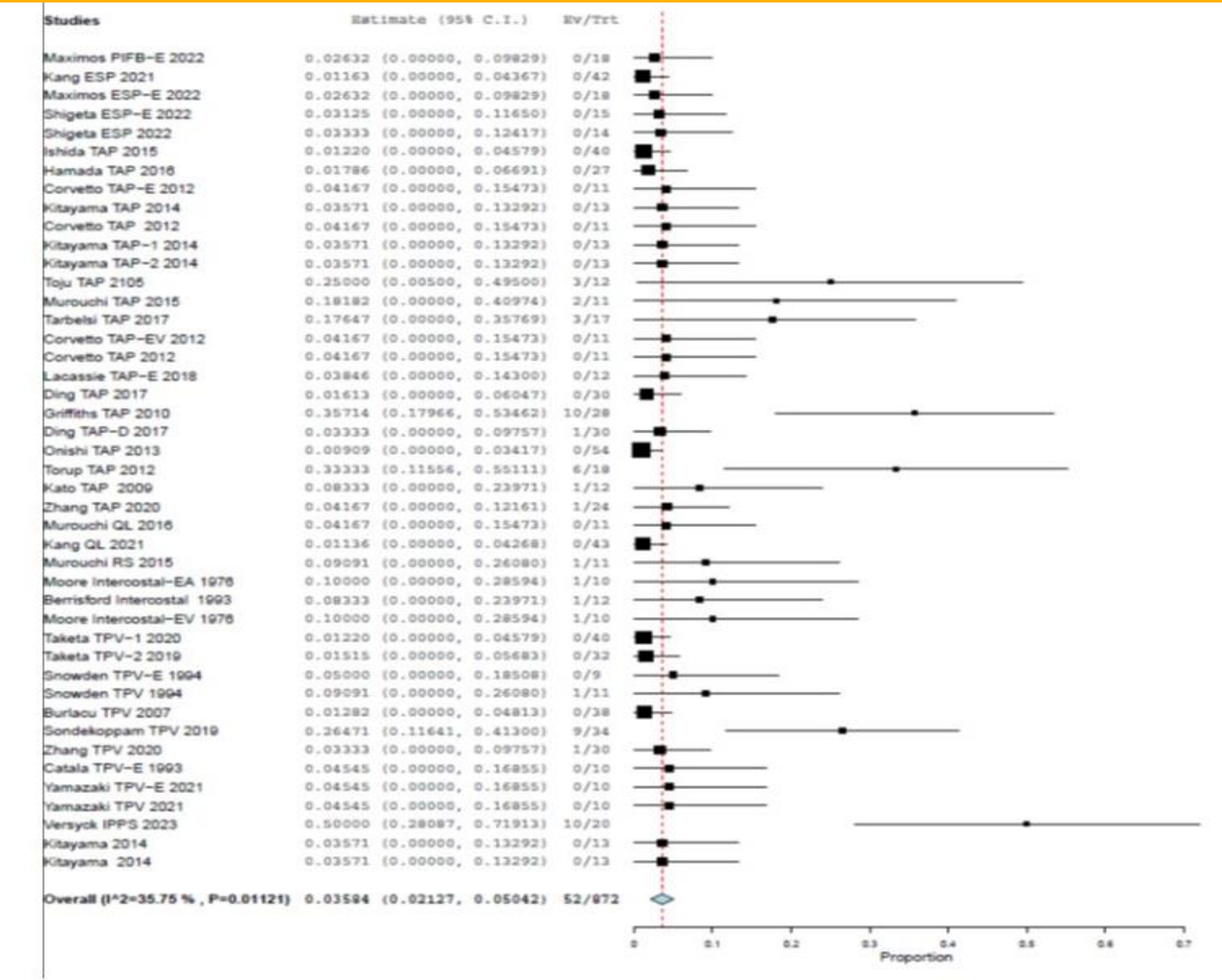


Figure 1 Proportion of patients breaching the acceptable range of plasma LA level

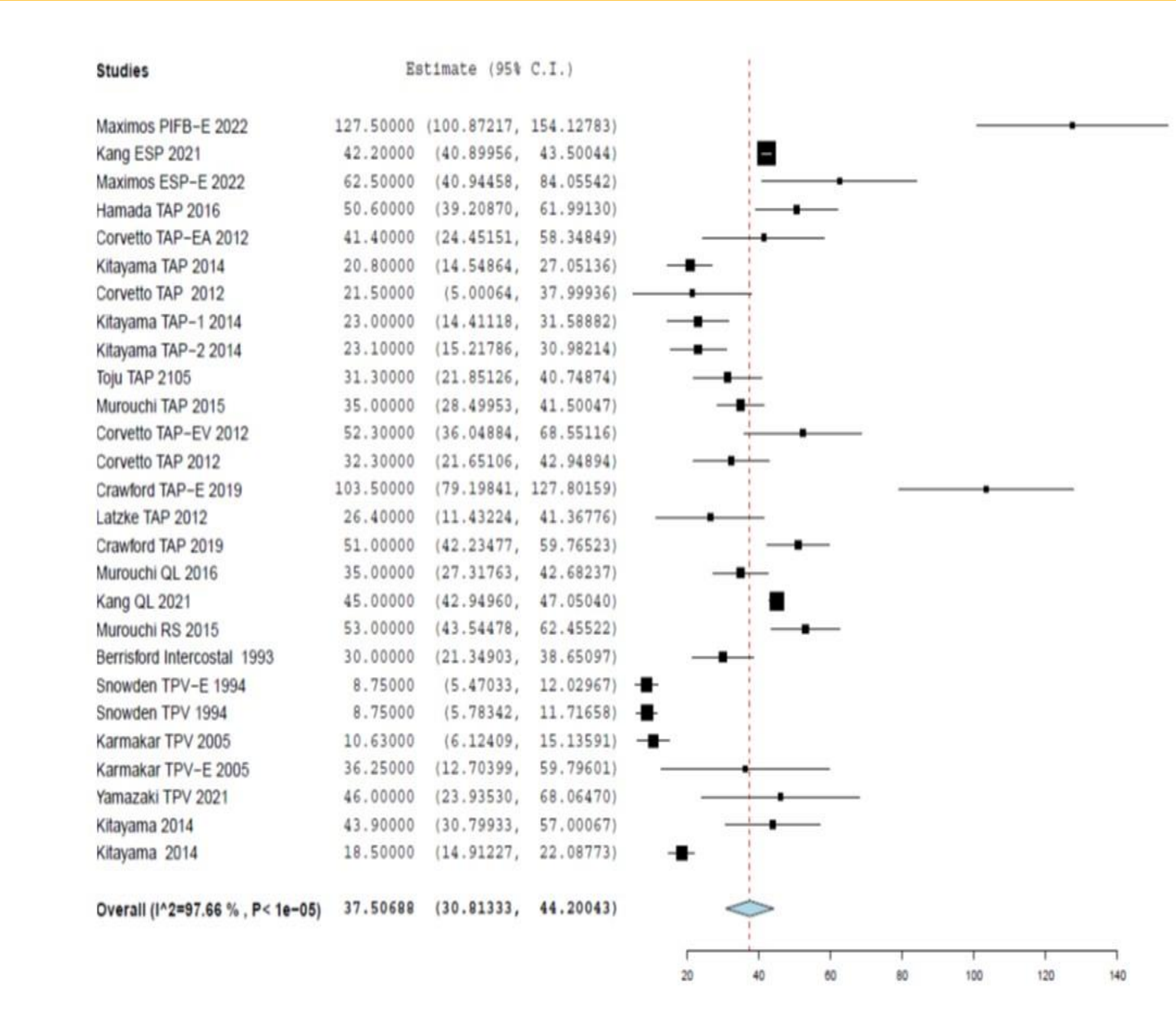


Figure 2 Individual Blocks in respective studies and corresponding mean Tmax

Block	LA	Cmax Pooled estimate (95% CI)	Tmax Pooled estimate (95% CI)	Toxic level (mcg/ml)
TPV	Lidocaine	-	Without epi: 21.803 (-2.104, 45.710) (3 studies)	>6.0 (1-5 has caused CNS toxicity)
	Bupivacaine	A: 1.12 (0.73; 1.51) 1 study	With epi: 18.985 (2.069, 35.901) (3 studies)	Arterial: 4.0 (1.4) (1.1-6.2) Venous: 2.1 (1.2) (0.8-4.5)
	Bupivacaine with epi	A: 0.74 (0.60, 0.87) 1 study		Arterial: 4.0 (1.4) (1.1-6.2) Venous: 2.1 (1.2) (0.8-4.5)
	Levobupivacaine	A: 0.57 (0.35, 0.79) 2 studies V: 0.51 (0.43; 0.58) 1 study		Venous: 2.6 mcg/ml
TAP	Ropivacaine	A: 2.47 (2.16; 2.78) 1 study With Epi A: 1.85 (1.41; 2.28)		Arterial: 4.3 (0.6) (3.4-5.3) Venous: 2.2 (0.8) (0.5-3.2)
	Lidocaine	V: 3.60 (3.20; 3.99) 1 study	Without epi: 31.05 (25.21, 36.89) 8 studies	>6.0 (1-5 has caused CNS toxicity)
ESP	Bupivacaine	V: 0.80 (0.37; 1.23) 1 study	With epi: 65.60 (32.09, 99.11) (3 studies)	Arterial: 4.0 (1.4) (1.1-6.2) Venous: 2.1 (1.2) (0.8-4.5)
	Levobupivacaine	A: 0.84 (0.31, 1.37) 3 studies V: 0.39 (0.22, 0.55) 1 study		Venous: 2.6 mcg/ml
	Ropivacaine	A: 1.30 (0.58, 2.01) 3 studies V: 1.77 (1.48, 2.05) 4 studies		Arterial: 4.3 (0.6) (3.4-5.3) Venous: 2.2 (0.8) (0.5-3.2)
	Bupivacaine with epi	V: 0.37 (0.31; 0.42) (One study)	Without Epi: 42.20 (29.49; 54.90) (1 study)	Arterial: 4.0 (1.4) (1.1-6.2) Venous: 2.1 (1.2) (0.8-4.5)
Intercostal	Bupivacaine	V: 0.93 (0.36, 1.50) (One study)	With Epi: 62.50 (51.18; 70.81) (1 study)	Venous: 2.6 mcg/ml
	Ropivacaine	A: 1.50 (1.41; 1.59) (One study only)		Arterial: 4.3 (0.6) (3.4-5.3) Venous: 2.2 (0.8) (0.5-3.2)
QLB	Bupivacaine	V: 1.450 (1.26; 1.63) 1 study	Without epi: 30.00 (23.21; 36.79) (1 study)	Arterial: 4.0 (1.4) (1.1-6.2) Venous: 2.1 (1.2) (0.8-4.5)
	Bupivacaine with epi	A: 3.29 (2.83; 3.74) 1 study V: 2.52 (2.11; 2.92) 1 study		Arterial: 4.0 (1.4) (1.1-6.2) Venous: 2.1 (1.2) (0.8-4.5)
Rectus sheath	Ropivacaine	A: 1.17 (0.88, 1.46) 2 studies	Without epi: 38.40 (29.11; 47.68) (2 studies)	Arterial: 4.3 (0.6) (3.4-5.3) Venous: 2.2 (0.8) (0.5-3.2)
	Ropivacaine	A: 1.79 (1.59, 1.98) One study	Without epi: 53.00 (46.50; 59.50) (1 study)	Arterial: 4.3 (0.6) (3.4-5.3) Venous: 2.2 (0.8) (0.5-3.2)
PFIB	Bupivacaine	A: 0.32 (0.22, 0.41) 1 study	With epi: 127.50 (119.18; 135.81) (1 study)	Arterial: 4.0 (1.4) (1.1-6.2) Venous: 2.1 (1.2) (0.8-4.5)

Table 1 Pooled data for individual nerve blocks with corresponding arterial or venous level Cmax and Tmax

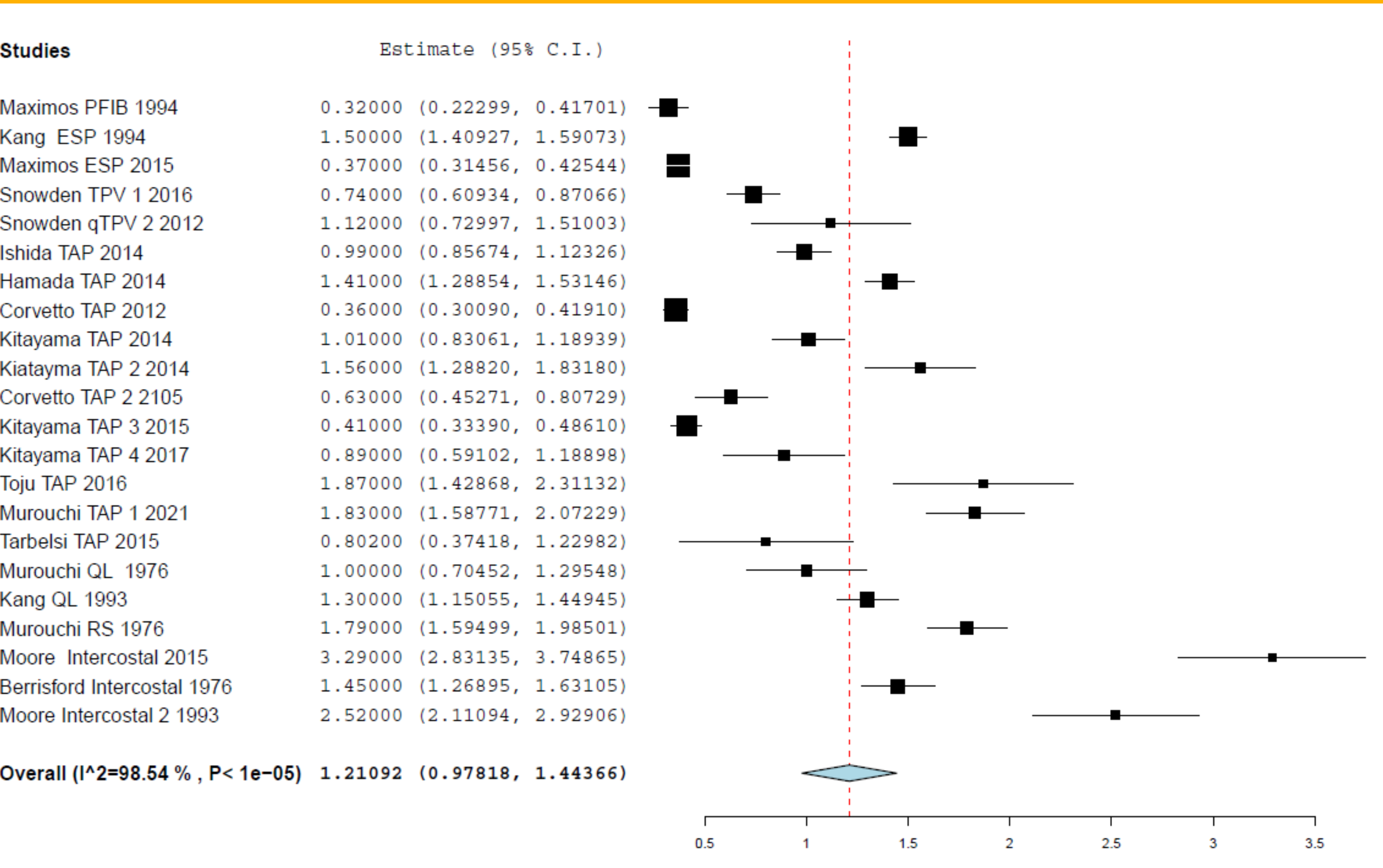


Figure 3 Individual Blocks in respective studies and corresponding mean Cmax

DISCUSSION

- Our review of literature showed that plasma levels of LA after single shot truncal blocks varied widely within a given block and for different truncal blocks
- While we did not observe a higher incidence of LAST in any reports, it is important to note that none of these studies were primarily powered to assess for subclinical or overt LAST and have small sample of patients.
- The fact that T max shows a wide variability among different blocks should be correlated with clinical practice pertaining to patient observation after a regional block. Rather than setting a standardized time for block recovery, monitoring time should be tailored to each block.
- Tmax and Cmax associated with individual blocks may serve as a guide to ensure adequate monitoring periods following single shot truncal blocks.

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