Safety of CT-Guided Lumbar Nerve Root Infiltrations

Analysis of a Two-Year Period

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Summary

Selective nerve root infiltrations are frequently performed in patients with lumbar radiculopathy. Computed tomography (CT) is now commonly used for image guidance. Despite the widespread use of CT-guided lumbar nerve root infiltrations few studies have systematically examined the safety of this approach. In a two-year period, 231 lumbar nerve root infiltrations were performed on in-patients and were retrospectively reviewed. No major complications like inflammation (especially spondylodiscitis), large haematomas requiring surgery, severe allergic reactions or spinal ischaemia occurred. In accordance with other published studies, CT-guided lumbar nerve root infiltrations seem to be safe. To minimize the risk of catastrophic neurological complications due to spinal ischaemia, careful needle placement dorsal to the nerve root and the use of a non-particulate corticosteroid, like dexamethasone, are advocated.

Introduction

Selective nerve root infiltrations are frequently performed in patients with lumbar radiculopathy. These infiltrations are also called peri-/pararadicular infiltrations or transforaminal epidural infiltrations. The goal is to deliver medications directly to a disturbed spinal nerve root, most commonly a mixture of local anaesthetics and a corticosteroid is applied. Because of the favourable prognosis of most radiculopathies due to lumbar disc herniations, lumbar nerve root infiltrations are now incorpo-

rated into a conservative treatment approach in many institutions. Image guidance in lumbar nerve root infiltrations is mandatory. Traditionally these infiltrations have been performed under fluoroscopy, but the use of computed tomographic (CT) guidance has steadily increased. CT guidance offers superior anatomic orientation compared to fluoroscopy and the puncture needle can be placed directly near the visible affected nerve root. CT guidance is now commonly used for image guidance in selective lumbar nerve root infiltrations. Despite the widespread use of CT-guided lumbar nerve root infiltrations surprisingly few literature reports have systematically examined the safety of this approach. The complication rate has been reported in research articles or is summarized in reviews only¹⁻¹³. A systematic study examining the safety of CT-guided lumbar nerve root infiltrations is missing.

Material and Methods

This is a retrospective analysis of lumbar nerve root infiltrations performed in 2011 and 2012 at the Department of Clinical Radiology at Göttingen-Weende hospital. Patients were included if the infiltration was performed on an in-patient basis, i.e. the patients stayed at least one night in hospital after the infiltration and were discharged only after being examined by an orthopaedic surgeon. All patients were advised to return to the emergency room immediately if any signs of neurological deterioration or infection were noted. Medical records including the radiologist's report of the infiltra-

tion, the discharge letter and laboratory data were reviewed. The occurrence of major complications like spinal ischaemia, infection, a large haematoma requiring surgery or severe allergic reactions was noted. If performed after the intervention, laboratory markers of inflammation (leucocyte count, C-reactive protein) were reviewed. In the two-year period, 405 spinal interventions (cervical and lumbar nerve root infiltrations, facet and ileosacral joint infiltrations) were performed, 231 met the criteria for inclusion. Of these 231 CT-guided lumbar nerve root infiltrations 99 were men (42.8%) and 132 were women (57.2%). The mean age was 58.7 years (range 19-91 years). Most commonly the L5 or S1 nerve roots were infiltrated (60% of injections). Most infiltrations were performed by three board certified radiologists, while a few were performed by residents under close supervision of one of the above-mentioned radiologists. For the infiltration the patient was positioned prone or on the side. A scout scan was performed at the target level. After sterile draping and local anaesthesia a 21-G needle (Sterican®, B. Braun, Melsungen, Germany) was positioned dorsal to the nerve root. A small amount of diluted contrast medium (Imeron® 350, Bracco Imaging, Konstanz, Göttingen) was injected to show spread around the nerve root. If no blood could be aspirated a mixture of 1 ml mepivacaine 1% (Scandicain® 1%, Astra Zeneca, Wedel, Germany) and 1 ml

dexamethasone (Lipotalon®, Recordati Pharma, Ulm, Germany) were injected. Patients were transferred back to bed and advised to rest for the next hour.

Results

In the two-year period, 231 CT-guided lumbar nerve root infiltrations were performed on in-patients. No major complications like inflammation (especially spondylodiscitis), large haematomas requiring surgery, severe allergic reactions or spinal ischaemia occurred. In a few patients, a rise in C-reactive protein (CRP) was found after the intervention, but none of these patients showed spondylodiscitis in the further clinical course. In one adipose patient, needle placement was complicated and a puncture of the facet joint capsule occurred (shown by intra-articular contrast medium). In one patient, bloody aspiration occurred despite numerous attempts, only after several attempts was a needle positioned without aspiration of blood and regular spread of the contrast medium occurred. Temporary muscle weakness and dysaesthesias according to the infiltrated nerve root occurred and were sometimes noted in the radiologist's report. But these minor complications were not recorded systematically. In none of the patients was a deterioration of symptoms reported.

Table 1 Published and personal data of major complications in patients undergoing CT-guided lumbar nerve root infiltrations.

Author and year	Number of infiltrations	Corticosteroid	Major complications	Data collection
Uhlenbrock et al. 1997	16	Triamcinolone	0%	Retrospective
Zennaro et al. 1998	41	Hydrocortisone	0%	Not specified
Berger et al. 1999	160	Hydrocortisone	0%	Retrospective
Porter et al. 1999	22	Triamcinolone	0%	Retrospective
Wagner 2004	348	Depomedrole	0%	Prospective
Lee et al. 2005	143	Triamcinolone	0%	Prospective
Karaeminoğullari et al. 2005	42	Triamcinolone	0%	Prospective
Riboud et al. 2008	23	Dexamethasone/ Cortivazole	0%	Prospective
Gruenberg et al. 2011	61	Not specified	0%	Retrospective
Loizides et al. 2012	20	Betamethasone	0%	Prospective
Personal data	231	Dexamethasone	0%	Retrospective
Total	1007		0%

Figure 1 CT-guided lumbar nerve root infiltration in a 36-year old man. A large disc herniation with compression of the right L5 nerve root can be seen in the scout image (on the left). CT confirms correct needle placement dorsal to the affected nerve root (in the middle) and correct distribution of the diluted contrast medium along the nerve root (on the right).

Discussion

In our sample, no major complications occurred in patients undergoing CT-guided lumbar nerve root infiltrations. This is in accordance to the published literature. Several clinical studies with sample sizes of 20 to 140 patients reported no major complications (Table 1)¹⁻¹⁰. Grönemeyer et al. reported on CT-guided lumbar nerve root infiltration in 228 patients, with each patient receiving four to 11 infiltrations. In that series of more than 912 infiltrations (the exact number of infiltrations was not reported) no major complication occurred¹². But they did report one case of spinal ischaemia after CT-guided lumbar nerve root infiltration, which occurred outside the study. A review by Depriester et al. reported on 1156 performed CT-guided lumbar transforaminal epidural infiltrations performed in the year before publication without major complications¹³. Given the format of this educational review they only describe the technique in general, i.e. details on the sample (mean age, gender, distribution of the infiltrated level, follow-up) are not described and this hinders the generalizability of their findings. In contrast to CT-guided lumbar nerve root infiltrations, larger prospective studies have reported the safety of fluoroscopic-guided lumbar transforaminal epidural infiltrations. The two largest series with 1305 and 1310 fluoroscopic lumbar nerve root infiltrations did not find any major complication^{14,15}. Given these findings, lumbar nerve root infiltrations seem to be a safe procedure. But there are several case reports of severe neurological sequelae due to spinal is-

chaemia after lumbar nerve root infiltrations. As reviewed by Atluri et al., 18 cases have been reported so far¹⁶. This rare and severe complication seems to be caused by inadvertent injection of corticosteroid into a feeding spinal artery¹⁷. Even with CT guidance and injection of contrast medium, these complications may occur (five reported cases). The number of these complications is very low compared to the number of lumbar nerve root infiltrations performed. But the possibility of such a severe complication has to be kept in mind when performing CT-guided lumbar nerve root infiltrations. To minimize the risk of such a catastrophic side-effect, several precautions should be taken. The tip of the needle should always be positioned dorsal to the nerve root because the feeding arteries for the spinal cord are usually located anterior and superior to the nerve root (Figure 1). Before the injection of medication a small amount of contrast medium should be administered (Figure 1). If this contrast medium is not readily seen on the control scan a possible intravascular needle position should be suspected and repositioning is mandatory. With the use of dexamethasone, which is non-particulate, no spinal ischaemia after injection in spinal arteries has been shown in a pig model. Other commonly used corticosteroids (triamcinolone, betamethasone) seem to aggregate and these aggregates may be larger than red blood cells with the subsequent risk of embolism^{17,18}. As an alternative to the use of corticosteroids, intraforaminal gas injection of an oxygen-ozone (O₂-O₃) mixture has been reported. In a randomized trial on 306 patients, the injection of

this gas mixture showed similar short-term relief, but superior long-term pain relief¹⁹. In the analysis of a large series of 2200 patients treated with intraforaminal oxygen-ozone injections no complications were noted, showing the safety of this alternative approach²⁰.

In this series, temporarily elevated CRP was sometimes found after CT-guided spinal interventions. This finding is a known occurrence after operations, the peak of these elevations is usually found around the second or third day after the intervention²¹. It has to be kept in mind that disc herniation itself leads to a systemic inflammatory response with possible slight elevations in CRP²². But severe CRP elevations with other signs of inflammation like fever, local pain or swelling should prompt a further search for possible post-interventional spondylodiscitis.

The major limitation of this study is its retrospective design. There was no systematic prospective monitoring of complications during the follow-up. To overcome these limitations only in-patients were considered for this study. This also explains the relatively small sample

size, which is nonetheless larger than in most reported clinical trials (Table 1).

Patients stayed in hospital at least until the next morning, i.e. the most feared complication of spinal ischaemia is impossible to overlook in this setting. Infectious complications may have been undetected in this study, as patients may have presented at another hospital. Minor complications were also not routinely recorded. Even if major complications seem to be absent in our retrospective evaluated sample, this needs to be replicated in a larger prospective study.

Conclusion

CT-guided lumbar nerve root infiltrations seem to be a safe intervention in patients with radiculopathies.

Nevertheless, to minimize the risk of catastrophic neurological complications careful needle placement dorsal to the nerve root and the use of a non-particulate corticoid like dexamethasone are advocated.

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