

A709

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Room Hall E, Area K

Spinal Cord Stimulation Using a Midline Cathode Has a Better Dorsal Column Recruitment Ratio

Joshua P. Prager, M.D., M.S., Edgar L. Ross, M.D., Wilbert A. Wesselink, Ph.D.

Anesthesiology, Center for the Rehabilitation of Pain Syndromes (CRPS) at UCLA Medical Plaza, Los Angeles, California

INTRODUCTION: Implantable neurostimulation systems are capable now of powering up to 16 contacts on multiple leads. Computer modeling of spinal cord stimulation (SCS) has become an essential tool in predicting the voltages at which various dorsal column (DC) or dorsal root (DR) fibers may be recruited. The ratio of activation of dorsal column and dorsal root fibers offers understanding of the clinical utility of complex active contacts geometries. Modeling results presented here address fundamental questions such as how do two leads symmetrical to the midline perform in comparison to patterns available with one or three leads?

METHODS: The University of Twente computer model was used to predict the effects of electrical stimulation using various contact combinations and geometries. The modeled configurations include: 1) A single midline cathode in an unguarded bipole (UB) or guarded cathode tripole (GC) configuration on a single lead, 2) A single midline cathode with transverse tripole (TTS) or longitudinal (LFS) fields using contacts on three leads, 3) A single bipole off the midline (UBO-1), and 4) dual bipoles symmetric across the midline at spacings of 1 (UBO2-1) or 2 (UBO2-2) millimeters apart.

RESULTS: The recruitment voltage of dorsal column and dorsal root fibers was obtained at a cerebral spinal fluid depth (dCSF) of 3.8 millimeters approximating a typical T8 and T9 vertebral level lead placement. Separation of contacts was 1.5 millimeters. The lowest (i.e., best) ratio of recruitment voltages (VDC/VDR) for a midline cathode is with three-lead transverse tripole (0.42), followed by a guarded cathode on a single midline lead (0.49), longitudinal fields on three leads (0.54) and an unguarded midline bipole (0.64). An off-midline (by as little as one millimeter) bipole pattern has a high ratio (0.83), but can be mitigated by using two symmetric bipoles--UBO2-1 (0.69) and UBO2-2 (.74). Closeness of the leads is an important factor.

CONCLUSIONS: Although difficult to achieve and in need of clinical replication, good paresthesia coverage of the low back is possible. Computer modeling results of contact configurations presented here suggest that single cathodes on the midline offer the best recruitment ratio of dorsal column to dorsal root fibers. The ratio is maximized with transverse tripoles--in agreement with work presented at the International Neuromodulation Society World Pain Congress, San Francisco, August 2000. Cathodes placed off the midline adversely impact the recruitment ratio since they are closer to the dorsal roots.

KEYWORDS: Spinal Cord Stimulation, Three Lead Configurations, Recruitment Ratio, Computer Modeling.[figure1]

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Figure 1