by Elisa assay (0.08 g/l). The classical chronometric assay (Von Clauss) showed a concentration less than 0.2 g/l. Platelet fibrinogen tested by Elisa was about 90% of control level. The activated partial thromboplastin time (APTT) ratio was greater than 5.00.

On the day before surgery, low molecular weight heparin (enoxaparin, 40 mg) was administered subcutaneously, followed 60 min later by an iv infusion of 3 g of solvent detergent refined fibrinogen in a 30-min period. One hour later, the fibrinogen level was 1.7 g/l and the APTT ratio was 1.18. On the operative day, APTT ratio was 1.18 and fibrinogen residual level was 1.1 g/l. As we had decided to keep the fibrinogen level within the normal range, a second 3-g injection was given. One hour later, the fibrinogen level increased to 1.68 g/l and the APTT ratio was 1.15. General anesthesia was then induced and sympathectomy was performed without any abnormal bleeding.

During the postoperative period, 20 mg of enoxaparin was administered 8 h after the completion of surgery, then 40 mg every morning for 10 days. The blood fibrinogen concentration was assessed every morning. When a concentration less than 1.6 g/l was found (nearly every second day), a fibrinogen infusion of 3 g was administered. During the postoperative period, we did not find any clinical evidence for bleeding or thromboembolic complications.

Thrombotic complications have been reported in the literature after infusion of fibrinogen in patients with congenital severe hypofibrinogenemia.2 Such treatment was associated with pulmonary embolism in the patient's sister. The mechanism for these thrombotic episodes is still unknown, but did not involve in this patient the formation of antifibrinogen-fibrinogen complexes as no antifibrinogen antibodies could be detected. This case report suggests that when fibrinogen is used to prevent bleeding, low molecular weight heparin can be safely used with the aim to avoid thromboembolic complications in such cases.

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Needle Bevel Direction and Postlumbar Puncture Headache

To the Editor—The study by Norris et al.1 claims there is an important relation between needle orientation and the severity of headache following inadvertent dural puncture.

The analysis used an unspecified chi-square test. I have organized their data into the 2 x 2 table (table 1).

<table>
<thead>
<tr>
<th></th>
<th>Pain</th>
<th>No Pain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bevel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inclined</td>
<td>P1</td>
<td>P2</td>
</tr>
<tr>
<td>Flat</td>
<td>P3</td>
<td>P4</td>
</tr>
</tbody>
</table>

Let P1 (P2) be the proportion of individuals in group 1, two who required a blood patch. The null hypothesis is that the proportions are equal: P1 = P2. The alternative hypothesis then is P1 ≠ P2. Fisher's exact test, which seems the most reasonable for evaluating two small independent samples, yields a P of .052. The Yates corrected chi-square result is P = .078. Using an alpha level of .05, the authors' chosen critical value, there is insufficient evidence to reject the null hypothesis.

This discrepancy is from application of a large sample procedure to the limited number of observations contained in the 2 x 2 contingency table. The chi-square distribution is continuous. Its approximation is strained when the number of cells and their expected frequencies is small. Test results in these circumstances tend to exaggerate significance.2

Were the differences "statistically significant?" Would they be clinically important? The Woolf/Taylor series 95% confidence interval for this data is 0.981, 7.027.* This interval, as expected, includes the null point. Further, it provides information about the magnitude of the effect and the precision of the estimate. In my opinion, the data suggest that bevel orientation and subsequent development of severe headache is clinically unimportant.

TABLE 1. Patients Requiring Blood Patch

<table>
<thead>
<tr>
<th>Blood Patch</th>
<th>Group 1 Perpendicular</th>
<th>Group 2 Parallel</th>
</tr>
</thead>
<tbody>
<tr>
<td>YES</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>NO</td>
<td>10</td>
<td>17</td>
</tr>
</tbody>
</table>

Others may have different conclusions. The authors should be congratulated for developing such a large clinical series and adding to our knowledge of risk factors for dural puncture.

Anesthesiology
71:624, 1989

In Reply—Dr. Dooner questions the statistical analysis of our data concerning the frequency of blood patch following dural puncture with a large-gauge needle with the bevel oriented either parallel or perpendicular to the longitudinal dural fibers. In his analysis, he tests the two-sided hypothesis \( P_1 \neq P_2 \) and finds insufficient evidence to reject the null hypothesis. However, as the incidence of headache was significantly less with parallel needle bevel insertion, we felt the need only to determine if the headache incidence was also less, and chose to test the one-sided hypothesis \( P_1 < P_2 \). With this approach, we obtain \( P = 0.0385 \) with Fisher's exact test,\(^1\) and \( P = 0.039 \) using a corrected one-tailed chi-square test.\(^2\)

The clinical importance of our findings may be more pertinently determined through further studies and clinical experience.

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Routine Use of Transesophageal Echocardiography is Expensive and Time Consuming

To the Editor—Martin and Bashein\(^1\) once again demonstrate the excellent potential of Transesophageal Echocardiography (TEE) for intraoperative cardiac assessment. They are to be commended particularly for their candid appraisal that detailed analysis is "very time consuming" and "suitable only for research studies."

I believe that this labor intensiveness has proven to be the single most important impediment to adoption of TEE as a clinical tool in many locations. The private practice anesthesiologist views TEE not only as a capital expense, but as a continuing salary expense for the person who has to watch the TEE picture, since it is commonly felt that watching the TEE occupies too much time to allow the anesthesiologist to monitor the patient. This creates a dilemma: TEE appears desirable, but it is too expensive. I propose that there is a possible solution.

The computer used in Martin and Bashein's study, as in all other (to my knowledge) TEE studies, is a serial computer. That is, it performs one arithmetic operation at a time. This mimics the way that the human mind performs arithmetic. Unfortunately, even with the considerable speed of modern computers, the sheer mass of data involved in processing a TEE image makes it impossible to analyze a TEE image in real time.

Not all computers operate in the serial mode. Parallel computers take multiple computing elements (Central Processing Units, or CPU's) and operate them all simultaneously. While each CPU operates serially, the parallel organization of the CPU's allows a multiplication of the efficiency of the computer in performing such tasks as image analysis. This is quite similar to the way the human brain analyzes images. With proper programming, the enhanced capability can be orders of magnitude greater than the number of CPU's. By using parallel processing, it should be relatively simple to perform cardiac output, ejection fraction, and segmental wall motion analysis in real time. With electronically steered ultrasound, it should be possible to do it all in three dimensions in real time! Three dimensional real-time graphic displays could give information not yet imagined.

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