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Potential Complications in Myelography: I. Technical Considerations

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Scanning electron microscopy demonstrated starch powder contamination on the stylet tip from a spinal needle after it was lightly touched with nonwashed surgical gloves. A sterile solution of Pantopaque was injected through the spinal needle after the stylet was withdrawn and carried particulate contaminants to a 0.2 μm millipore filter. Using both scanning electron microscopy and energy dispersive x-ray analysis, particles of various sizes (mostly 5–10 microns) and variable compositions, including starch, talc, and other elements, were identified. Also, glass particles from the Pantopaque vial and plastic particles from the plastic syringe and tubing used in drawing up the Pantopaque were seen. These observations indicate that strict attention to proper technique in myelography is essential in order to eliminate potential cerebrospinal fluid contamination.

Aseptic technique is essential in the performance of myelography. However, little attention has been given to potential cerebrospinal fluid (CSF) contamination from either powder on the outside of surgical gloves or particulate matter within contrast agents. We have demonstrated how starch powder (Biosorb, Arbrook, Arlington, Tex.) from surgical gloves and other particulate contaminants within iophendylate (Pantopaque) can be inadvertently introduced into the CSF. Some suggestions are offered to avoid introducing these contaminants into the CSF and for reducing the potential for either chemical meningitis or arachnoiditis after myelography.

Materials and Methods

The tip of a myelographic needle stylet was deliberately touched with nonwashed sterile latex surgeon's gloves (Triflex, Travenol Labs., Deerfield, Ill.). The tip was subjected to routine preparation for scanning electron microscopy and was subsequently examined at various magnifications. A second spinal needle stylet was handled similarly and then reinserted into the cannula portion of the needle. The stylet was removed and a sterile solution of Pantopaque was injected through the spinal needle cannula onto a 0.2 μm millipore filter. The filter was examined by scanning electron microscopy (SEM) at various magnifications in order to determine particle number, size, and shape. Energy dispersive x-ray analysis (EDAX) was also performed on the filter to determine element content [1, 2]. An untouched myelographic needle tip and a blank 0.2 μm millipore filter underwent SEM and the filter was also subjected to EDAX analysis.

Pantopaque was drawn up into a glass syringe using a 19 gauge, 5 μm filter needle (Jelco Labs., Raritan, N.J.) It was then injected through a 0.2 μm millipore filter and examined by SEM. Pantopaque was also drawn up into a plastic syringe through a standard 18 gauge needle without a filter and was injected through a 0.2 μm millipore filter using the plastic syringe and 3 cc plastic extension tubing. The filter was examined by SEM at various magnifications. EDAX was also performed both on filters containing Pantopaque and on the starch particles.

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Results

The untouched myelographic needle tip and the blank millipore filter revealed no particulate contamination under the scanning electron microscope. Likewise, organic materials were not present on an EDAX analysis of the millipore filter. After touching the tip of a spinal myelographic needle stylet with unwashed sterile latex surgeon's gloves the SEM (fig. 1) revealed starch particles on the stylet tip. The average diameter of these particles was about 10 μm.

Following the placement of the stylet into the spinal needle cannula and subsequent injection of Pantopaque through the cannula, moderate particulate contamination was present on the filter. High power SEM demonstrated numerous starch particles (fig. 2). Other particulate contamination, such as glass fragments of 10–140 μm in diameter, were also identified (fig. 3).

EDAX of powder directly from surgeon's gloves (fig. 4A) demonstrated a silica to magnesium ratio of about 3.5 to 1, indicative of talc contamination [3]. No talc contamination was found when a sample from a package of Biosorb (starch powder) was examined with EDAX (fig. 4B). EDAX analysis of Pantopaque (fig. 4C) likewise demonstrated trace element impurities, such as barium and sulfur. Strong iodine peaks were easily identifiable.

When Pantopaque was drawn up through a normal 18 gauge needle using a plastic syringe and connecting tubing and subsequently injected through a 0.2 μm millipore filter, a large plastic particle was readily visible on SEM (fig. 5). In an attempt to reduce both plastic and glass particulate contamination, a 5 μm filter needle and glass syringe were used to draw up Pantopaque. The Pantopaque was then injected through a 0.2 μm filter that demonstrated a marked reduction in particulate contamination on SEM (Fig. 6).

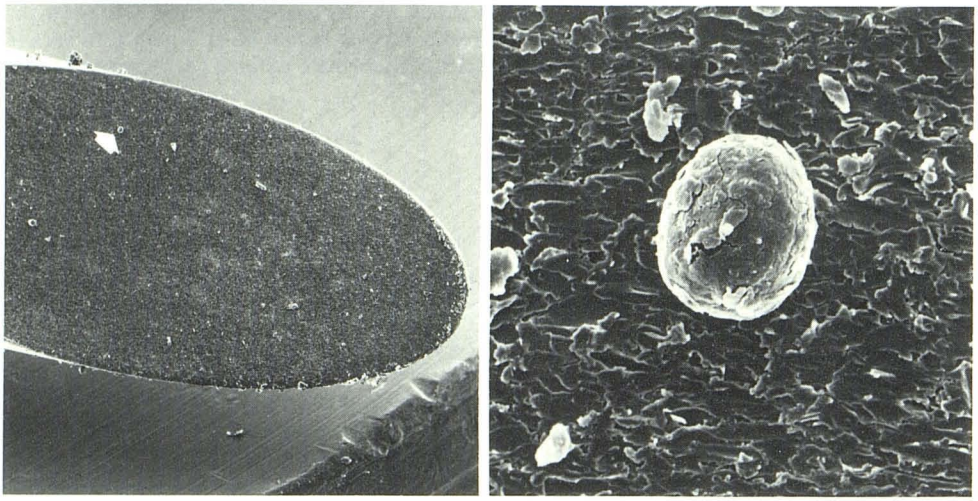


Fig. 1.—Scanning electron micrographs. **A**, Myelographic needle stylet touched by unwashed sterile surgeon's gloves (×100). **B**, Starch particle (**A**, *arrow*) on surface of stylet (×2,900).

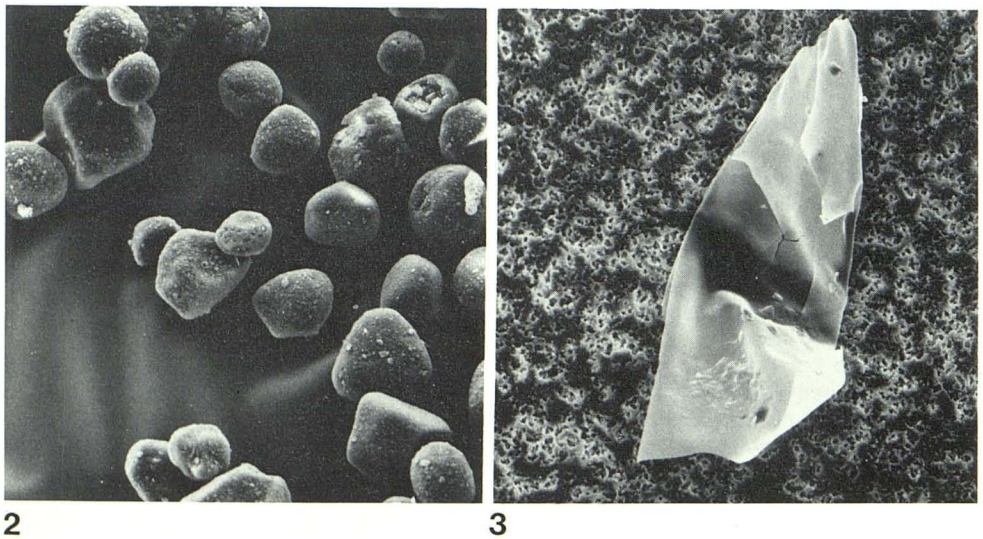


Fig. 2.—Scanning electron micrograph. Numerous starch particles of 5–15 μm from surgeon's gloves (×1,500).

Fig. 3.—Scanning electron micrograph. Solitary glass particle of about 140 μm in greatest diameter (× 700).

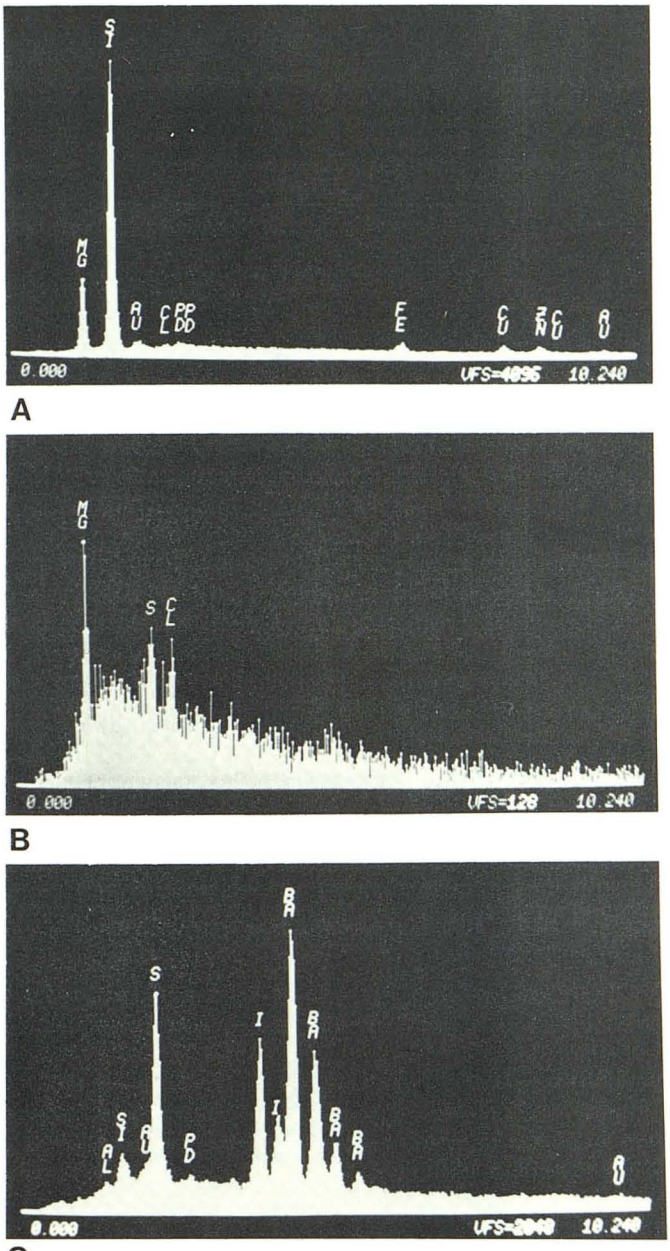


Fig. 4.—Energy dispersive x-ray analysis (EDAX). **A**, Starch particles directly from surgeon's gloves. Silica (SI) to magnesium (MG) ratio is about 3.5:1, indicative of talc contamination. **B**, Biosorb shows no evidence of talc contamination. Magnesium peak (MG) secondary to magnesium oxide used as dispersing agent. **C**, Pantopaque. Strong sulfur (S), iodine (I), and barium (BA) peaks. Barium and sulfur may represent trace element impurities in Pantopaque.

Discussion

Many factors have been implicated in the production of adhesive spinal arachnoiditis [4–6], but there has been no mention of powder from sterile surgeon's gloves as an etiologic agent. Although the incidence of symptomatic spinal arachnoiditis associated with positive contrast myelography is about 1%, the symptoms of meningeal reaction are not uncommon [7–9]. The literature is replete with various theories on possible mechanisms for production of arachnoiditis including hypersensitivity, chemical irritation, infection, spinal anesthetics, surgical procedures, hemorrhage, etc. [4–8, 10–15]. Bergeron et al. [11] implicated retained Pantopaque in the production of arachnoidal reaction. They and others [12, 13] described the potentiating effect of blood mixed with Pantopaque in the development of arachnoiditis. One article in the surgical literature demonstrated that glove powder (talc or starch) directly applied to the conus medullaris or cauda equina in dogs could produce spinal arachnoiditis [16].

Despite all of the conjecture and theories related to meningeal and arachnoidal reaction after injection of Pantopaque or even water-soluble myelographic agents, to our knowledge, there has been no report or suggestion that particulate contamination such as starch, talc, glass, or plastic could be introduced into the CSF during myelography and potentially produce or potentiate spinal arachnoiditis.

The results of this experiment clearly show that the inadvertent touching or handling of the stylet of the spinal needle can lead to introduction of starch particles into the CSF. In addition, the EDAX analysis of starch directly from one manufacturer's gloves clearly shows a magnesium to silica ratio of about 3.5 to 1, indicative of talc contamination [3].

The talc contamination of various gloves from different manufacturers both in this country and Great Britain has been demonstrated by EDAX analysis [3]. Wise [16] showed talc to be more irritative to the central nervous system than starch in the experimental production of arachnoiditis. After demonstrating that starch particles could be inadvertently introduced into the CSF through a spinal needle, we have since proven starch powder mixed with Pantopaque to be synergistic in producing arachnoiditis in a rabbit model [17].

Other CSF contaminants demonstrated by SEM that could potentially be introduced during a myelogram included both glass and plastic particles. Presumably, the glass particles came from the opening of the Pantopaque vial and the plastic particles either from the syringes or tubing used to draw up the Pantopaque. Certainly, more glass particles will be dispersed into the Pantopaque solution if the vial is broken in an upward rather than downward fashion. While the glass may be inert and nonreactive, the use of a commercially available 5 μm filter needle (Jelco) to draw up the Pantopaque would eliminate this contaminant. Because of the high viscosity of Pantopaque, drawing up the contrast material through such a small filter needle takes extra time and effort, but can be readily accomplished.

The plastic particles on the millipore filter suggest that there may be a similar leaching out process with plastic tubing or syringes as has been noted to occur with rubber products and is clearly stated on the Pantopaque package insert. These particles may be inert, but avoiding their introduction into the CSF certainly could be of no harm to the patient.

It may be difficult or impractical to cleanse the sterile surgeon's gloves before myelography, particularly if a disposable myelographic tray is used. In addition, Lee and

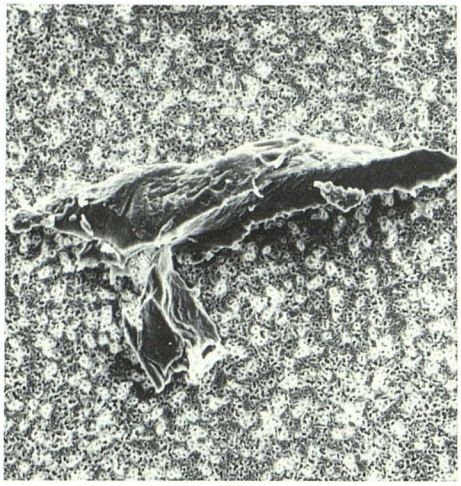
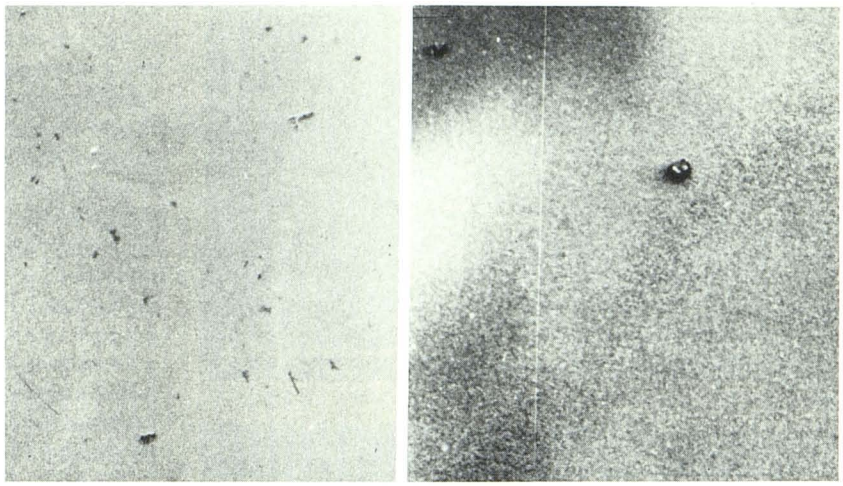


Fig. 5.—Scanning electron micrograph of plastic particle (×500).



A B

Fig. 6.—Low power scanning electron micrographs of 0.2 μm millipore filter (×20). **A**, Pantopaque drawn up without 5 μm filter needle and injected through 0.2 μm millipore filter using plastic syringe and tubing. **B**, Pantopaque drawn up with 5 μ filter needle and injected through 0.2 μ millipore filter using glass syringe only. Particulate contamination is reduced.

Lehman [18] demonstrated that the outer surfaces of sterile surgeon's gloves washed with quantities of water were still abundantly covered with a fine coating of powder after air drying. They found that 0.53 g of powder remained from four pairs of gloves [18]. Therefore, we recommend that neither the tip nor the stylet of the spinal needle be handled during the myelographic procedure. This would eliminate any potential introduction of starch or talc particles into the CSF. We also strongly recommend the use of a 5 μm filter needle to draw up the Pantopaque solution and the use of glass syringes for introduction of contrast material through the spinal needle into the CSF.

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