Cephalad Angulation of Epidural Needle Insertion May Be a Major Factor for Epidural Space Safe Approach: a Mathematical Model

Regarding the mathematical study of Inoue et al., it is appropriate to mention the study by Cheng (Apud Collins) published more than half a century ago in which the width of the circular epidural space (EP) and thickness of the dura mater (DM) were measured. According to Cheng, the axial width of EP at L2-L3 is 6 mm and if the puncture is 30 degrees to the skin, the puncture safety margin (Figure 1 A) becomes 12 mm ($\sin 30^\circ = 6 \text{ mm} / A$). In this line of thought, with a puncture angulation of 45 degrees, the safety margin (SM) of the EP will be 8.6 mm, which is smaller than the 30 degrees puncture. In the thoracic and cervical regions, EP decreases and the angulation of the median and paramedian punctures has that tendency as well due to the bony anatomy of the Spinal apophyses that guide the puncture angulation. Because there is no data on the incidence of thoracic DM perforation, it is assumed that it is lower compared with the lumbar DM perforation. It is likely that many anesthesiologists, based on Euclidean reasoning, prefer the latter for the following reasons: 1) facilitate access to the EP; 2) result in greater SM (Figure 1); 3) prevent DM perforation; 4) consume less time for blockade performance; and 5) facilitate catheter introduction. This reasoning also applies in peripheral regional anesthesia, provided that a profound anatomical parameter is recognized, as shown in Figures 1 and 2.

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Figure 1. Ischiatic Blockade. 1: puncture $90^\circ$ to the skin; 2: puncture $30^\circ$ to the skin; 3: femoral biceps; 4: ischiatic nerve; 5: popliteal artery/vein; 6: semi-tendinous/semi-membrana (adapted) RB nº 4.

Figure 2. Member in External Rotation $47^\circ$. Ischiatic Blockade. puncture $90^\circ$ to the skin = 4.2 cm; puncture $30^\circ$ to the skin = 5.5 cm; NF: peroneal nerve; NT: tibial nerve (adapted) RB nº 5.
REFERENCES


