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COMPLICATIONS OF FLUOROSCOPICALLY GUIDED EXTRAFORAMINAL CERVICAL NERVE BLOCKS

AN ANALYSIS OF 1036 INJECTIONS

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Background: A number of serious complications associated with fluoroscopically guided extraforaminal cervical nerve blocks have been reported in the literature. The purpose of the present study was to determine the rate of complications associated with these blocks and to determine whether needle positioning during the procedure affected the prevalence of complications at one institution.

Methods: Between October 1999 and June 2003, we performed 1036 fluoroscopically guided extraforaminal cervical nerve blocks in 844 patients. Plain radiographs documenting the procedure were made as part of the standard quality-assurance protocol. An independent observer who was uninvolved with the procedures reviewed a prospectively kept database on all patients. We subsequently reviewed the patient records to identify complications.

Results: There were no catastrophic complications such as vessel damage, paralysis, or death. Overall, fourteen patients (1.66%) had a minor complication in association with the procedure. With the numbers available, the rate of complications associated with pdeep injection (798 blocks) was not significantly different from that associated with shallow injection (238 blocks) (1.89% compared with 0.84%). However, the rate of complications associated with anterior placement of the needle tip (thirty-three blocks) was higher than that associated with ideal placement of the needle tip (904 blocks) (6.06% compared with 1.55%) ($p = 0.04$).

Conclusions: No catastrophic complications occurred in this series of 1036 nerve blocks. We found that the medial-lateral needle depth as seen on frontal-view radiographs was not associated with complications, although the anterior positioning of the needle as seen on lateral-view radiographs was associated with minor complications. Our results suggest that, with our technique, cervical nerve blocks are relatively safe procedures.

Level of Evidence: Therapeutic Level III. See Instructions to Authors for a complete description of levels of evidence.

Fluoroscopically guided extraforaminal cervical nerve blocks are a noninvasive alternative to surgical treatment¹. In addition, they have been reported to be of value in helping to determine the pain-generating level preoperatively². Fluoroscopic guidance was added as a means of avoiding needle misplacement associated with blind cervical nerve blocks^{3,7}.

As with any nerve block, minor complications such as headache, temporary pain, nausea, numbness, and weakness have been associated with the procedure². Alarming, there have also been recent case reports of fatal spinal cord infarction⁴, injection into an anterior radicular artery⁵, and puncture of the epidural sac of the nerve root sleeve¹. In addition, there has been concern regarding potential injury to the vertebral artery⁶. The potential for these and other catastrophic complications, and the associated potential for litigation, have

anecdotally prompted some groups to advocate protocols that maintain a shallow needle position and have influenced others to cease performing the procedure altogether. Although informative, these alarming case reports may not accurately reflect the true risks associated with the procedure. In order to ascertain a more objective measure of associated risks, we reviewed our experience with cervical nerve blocks to determine the prevalence of catastrophic complications, including death, paralysis, spinal cord injury, stroke, vertebral artery injury, and infection. In our review of the English-language literature, we were unable to identify any large series that have examined the complication rate associated with the procedure. We also investigated whether the depth and position of needle placement as measured on frontal and lateral radiographs were associated with the prevalence of minor complications, including headache, numbness, pain, weakness, and nausea.

Materials and Methods

All patients who received a fluoroscopically guided extraforaminal cervical nerve block at our institution between October 1999 and June 2003 were included in the present retrospective study. One thousand and thirty-six injections were performed on 844 patients, for an average of 1.23 injections per patient. The average age of the patients at the time of injection was forty-seven years. Fifty-four percent of the patients were women, and 46% were men. The large majority of patients had symptoms related to either disc herniation or foraminal stenosis and had been referred by a single orthopaedic spine surgeon (K.D.R.). Blocks were performed either for verification of a pathological nerve root level or to prevent or delay the need for surgery. The injections were performed by or under the direction of three attending radiologists in our radiology department. All three radiologists used a standardized technique, which was verified prospectively by the senior radiologist (L.A.G.) by means of a quality-assurance review of all of the injections.

Before the procedure, each patient completed a form indicating the distribution pattern of pain as well as the severity of pain on a scale from 0 to 10. For the procedure, the patient was placed in the lateral decubitus position with the side of interest elevated. C-arm fluoroscopy was used to place a 25-gauge needle into the extraforaminal area of the level of interest. The needle was inserted to slide along the anterior surface of the articular pillar (lateral mass) and was kept as posterior as possible in order to avoid the vertebral artery. To ascertain that the needle tip was not located in a vascular structure, myelographic contrast material (iohexol) (Omnipaque 180 or 300; Amersham Health, Princeton, New Jersey) was injected prior to the injection of the anesthetic and medication mixture.

Once the needle was adequately positioned, 1 mL of Celestone Soluspan (betamethasone sodium phosphate and betamethasone acetate; Schering-Plough, Chatsworth, Georgia) with 0.5 mL of preservative-free 2% lidocaine or Xylocaine, or 0.5 mL of methylprednisolone acetate suspension (DepoMedrol 80 mg/mL; Pharmacia-Upjohn, Kalamazoo, Michigan) with 0.5 mL of 2% preservative-free Xylocaine and 0.5 mL Omnipaque 180 or 300, for a total volume of 1.5 mL, was injected. DepoMedrol was used later in the study period as Celestone became unavailable commercially. Images were made during and after injection to verify needle tip placement.

A duplicate fluoroscopic record of each procedure was obtained prospectively as part of our standard quality-assurance protocol. Every patient was observed for ten to twenty minutes after the injection and was given a follow-up form regarding pain. Immediate pain relief and complications were recorded in the dictated radiographic report. Patients were instructed to contact the referring doctor if delayed complications occurred. An independent observer (D.J.M.) who had not been involved in the procedures reviewed a prospectively kept database on all patients who had undergone cervical nerve blocks during the study period. Radiographs were reviewed, and the needle position in both the frontal and lateral views was noted and labeled. Uncertainties about needle position were resolved by means of a consensus between the independent reviewer and the radiologist (L.A.G.).

On the frontal view, needle depth was measured with use of the lateral mass as a marker. Needle tips that were peripheral to the lateral border of the lateral mass were labeled as being in Zone 1. Needle tips overlying the lateral mass but lateral to the midline were labeled as being in Zone 2. Needle tips overlying the medial half of the lateral mass but within the

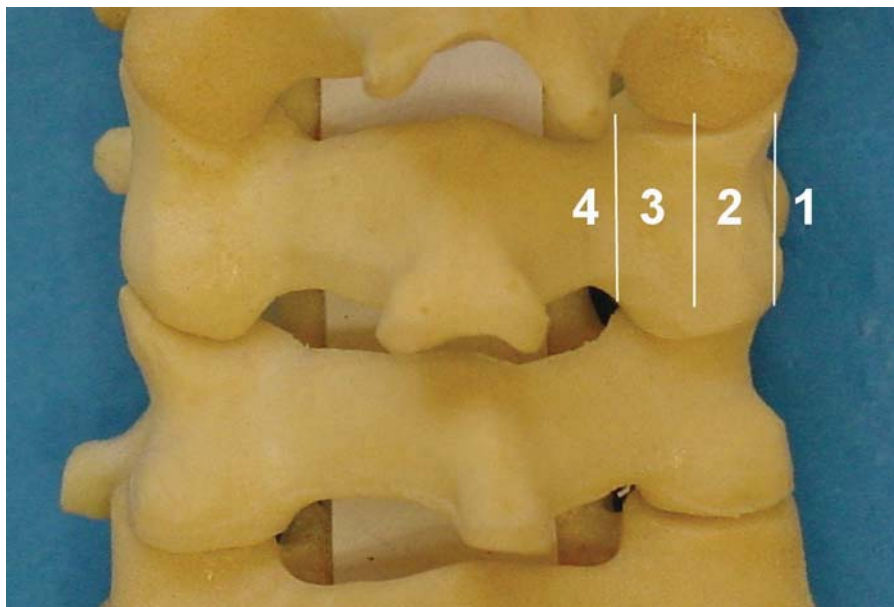


Fig. 1

Frontal view of a cervical spine model, demonstrating the boundaries of the various frontal zones. (See the text for a description of Zones 1 through 4.)

mass were labeled as being in Zone 3. Needle tips medial to the lateral mass were labeled as being in Zone 4 (Fig. 1). Needle tips that were on the boundary between zones were labeled as being within the deeper zone.

On the lateral view, ideal needle placement (defined as placement directly on the anterior edge of the lateral mass) was labeled as Zone A. Needle positions that were within two needle-tip diameters anterior to Zone A were labeled as Zone B. Positions further anterior than Zone B were labeled as Zone C (Fig. 2). Radiographs with inadequate lateral views were labeled U. Radiographs were labeled inadequate if the lateral masses did not overlap by at least 50%.

A thorough review of a list of complications concurrently recorded by the radiology department as well as of all procedure reports was performed to identify which procedures were associated with complications. These complications were matched to the needle position within the radiographic image. Institutional review board approval was obtained for this retrospective study.

Results

No catastrophic complications such as death, paralysis, stroke, spinal cord injury, vertebral artery injury, or infection were recorded. Seventeen injections (1.64%) were associated with complications, most of which were minor and transient (Tables I and II). Two patients with complications had had multiple injections: one had had two simultaneous injections, and the other had had three. Thus, a total of fourteen patients (1.66%) had a complication in association with the procedure. Ninety-nine injections were excluded because of an inadequate lateral fluoroscopic record. None of these injections were associated with any reported complications, and

| Needle Position | Number of Injections | Prevalence of Minor Complications |
|-----------------|----------------------|-----------------------------------|
| Total | 1036 | 1.64% |
| Frontal Zones | | |
| Zone 1 | 1 | 0% |
| Zone 2 | 237 | 0.84% |
| Zone 3 | 792 | 2.15% |
| Zone 4 | 6 | 1.89% |
| Lateral Zones | | |
| Zone A | 794 | 1.51% |
| Zone B | 110 | 1.81% |
| Zone C | 33 | 6.06% |
| Zone U | 99 | 1.01% |

all were excluded only because of the inability to analyze the radiographs.

The prevalence of minor complications according to needle position is summarized in Table I. The complications that were encountered are summarized in Table II. Three patients had symptoms that probably were linked to uncontrolled diabetes, concomitant neurological findings, or alcohol consumption, but we included them for completeness. One patient who had transient global amnesia, dizziness, and nausea was admitted to the hospital overnight and had a thorough neurological workup, which revealed negative findings. The dizziness had resolved by two weeks.

In addition to the fourteen patients who had complications, two patients received the injection at the wrong level

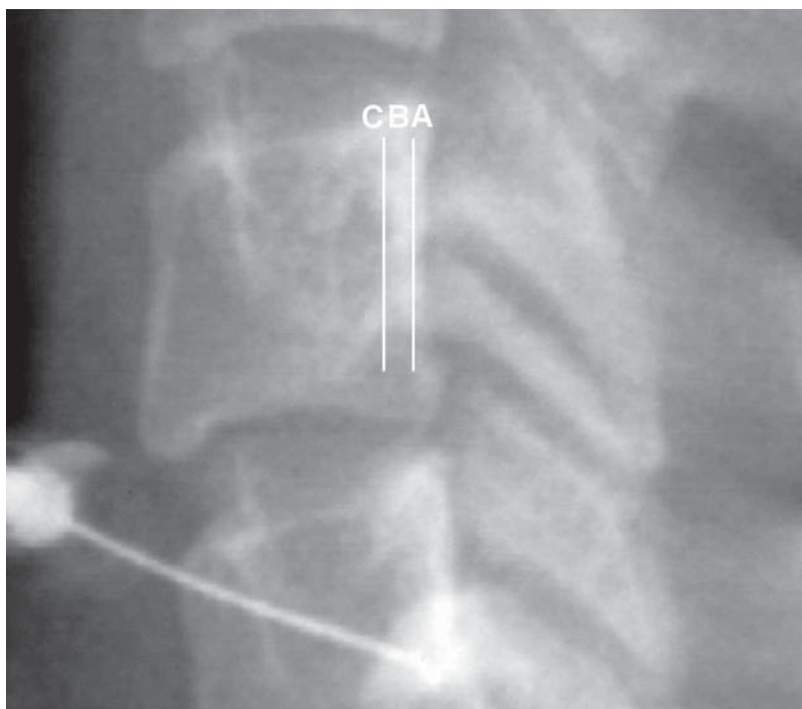


Fig. 2

Lateral radiograph of the cervical spine, demonstrating the boundaries of various lateral zones. (See the text for a description of Zones A, B, and C).

and one patient received a facet block instead of a nerve block. While the wrong-level injections and the facet injection did not produce complications, they do nevertheless represent complications of the procedure. For the purposes of statistical analysis, however, we did not consider these procedural errors as complications.

Chi-square tests were performed to determine whether there were any significant differences in the rate of complications associated with differences in needle placement. Analysis of needle tip depth on the frontal view revealed no significant difference, with the numbers available, between the rate of complications associated with deep injections (Zones 3 and 4; 798 blocks) and that associated with superficial injections (Zones 1 and 2; 238 blocks) ($p = 0.31$). Analysis of needle placement on the lateral view, however, demonstrated a significant result. Specifically, the rate of complications associated with skewed (anterior) placement of the needle tip (Zone C; thirty-three blocks) was significantly higher than that associated with ideal or near-ideal placement of the needle tip (Zones A and B; 904 blocks) ($p = 0.04$).

Discussion

Several small series have established the efficacy of fluoroscopically guided extraforaminal cervical nerve blocks⁷⁻⁹. The complications associated with this procedure, however, have only been mentioned in passing in those articles as well as in isolated case reports⁸. To our knowledge, the present study represents the largest reported series of such blocks to date as well as the only study that has focused on the complications of such blocks.

Several articles have described catastrophic complications that have occurred in association with fluoroscopically

TABLE II Summary of Complications

| Complication | Number of Patients with Complications |
|--|---------------------------------------|
| Complication following injection | |
| Headache/dizziness | 5 |
| Transient neurologic deficits (pain or weakness) | 6 |
| Hypersensitivity reaction | 1 |
| Vasovagal reaction | 1 |
| Transient global amnesia | 1 |
| Total | 14 |
| Wrong-site injection | |
| Injection at incorrect level | 2 |
| Facet injection | 1 |
| Total | 3 |

guided extraforaminal cervical nerve blocks³⁻⁶. Intravascular penetration has always been the primary concern related to this procedure. Furman et al. attempted to address this concern by detailing the prevalence of intravascular penetration associated with transforaminal procedures¹⁰. However, none of their 337 patients experienced symptoms associated with intravascular contrast medium because the needle was immediately repositioned if any contrast medium was found to pass intravascularly. Our study confirmed this finding. The risks of intravascular injection can be minimized by injecting contrast medium before performing the nerve block. We observed none of the catastrophic complications that have been associated with intravascular penetration, and we have modified our injection procedure to avoid intravascular injection by adding

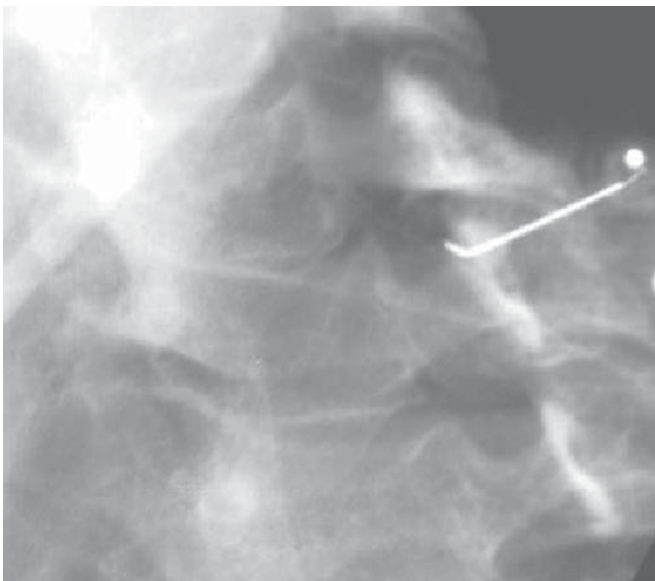


Fig. 3-A

Fig. 3-A Oblique radiograph demonstrating the needle tip and contrast medium projecting over the posterior aspect of the extraforaminal area.

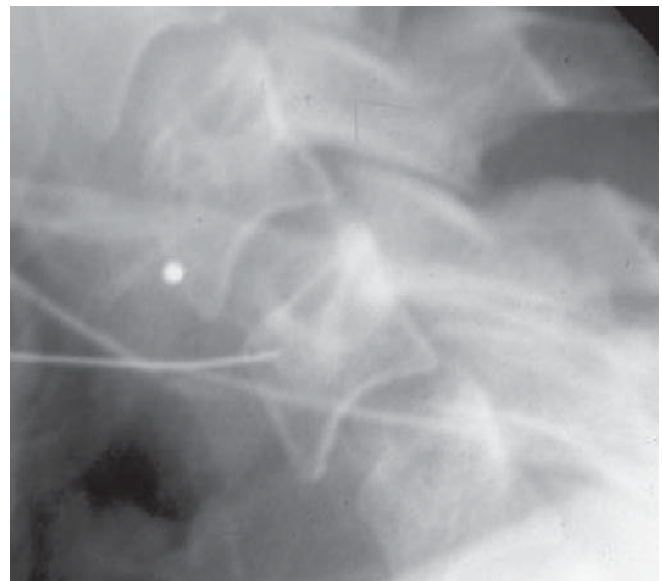


Fig. 3-B

Fig. 3-B Lateral radiograph of the same patient. What appeared to be an adequate needle tip position on the oblique radiograph is actually an anteriorly placed needle tip position on the true lateral radiograph.

contrast medium to the final injectate. Another method for preventing intravascular injection is to attach the needle to a thin-walled, short lymphangiographic tube (MX453; Medex, Dalton, Ohio) through which contrast medium can be injected. Another syringe containing the injectate can then be attached to the free end of the connecting tube to inject the medication, thereby eliminating the need to retouch the needle to instill the injectate¹¹.

The International Spine Injection Society and Windsor et al. recommend frontal and oblique radiographic views for verification of needle tip position^{12,13}. The importance of lateral views was not stressed. It has been our experience, however, that an apparently adequate needle position as seen on the oblique view does not necessarily translate into an adequate needle position on the lateral view (Figs. 3-A and 3-B). In order to prevent damage to the vertebral artery, we routinely keep the needle close to the anterior surface of the lateral mass, a position that can only be ascertained on a true lateral view. This is relevant because we also found that anteriorly positioned needles were associated with a higher complication rate than more posteriorly positioned needles were.

As with any study, the present study is not without flaws. This was a retrospective study and therefore is constrained by the limitations of such analyses. As is the case with all retrospective studies, we cannot be certain if there were any unreported complications that occurred. Our standard policy was to inform the patient of the potential known or probable complications of the procedure, including all of the complications that we have analyzed. All patients were observed in the radiology department postoperatively in order to identify any immediate complications, which were duly recorded. Upon discharge, the patients were given specific instructions about how to contact the radiology department in order to notify us of any late complications. In addition, all patients were instructed to contact the referring doctor, both to notify him or her of the results of the injection as well as to report any complications. Despite all of these precautions, we believe that it is quite probable that a certain number of patients may have suffered a minor complication without informing the physicians or that the referring doctor may have neglected to inform the radiologist. However, problems such as death, stroke, and paralysis are not subtle findings and cannot be ignored or self-treated by the patient. We believe that it is highly unlikely that these catastrophic events could have occurred without our knowledge. As stated previously, all patients were requested to fill out a post-injection questionnaire regarding the immediate and one-week results. While we did not specifically use the questionnaire to detect complications, we believe it provided the patients with an additional means of informing their refer-

ring doctors of any complications.

Another shortcoming of our study is that the static fluoroscopic image that we utilized to analyze the position of the needle recorded only where the needle was at the time that the image was made. However, we took specific precautions to prevent accidental movement of the needle during the procedure. All of the injections were performed under fluoroscopic control, and the needle was repositioned correctly if any movement was detected on the fluoroscopic image. Also, a post-injection image was made to verify the position of the needle tip. Therefore, we believe that the spot image that was recorded reasonably reflects the actual location of the injection. As with any technique-dependent procedure, our results will not be universally reproducible. Nevertheless, we believe that, in competent hands, our results will be reproducible at other institutions as there were no apparent differences with regard to complication rates among the three radiologists at our institution.

In conclusion, case reports on complications can be unnecessarily alarming in that they most often do not provide the prevalence of such complications. We undertook the present study on nerve blocks that had been performed at a single institution to put such complications into perspective. There were no catastrophic complications, and the rate of minor complications was low. We believe that the risk of complications can be further minimized by positioning the needle as posteriorly as possible, hugging the anterior wall of the lateral mass. Our results suggest that, in experienced hands, the described technique for cervical nerve root blocks has an acceptable safety profile. ■

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