

# Evaluation of Efficacy of Different Identification Tests to Distinguish Cerebrospinal Fluid from Local Anaesthetic Solution: A Comparative Study

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## ABSTRACT

**Background:** Local anaesthetics (LAs) are used clinically for anaesthesia and analgesia either following surgery or for management of other acute and chronic pain conditions; they only last a few hours. Various methods have been mentioned in the past literature for differentiating the CSF and the local anaesthetic solutions. Hence; we planned the present study to check and compare the efficacy of simple identifications tests to distinguish local anesthetic solutions from CSF.

**Materials & Methods:** We planned the present study to compare the efficacy of simple identifications tests to distinguish local anesthetic solutions from CSF. We involved five experienced anesthetists for the present study. Both the anesthetics were asked to identify 0.1 ml sample of bupivacaine and mock CSF (tap water) by each of four physicochemical characteristics based on criteria: Temperature, pH, Presence of glucose, and Turbidity when mixed with thiopentone. The anesthetics involved in the present study were unaware of the results. All the results were recorded on excel sheet and were analyzed by SPSS software.

**Results:** The two test solutions were identified conveniently together with the four physicochemical tests. However, the anesthetics were not able to identify and differentiate the solutions clearly with individual tests. **Conclusion:** Anesthetist should be accustomed with different physicochemical methods available for differentiating between CSF and local anaesthetic solution. However; no single test appears to have complete reliability. Therefore, combinations of tests must be used.

**Key words:** Cerebrospinal, Fluid, Local Anesthetic

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## INTRODUCTION

Local anaesthetics (LAs) are used clinically for anaesthesia and analgesia either following surgery or for management of other acute and chronic pain conditions; they only last a few hours.<sup>[1]</sup> Injectable local anaesthetics are subject to absorption; a large fraction of the injected drug is removed by the systemic circulation and distributed to distant organs according to their vascular density. Highly vascular organs (brain, heart, lung, liver, and kidneys) are exposed to unmetabolized local anaesthetic at peak concentration. The local anaesthetic is taken up within each organ according to its tissue-plasma partition coefficient.<sup>[2-5]</sup>

Various methods have been mentioned in the past literature for differentiating the CSF and the local anaesthetic


solutions. These methods include mainly assessment of their respective physical properties like temperatures, presence of glucose, pH, and turbidity when mixed with thiopentone.

Results of these tests are used to differentiate between CSF and local anaesthetic.<sup>[6-8]</sup> Hence; we planned the present study to check and compare the efficacy of simple identifications tests to distinguish local anesthetic solutions from CSF.

## METHODS

We planned the present study in the department of General Anesthesia of THAR Hospital, Barmer, Rajasthan, India and

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included comparison of efficacy of simple identifications tests to distinguish local anesthetic solutions from CSF.

Ethical approval was obtained from institutional ethical committee and written consent was obtained after explaining in detail the entire research protocol. We involved five experienced anesthetists for the present study. Both the anesthetics were asked to identify 0.1 ml sample of bupivacaine and mock CSF (tap water) by each of four physicochemical characteristics based on criteria given previously in the literature.<sup>[7-9]</sup>

1. Temperature,
2. pH
3. Presence of glucose, and
4. Turbidity when mixed with thiopentone

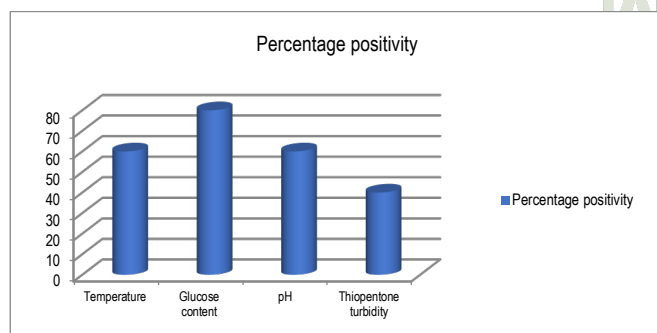
The anesthetics involved in the present study were unaware of the results. All the results were recorded on excel sheet and were analyzed by SPSS software. Student t test was used for assessment of level of significance. P- value of less than 0.05 was taken as significant.

## RESULTS

The two test solutions were identified conveniently together with the four physicochemical tests. However, the anesthetics were not able to identify and differentiate the solutions clearly with individual tests. Presence of glucose alone was the single test with which, four out of the five anesthetists was able to differentiate between the two solutions.

**Table 1: Correct identification of simulated cerebrospinal fluid or bupivacaine 0.25%**

S No.	Tests	Percentage positivity
1.	Temperature	60
2.	Glucose content	80
3.	pH	60
4.	Thiopentone turbidity	40



**Graph 1: Correct identification of simulated cerebrospinal fluid or bupivacaine 0.25%**

## DISCUSSION

Local anaesthetics are being used increasingly as analgesia and for anaesthesia, as a supplement to or as an alternative to general anaesthesia. In the present study, we observed that the two test solutions were identified conveniently together with the four physicochemical tests. Waters JH et al tested the efficacy of this test in distinguishing opioids from CSF. Three in vitro studies were performed. The first study tested for precipitation when thiopental was mixed with several commonly used epidural medications. Then, thiopental was mixed in combinations of opioids with local anesthetics to see if the opioid might prevent the precipitation of the local anesthetics. Finally, lidocaine was serially diluted and precipitation with thiopental was assessed. It was found

that certain concentrations of opioids as well as normal saline do not precipitate with thiopental. In addition, the ratio of opioids to local anesthetic of 10:1 prevented precipitation when thiopental was added. Local anesthetics combined with cerebrospinal fluid in a 1:10 ratio produced a precipitate on mixing with thiopental. Use of thiopental to differentiate opioids from cerebrospinal fluid is unreliable. In addition, in some simulated situations, opioids may mask the presence of local anesthetic.<sup>[6]</sup> Knudsen K examined how CSF and different anaesthetic solutions change the colour of yellowish phenol red absorbed in cotton pads. Sodium chloride and local anaesthetic agents do not change the colour of yellowish phenol red. However, CSF immediately changes the colour from yellow to pink or red. Letting a drop of fluid from the epidural/spinal needle fall on to the cleaning pads filled with phenol red will enable the anesthesiologist to immediately confirm the presence or absence of CSF. The higher pH of CSF relative to that of sodium chloride and local anaesthetic agents explains the different colour reaction. This colour reaction quickly identifies the presence of CSF and thus the intradural space during the procedure of spinal or epidural anaesthesia.<sup>[9]</sup>

Soliveres Ripoll J et al validated the use of a digital blood glucose meter for detecting the presence of spinal fluid during combined spinal-epidural anesthesia in terms of specificity, positive and negative predictive values, and likelihood ratios. Validation was studied in 30 patients scheduled for surgery under combined spinal-epidural anesthesia. A positive finding, defined as detection of spinal fluid return or aspiration by the epidural or spinal needle, was compared with results of standard reference tests (the pattern of sensory or motor block after administration of the local anesthetic). After locating the epidural space with saline solution, the test was performed, and 3 mL of local anesthetic was administered. If no sensory or motor blockade was evident, the test was considered a true negative. Spinal puncture was then performed, the test was repeated, and 2 to 3 mL of local anesthetic was injected. The test was considered a true positive if sensory or motor blockade was evident. These findings entered into the validation analyses. Sensitivity was 100%, specificity 94%, positive predictive value 93%, negative predictive value 100%, the positive likelihood ratio 15.5, and negative likelihood 0. Blood glucose meter readings provide a valid quantitative measure for distinguishing spinal fluid from saline solution during combined spinal-epidural anesthesia.<sup>[10]</sup> Imbelloni LE et al in their randomized clinical study, compared the blocking properties and side effects of CSA with single interspace CSE, among patients scheduled for major hip or knee surgery. 240 patients scheduled for hip arthroplasty, knee arthroplasty or femoral fracture treatment were randomly assigned to receive either CSA or CSE. Blockades were performed in the lateral position at the L3-L4 interspace. Puncture success, technical difficulties, paresthesia, highest level of sensory and motor blockade, need for complementary doses of local anesthetic, degree of technical difficulties, cardiocirculatory changes and post dural puncture headache (PDPH) were recorded. At the end of the surgery, the catheter was removed, and cerebrospinal fluid leakage was evaluated. Seven patients were excluded (three CSA and four CSE). There was significantly lower incidence of paresthesia in the CSE group. The resultant sensory blockade level was significantly higher with CSE. Complete motor blockade occurred in 110 CSA patients and in 109

CSE patients. Arterial hypotension was observed significantly more often in the CSE group. PDPH was observed in two patients of each group. Their results suggested that both CSA and CSE provided good surgical conditions with low incidence of complications. The sensory blockade level and hemodynamic changes were lower with CSA.<sup>[11]</sup>

## CONCLUSION

From the above results, the authors concluded that anesthetist should be accustomed with different physicochemical methods available for differentiating between CSF and local anaesthetic solution. However; no single test appears to have complete reliability. Therefore, combinations of tests must be used.

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