Comparative Study between Levobupivacaine 0.5% versus Bupivacaine 0.5% in Vitreoretinal Surgery through a Single Injection Medial Canthus Technique and an Animal Study of its Myotoxicity

Thesis

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By

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Abstract

Levobupivacaine is a local anesthetic having similar efficacy of bupivacaine but with enhanced safety. Regarding the medial canthus peribulbar site of injection it has nearly the same effect as the traditional double site injection technique. Extraocular muscles are among the fastest and the most fatigue resistant muscles due to their dense blood supply and the fewer number of muscle fibers included in the motor unit, showing myotoxicity after local anesthetic injection according to the concentration of the agent, volume injected and the mixture used, where levobupivacaine showed more muscle damage when injected as a sole agent in the experimental work.

Keywords:

Levobupivacaine, bupivacaine, medial canthus injection technique, myotoxicity.

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List of Abbreviations

A band: Anisotropic band

ANOVA: Analysis of variance

ASA: American society of the anesthesiologists

bv: blood vessels

CBF: cerebral blood flow

$CMRO_2$: cerebral oxygen consumption

CNS: Central Nervous System

CT: Computed tomography

df: degrees of freedom

EC50: Concentration of drug at the half way point of its Dose-response curve, midway between minimum and maximum points.

ECG: Electrocardiography

EOMs: Extra ocular muscles

FDA: Food and drug administration

G: Gauge

GABA: γ-aminobutyric acid

h: hour

I band: Isotropic band

IM: intramuscular

IO: Inferior Oblique

IOP: Intraocular pressure

IR: Inferior Rectus

IU: International Unit

IV: Intravenous

L: lymphocyte infiltrate

LAs: Local Anesthetics

LGN: Lateral Geniculate Nucleus

LR: Lateral Rectus

LS: Longitudinal Section

mf: muscle fibers

min: minutes

MR: Medial Rectus

n: large rounded nuclei

PAG: periaqueductal gray matter

rmf: regenerating muscle fibers

RVM: rostral ventromedial medulla

s: stroma

SD: standard deviation

SO: Superior Oblique

SPSS: statistical package for social science

SR: Sarcoplasmic reticulum

T tubules: Transverse Tubules

t= Student t-test

TS: transverse section

v: microvacuolation

V_{max}: maximum upstroke velocity of the action potential

vs: versus

X^2: Chi- square

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Anatomy of the Eye and the Orbit

The skull and the orbit:

The orbits are bony cavities on either side of the midsagittal plane of the skull below the cranium, containing the globes, the extraocular muscles, and orbital nerves, blood vessels, and connective tissue. ***(Remington, 2005)*** (Figure 1)

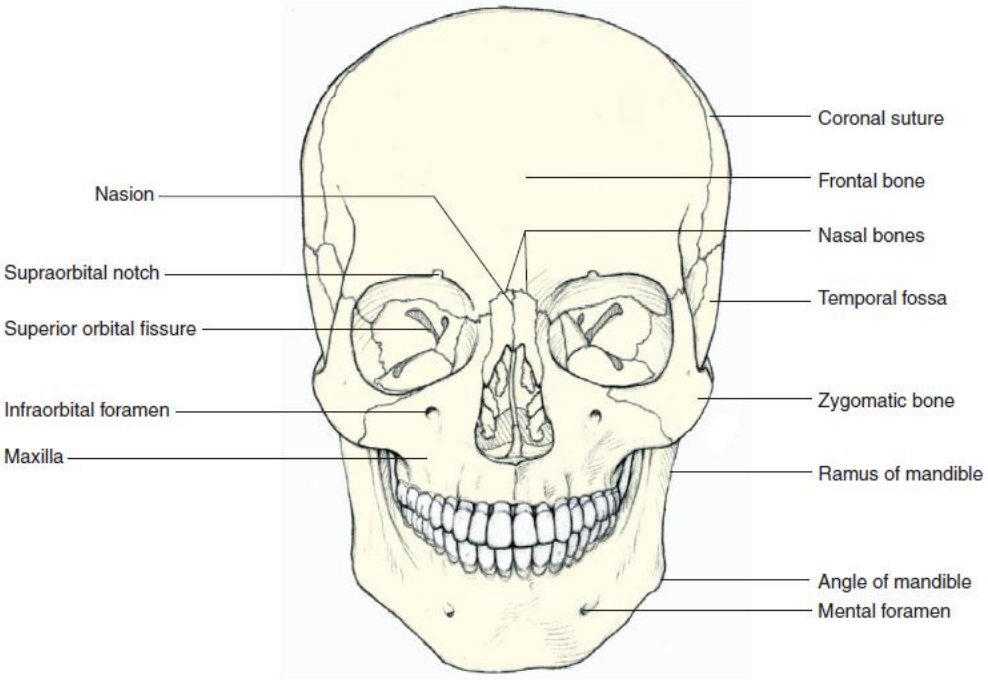

Figure 1: Anterior view of skull. ***(Mathers et al, 1996)***

The orbit is shaped like a four-sided pyramid, the base of which is at the anterior orbital margin and the apex at the posterior margin within the skull. Orbital walls are referred to as roof, floor, medial and lateral walls. The medial walls run approximately parallel to each other, whereas the two lateral walls, if extended posteriorly, would form approximately a 90-degree angle with each other. ***(Doxanas & Anderson, 1984)*** (Figure 2)

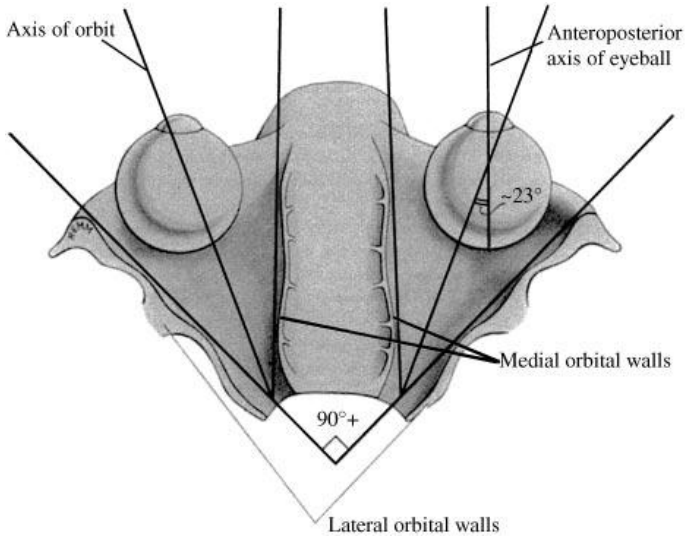

Figure 2*:** The general arrangement of the orbit. ***(Smerdon 2000)

The orbit narrows progressively to the orbital apex, through and around which enter the important nerve vessels and the *optic nerve*. Behind the apex of the orbit are the cavernous sinus and the important structures of the midbrain. Between the medial walls are sinuses, the nasal cavity and the nasolacrimal system. Outside the lateral wall is the temporal fossa, which houses the temporalis muscle. Outside the roof of the orbit is the frontal lobe of the brain posteriorly and the frontal sinus anteriorly. Outside the floor of the orbit are the maxillary sinus and the infra-orbital nerve. The thick lateral wall of the orbit is at 45º to the medial. ***(Smerdon 2000)*** The average orbital depth is 4.5 cm. ***(Doxanas & Anderson, 1984)***

The highest point of the superior orbital margin's arch is located one-third the way from the superior medial corner of the orbit. The *supraorbital notch* (figure 3) is located just medial to the center of the superior orbital margin and is the conduit for the supraorbital vessels and nerves, where it can be palpated easily, although in 25% of orbits the supraorbital notch is enclosed to form a foramen. ***(Webster et al., 1986)***

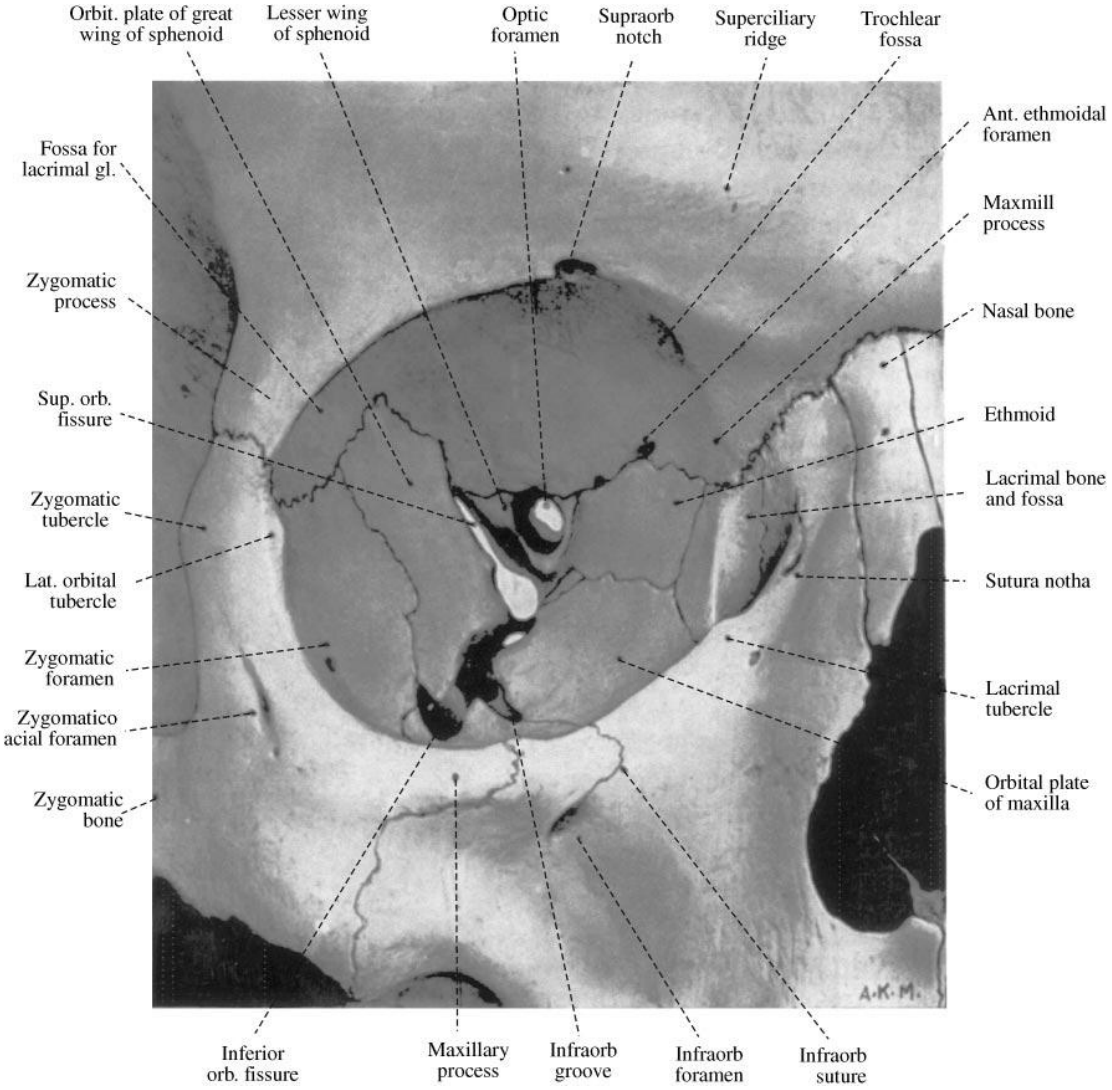

Figure 3: The bones of the orbit. ***(Smerdon 2000)***

The eyelids are covered with thin sensitive skin, where the palpebral (eyelid) part of orbicularis oculi provides gentle closure of the eye by its sphincter effect, being supplied by the facial nerve. Under the orbicularis is the levator muscle, which inserts in the lower anterior part of the tarsal plate, that lies internal to the orbicularis, providing rigidity to the eyelid, and containing meibomian glands. The meibomian glands secrete light oil, which reduces tear evaporation. ***(Smerdon 2000)***