

2. Frumin MJ, Schwartz H, Burns JJ, et al: Sites of sensory blockade during segmental spinal and segmental peridural anesthesia in man. *ANESTHESIOLOGY* 14:576-583, 1953
3. Frumin MJ, Schwartz H, Burns JJ, et al: Dorsal root ganglion blockade during threshold segmental spinal anesthesia in man. *J Pharmacol Exp Ther* 112:387-392, 1954

4. Galindo A, Witcher T: Vulnerability of sensory pathways to local anesthetics. *ANESTHESIOLOGY* 51:S212, 1979

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*In reply:*—Our article was not intended to be a review of the various proposed mechanisms of action of epidural analgesia, but Frumin's comments do serve to emphasize the value and need for our model in such investigations. Its capability to give objective, direct and reproducible evidence regarding the varying sites of altered neural conduction during epidural analgesia must be considered preferable to many of the previous studies including that of Frumin and associates<sup>1</sup> which developed a hypothesis of the mechanism of action from secondary and remote observations. Although we purposely reserved many interpretations regarding the participation of peripheral nerve, dorsal roots and dorsal root entry zone from our study until completion of additional investigations with varying drug doses and concentrations are completed, certain information regarding the dorsal root ganglia can be obtained from that study. The positioning of the cauda equina electrode in many of our preparations usually was located distal to dorsal root ganglia relative to the stimulated nerve, and, therefore, comments regarding the peripheral nerve component may be considered pertinent to the possible participation of the dorsal root ganglia relative to the local anesthetic agents used in our study. In fairness, it must be noted that the previous studies concerned with the participation of the dorsal root ganglia present an oversimplification of the neurophysiologic function of this structure, as well as indicating a seemingly mistaken concept of its anatomic configuration and localization (an extra arachnoidal structure, an area of tissue transition with thickened tissue barriers, an outpouching of the conducting afferent fibers, *etc.*<sup>2</sup>). Frumin's implication that studies done by Galindo and Witcher<sup>3</sup> using the frog sciatic nerve-spinal cord preparation either verified his hypothesis or suggested that our evaluation using the present model was erroneous do not appear warranted. In that study, the sensitivity of various

levels along the peripheral nerve and dorsal nerve roots to local application of varying concentrations of procaine was evaluated by applying a shock stimulus at the sciatic nerve level and recording the response from the dorsal roots. Therefore, this preparation examined the anesthetic susceptibility only of the peripheral nerve and dorsal roots (apparently proximal to their glial-Schwann transition zone just prior to their entrance into the dorsal horn gray matter), used a local anesthetic agent not studied in our investigation, and in no fashion mimicked a model of epidural infusion. Therefore, we are unable to offer any support to Frumin's contention that the dorsal root ganglion is an important site of altered neural conduction during epidural analgesia. Our studies using epidurally administered bupivacaine, chloroprocaine, and etidocaine, all indicated that the major site of action of these anesthetic agents was at the spinal cord level. The various regions of the spinal cord, especially that area of transition zone in the dorsal root fibers, requires further differential studies.

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#### REFERENCE

1. Frumin MJ, Schwartz H, Burns JJ, Brodie BB, Papper EM: Dorsal root ganglion blockade during threshold segmental spinal anesthesia in man. *J Pharmacol Exp Ther* 112:387-392, 1954
2. McCabe JS, Low FN: The subarachnoid angle: An area of transition in peripheral nerve. *Anat Rec* 164:15-34, 1969
3. Galindo A, Witcher T: Vulnerability of sensory pathways to local anesthesia *ANESTHESIOLOGY* 51: S212, 1979

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