Lumbar Dural Sac Volume Assessed by Spinal Ultrasound Predicts Sensory Block Extent During Combined Spinal Epidural for Labor

Introduction: Lumbar cerebrospinal fluid (CSF) volume measured by magnetic resonance imaging (MRI) correlates well with the intrathecal spread of anesthetic solutions, bearing an inverse relationship. While MRI is a valuable research tool, it is difficult to apply in clinical practice. Ultrasound reliably identifies anatomical landmarks to facilitate spinal and epidural anesthesia. A previous study assessing the antero-posterior width of the dural sac at a single lumbar segment failed to show correlation with intrathecal spread (1,2). We hypothesized that lumbar dural sac dimensions at multiple segments, as measured by ultrasound, will correlate with intrathecal spread.

Methods: With REB approval and informed consent, we recruited women with singleton term pregnancies requesting neuraxial analgesia while in labor. Ultrasound imaging was performed with a 5-2 MHz curved array probe in the left paramedian longitudinal plane at levels L5-S1 to L1-L2. The dural sac width (DSW) was measured at each lumbar interspace, and the lumbar dural sac height (DSH) was measured on the skin as the distance between the L5-S1 and the L1-L2 interspaces. A lumbar dural sac volume (DSV) was subsequently calculated, based on the spinal canal being a cylinder with a diameter equal to the mean value of the five DSW measurements. Combined spinal-epidural analgesia (0.7ml 0.25% bupivacaine with 15µg fentanyl) was administered. Sensory block to cotton, ice, and pinprick (60g Von Frey filament) was assessed at 10, 20, and 30 min. Upper sensory block levels were correlated with lumbar DSW, DSH, and DSV using Spearman’s rank correlation.

Results: We studied 31 women. Mean height, weight, and BMI were 164.5cm, 79.3kg, and 29.1kg/m2. Mean DSW from L5/S1 to L1/L2 were 1.01, 1.05, 1.20, 1.28, 1.31cm respectively. Mean DSH and DSV were 12.9 cm and 14.3 cm3 respectively. The median upper sensory block levels were T8 (cotton), T4 (ice), and T5(pinprick). There were significant correlations between the dural sac volume with upper sensory levels assessed by ice (0.61; p= 0.0068), and pinprick (0.62; p=0.0054), but not with cotton.

Discussion: Ultrasound evaluation of the dural sac volume is simple to obtain at the bedside and may assist in predicting block height in patients undergoing spinal anesthesia. Our findings represent a novel approach to the understanding of the pharmacology of spinal anesthesia.