Intravenous Injection During Chemonucleolysis

To the Editor: Dr. Charles D. Ray's recent Letter to the Editor (Ray CD: Danger of intravenous injection during chemonucleolysis. J Neurosurg 60:1327, June, 1984) is timely in view of recent reports of deaths and transverse myelitis associated with this procedure.

His observations of, first, contrast material appearing in the vena cava after discography, and second, tingling around the mouth or upper trunk after injection of enzyme in the awake patient suggest possible solutions to the problem of intravenous injection of enzyme. It should be possible in the awake patient to include a circulation time marker, such as sodium dehydrocholate in the contrast material used for discography. If the patient experiences the distinctive taste, it would seem prudent to discontinue the procedure. In the anesthetized patient inclusion of fluorescein in the contrast material would produce a green fluorescence of the lips when viewed under an ultraviolet lamp. Use of such techniques, of course, would be predicated on the compatibility of marker and enzyme.

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To the Editor: Dr. Ray, in his Letter to the Editor (Ray CD: Danger of intravenous injection during chemonucleolysis. J Neurosurg 60:1327, June, 1984), describes two cases in which the patients underwent intradiscal injection of Renografin-60, after which the dye was observed on the image intensifier swirling into the vena cava near the anterior border of the vertebra. He postulates that this is probably due to a communication between the disc space and the venous drainage in cases of a disrupted end-plate. The implication of his observation is that this mechanism may be responsible for the tragic consequences of intradiscal injection procedures in some patients. On the basis of his observations, he advocates lateral imaging before injection of the chemonucleolytic material and, if the dye is rapidly dissipated, the enzyme probably should not be injected. I have a couple of comments.

First, the communication between the basivertebral venous plexus, which is an intraosseous system, and the inferior vena cava via the anterior internal vertebral veins, ascending lumbar veins, and lumbar segmental veins is well described in the radiological literature. Thus, with disruption of the vertebral body end-plate, a ready communication between the disc space and the vena cava would ensue.

Second, while image intensification fluoroscopy is certainly an easy method for determining large-volume communications, the sensitivity of the contrast materials used in fluoroscopy is not adequate to determine smaller communications. Standard film/screen radiography (particularly with subtraction) can accomplish this, but a more optimal method is digital subtraction fluoroscopy, which has been especially developed to detect subtle opacifications after contrast administration. With this in mind, it can be advocated that chemonucleolysis, which relies heavily on radiology for its success, should be carried out wherever digital subtraction fluoroscopy is present and, if necessary, with the cooperation of neuroradiologists in the neuroradiology suite.

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References


Response: The comments of Drs. Beatty and Wolpert are appreciated. In addition to their letters, I have received other comments in writing and by telephone regarding my Letter to the Editor. Since my initial observation in January, 1984, of vena cava uptake during intradiscal injection, I have seen a total of nine such cases! I therefore believe that when a degenerated disc space is injected under pressure, it is quite likely that a liquid injectate will gain access to the venous system. One has the impression that there may well be a "potential" direct venous drainage of the disc space that allows the transport of fluid accumulations away from this otherwise avascular joint.

Dr. Wolfgang Rauschning, in his excellent cross-sectional studies of the lumbar spine, has found a number of cases that show vertebral body bone marrow growing (or regurgitating) into the basivertebral plexus. Therefore, one available venous path from the disc space would be through the vertebral body and then out posteriorly through this plexus into the epidural draining veins.

In my cases, the venous access, either into the vena cava or up the epidural plexus, was documented on

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plain films in six cases. Video and cinematographic recordings have been made on four cases. Five cases showed single level intravenous extravasation, although two or three disc levels were injected. Two cases showed two levels and one case showed three levels of venous access by the dye. Two of the nine cases had surprisingly little discal degeneration and no radiographic evidence of end-plate disruption. In these two cases and in at least three others, the dye appeared to reach the vena cava circulation via Batson’s plexus (extradural veins). The dye apparently dissected retrograde from the tip along the outer wall of the needle to gain venous access where, in all probability, the needle had penetrated a vein lying on the posterolateral anulus. For those readers who have not seen vascular access of dye (and to demonstrate the likelihood of retrograde intravenous injection), Fig. 1 shows such a case. Surprisingly, the volume of Renografin-60 used in this case was about 3 ml for each of these views! Note that only the L3-4 level showed venous outflow; the L4-5 did not. The L5-S1 level was collapsed and not injected in this patient.

Escape of the injectate back along the needle path represents a highly probable mechanism for intrathecal access by dye or chemonucleolytic material in certain cases and may well explain many of the catastrophies seen following the use of the enzyme, especially when both agents pass into the thecal compartment.

In four of my cases I have measured the pressure of injection by attaching a dial manometer designed for use in cardiac catheterization. Much to my surprise, when bimanual injection was performed with a three-ring 3-ml or 10-ml glass pressure syringe, pressures of greater than 10 atm (over 150 lb/sq in.) were easily obtained. In two cases, pressures of about 15 atm (225 lb/sq in., or about 8000 mm Hg) were reached! From these brief observations, I have attempted to correlate injection pressure with extravasation; I have the impression that injection pressures should not exceed about 5 atm (75 lb/sq in., or about 3800 mm Hg). It appears that in most cases adequate intradiscal injections are possible at pressures of around 4 or 5 atm. This observation suggests that the injection pressure may be a useful, measurable parameter during discography or chemonucleolysis.

Dr. Beatty’s letter suggests the addition of a marker
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or tracer substance to the injectate as a means for indicating venous access, without having to use contrast material. The reader should be aware that recent experimental evidence from studies on baboons showed that when either chymopapain or contrast material was injected into the theca there were serious toxic results. However, when both were injected together, the tissue toxicity was even greater. In a recent presentation on complications from chemonucleolysis (unpublished data), I also mentioned the possibility of combining a tracer material with the injectate. That is, I suggested it might be useful to include some innocuous substance in the injectate so that if the injectate were to gain rapid venous access, the patient might be able to report it. Such substances as sodium decholate, nicotinic acid, or perhaps fluorescein or ethyl ether might be considered. All of these are old methods for determining circulation time. However, should the injectate gain intrathecal access, these tracers themselves might produce adverse reactions. For the present, therefore, it would seem that fluoroscopic visualization of the dye injection and perhaps the monitoring of pressure might prove best; these should be studied further, however.

Dr. Wolpert suggests digital subtraction during dye injection as a means of improving on radiological sensitivity; his is an excellent suggestion, although the patient must remain rather immobile during the injection. Immobility is not always achievable since many patients will experience considerable low-back pain during the dye injection and will, by reflex, move about. We have made a few optical subtractions from finished x-ray films exposed just before and just at the end of dye extravasations and the lack of registration between x-ray films is quite apparent.

Dr. Jesse Weinger, an orthopedist from Peoria, Illinois, recently called me regarding “bloody discs;” that is, disc spaces that might yield blood through a No. 18 needle well placed inside the disc space. Although one can often find some bloody return through a No. 18 needle as it passes through deep muscle or the epidural venous space, blood is not seen in the No. 22 needle, as used in a two-needle technique to reach the disc center. Certainly, bloody disc spaces do occur and can be seen at the time of surgical discectomy, probably from recent end-plate disruption. However, this may be a rare phenomenon since the intradiscal pressure is normally much higher than venous or arterial blood pressure.

In summary, I believe that there is no substitute for experience and ability when placing needles into the disc space. The two-needle technique should be used in all cases to reduce the size of anular puncture and to permit a more lateral approach of the outer needle (to avoid the dura or dural root sleeve), after which it then curves inward to reach the disc center. Contrast material should be used but the pressure of injection should not be excessive (the pressure obtained by one hand alone should suffice; bimanual strength is too great).

Close observation of the injection should be maintained, perhaps with digital subtraction, as suggested by Dr. Wolpert.

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Reference


Chymopapain and General Anesthesia

To THE EDITOR: The rather surprising number of complications being reported now that chymopapain is available for general use makes the very excellent article on peripheral nerve injury by Mackinnon, et al., very timely (Mackinnon SE, Hudson AR, Llamas F, et al: Peripheral nerve injury by chymopapain injection. J Neurosurg 61:1–8, July, 1984). When we were first asked to evaluate this treatment method, we turned down the protocol (which was then insisted upon) because we could not agree with the required general anesthetic for two reasons: 1) we would be deprived of the best indicator that the needle was hitting a nerve root; and 2) we would be deprived of the earliest warning of the onset of anaphylaxis.

Another of our objections to the original protocol concerned the injection of contrast material into the disc immediately before the chymopapain injection. We argued that any dilution of the chymopapain could not possibly help, and that the two agents together might be more likely to cause trouble than either one alone. After we presented our paper on this subject at the annual meeting of the American Association of Neurological Surgeons in 1972,2 discussants claimed that the enzyme destroyed virtually anything it came into contact with, in particular, dura and nerve roots. They showed test tubes of amorphous material alleged to be the result of chymopapain being in contact with dura and nerve roots.

On returning home, we soaked nerve roots and dura in chymopapain, changed daily for a week, and found no evidence of any alteration in either type of tissue or in the enzyme solution as compared to control specimens soaked in saline. The photographs supporting our findings were never published but were used repeatedly in various meetings held in conjunction with the reintroduction of the enzyme. Therefore, it is very pleasant indeed to see this carefully prepared and objectively reported work by Mackinnon, et al., indicating that nerve damage results from mechanical “technical error in needle placement” rather than from chemical damage due to chymopapain. It is also interesting to find that, when mixed with contrast material, chymopapain can produce nerve damage, as we have maintained.

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