Title : The Contribution of Hypoosmolarity to Spinal Anesthesia

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Introduction. Hyperbaric spinal anesthesia is usually performed with low volume (2-3 ml) solution of 0.3-0.6 percent tetracaine of osmolarity approximately 400-500 mosm/l. Hypobaric tetracaine spinal, on the other hand, is performed with high volume (5-20 ml) solution of 0.1-0.05 percent tetracaine of osmolarity approximately 2-30 mosm/l. This study is a preliminary one designed to examine the contribution of hypoosmolarity to spinal anesthesia.

Methods. Hypobaric spinal anesthesia was performed in 26 patients ranging in age from 60-97 years. These patients were undergoing transureghral prostate resection or orthopedic surgery of the hip and lower limb. A constant high volume (10 ml) solution of 0.03-0.05 percent tetracaine was used of osmolarity 10-18 mosml/l injected at rates of 0.4-1 ml/sec. Hyperbaric spinal anesthesia was performed in another group of 12 patients ranging in age from 57-86 years undergoing similar types of operations to that of the hypobaric group. Low volume (2 ml) solution of 0.3-0.5 percent tetracaine was used, of osmolarity 400-440 mosml/l, injected at a rate of 0.1 ml/sec. Laboratory analysis of the two prepared solutions of tetracaine was performed for Na, K, pH and osmolarity. Cerebrospinal fluid (CSF) pH was measured before and following the injection. The dilution of the CSF with the two techniques was estimated by measuring the CSF electrolytes before and one and five minutes after the injection of the anesthetic.

Results. The extent of block and duration of operation with the two solutions were comparable. There was a distinctly lesser tendency to hypotension with the hypobaric hypoosmolar technique and a lesser amount of tetracaine was used. (Fig. I and Tab. I) These findings are in agreement with Lund and Rumball[1] The dilution of CSF electrolytes was considerably greater with the hypobaric, hypoosmolar high volume technique than with the hyperbaric hypermolar low volume technique, diverging from the result of Ernst[2] with a mechanical model, Table I. The upper thoracic segments remained blocked for a longer period of time with the hypobaric, hypoosmolar, high volume technique. Figure II

Discussion. Since the two solutions were approximately equivalent as regards extent and duration of sensory block but the high volume solution contained a lesser amount of tetracaine we infer that a potentiating factor, such as hypoosmolarity, was operating with the latter. This is consistent with the recently published in vitro finding (Fink et al[3]) that conduction blocking action of lidocaine can be potentiated by osmotic swelling of the nerve. The reason for the low incidence of hypotension with the hypoosmotic spinal anesthetic is still unclear. The relation of degree of hypoosmolarity of the injected spinal anesthetic solution, volume injected, and rate of injection to the CSF osmolarity changes and clinical effects need further study.

References:

1. Lund, P.C., and Rumball, A.C.: Hypobaric Pontocaine spinal anesthesia, 1640 consecutive cases. Anesthesiology 8:181-199, 1947.
2. Ernst, E.A.: In vitro changes of osmolarity and density of spinal anesthetic solutions Anesthesiology 29:104-109, 1968.
3. Fink, B.R., Barsa, J. and Calkins, D.: Osmotic potentiation of conduction of block in rabbit vagus nerve (Abstr.). Amercian Society of Anesthesiologists Annual Meeting, 1978, pp 361-362.

Figure 1. Time course of changes in mean arterial blood pressure

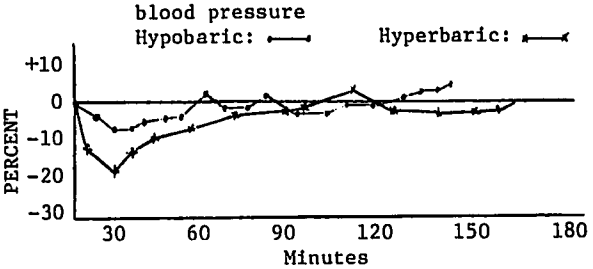

Figure 2. Mean duration and extent of analgesia (pin prick)

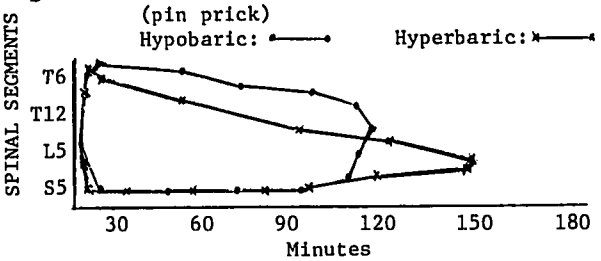

Table 1. Hypobaric versus hyperbaric spinal anesthesia data (mean ± S.E.)

	Hyperbaric	Hypobaric
Age (Years)	68 ± 4	71 ± 4
Weight (Kg)	64.5 ± 3	66 ± 2.5
Height (Cm)	168 ± 5	171 ± 4
Tetracaine Dose (mg)	7 ± 2	4 ± 1
Added Epinephrine (0.2 mg) percent of patients	75%	19%
Maximum Sensor Level	T 6.5 ± 0.8	T 5 ± 2.2
Maximum % Fall of Arteral Pressure	21%	9%
Sodium mmol/l:		
Tetracaine Solution	48 ± 9	5 ± 2
C.S.F. before injection	141 ± 2	139 ± 3
C.S.F. 1 minute after	128 ± 1	73 ± 4
C.S.F. 5 minutes after	135 ± 2	86 ± 3