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Pain Therapy – CT Assisted Cervical and Thoracic Nerve Root Blockages

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Abstract

Background/Aims: With the possibility of imaging the anatomical conditions by means of Computed Tomography (CT), Magnetic Resonance Imaging (MRT) or ultrasound, but above all with the increasing availability of CT devices, the need to optimize the "old blocking techniques" through modern imaging grew in general alternatively or adjuvantly to be able to offer pain-afflicted people with more certainty.

Using retrospective study, we were interested to see the results of the output of pain treatment by patients suffered from chronic radicular pain. We have evaluated the therapy by 320 patients receiving cervical and by 65 patients receiving thoracic blockages under CT control, which were performed during the period of twelve months.

Methods: Cervical nerve root and thoracic root blocks with the CT-controlled technique were used, as a routine method at the pain clinic. The average time of the block was between 15 min to 20 min. For pain evaluation VAS questioning was applied before and after block.

Results: Positive and significant effect of pain treatment was observed by 80% to 95% of patients and the average pain reduction was 50% and was statistically significant, P<0.0001. No serious problems were reported during and/or after the blockages. The result of CT or other image-assisted interventions is more predictable, especially when the distribution of the contrast agent is checked before the pain reliever is instilled.

Conclusion: By patients with chronic radicular pain the application of cervical and thoracic blockages under CT control was successful and significant to reduce the pain. We are convinced that the positive output of treatment was due to experienced team and excellent management of blockade performance with CT-controlled technique.

Keywords: Pain treatment; CT; MR; Chronic radicular pain; Cervical; Thoracic; Blockages

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Introduction

Root blockages in general

The treatment of radicular pain caused by a recent herniated disc, a recurrent prolapse, epidural fibrosis after disc surgery or after nerve root inflammation using a periradicular infiltration with a local anesthetic has been carried out for many decades [1-5]. However, due to the increased iatrogenic risk, cervical and thoracic blockades were only performed in exceptional cases by physicians experienced in this field. With the possibility of using imaging methods, there has been a renaissance of nerve root blocks in recent years [4]. In addition to non-particulate cortisone preparations local anesthetics can be added, which might increase the effect of a blockade [6]. Other possibility for treatment was ozone application, as well [7]. In our institution [8] an iodinated contrast medium is administered before the medication is instilled at the target site. Experience with non-ionic, water-soluble iodinated contrast media in myelography has shown that it is not uncommon for severe pain to be alleviated by the contrast media alone [Kepplinger, personal observation].

In the present study we evaluated retrospective the output of pain treatment by patients suffering from chronic radicular pain using cervical and thoracic blockages under CT control, during the

period of twelve months.

Patients and Methods

Patients

Cervical blockages were performed by 320 patients with an average age of 56.45 ± 0.74 years, minimum of 29 and maximum of 85 years, respectively. Thoracic blockages were performed by 65 patients with an average age of 55.45 ± 1.69, minimum of 29 and maximum of 81 years, respectively. Diagnosis of pain was based on the clinical pain profiles, physical examination and CT or MRI. The pain degree was collected by using Visual Analogue Scale (VAS) before and after blockage. All blockages were performed under CT control. All patients after blockages were observed at the clinic for 2 h. Thereafter, consultations and recommendations were performed by telephone. After two and four weeks of blockage all patients reported about the effect of treatment and the value of VAS was given by telephone. If the effect of treatment was negative an additional block in following days was recommended.

All the data and patients' privacy are maintained confidentially throughout the whole process. Approval from the Institutional Review Board Commissions of Low Austria was obtained, including a written informed consent. The patients were informed about this procedure and accepted to use the data.

Methods

Criteria for pain relief Visual Analogue Scale (VAS): Pain intensity was measured using Visual Analogue Scale (VAS) for pain from 0 to 10, where 0 is no pain and 10 is the worst pain imaginable. Using VAS patients determine the pain intensity, before and after blockage at 2 and 4 weeks.

Blockages used as routine performance

CT assisted block of cervical nerve roots: The patient is placed supine on the CT table, after a scanogram (scout view) a planning scan is made at the level of the respective neural foramen, from which the most favorable access route to the neural foramen is selected. Note the jugular vein, carotid artery, and vertebral artery.

CT assisted thoracic root blocks: The thoracic root block, like the cervical block, was performed exclusively with CT assistance, with the patient being positioned on the CT table in a prone or lateral position.

All interventions were performed without local anesthetic, for save reason. The duration of the intervention by all blockages was between 15 and 20 min.

Statistical analysis

Results were expressed as means ± Standard Error of the Mean (SEM). For statistical analyses one-way ANOVA and Student's t-test were applied. Asterisks indicate a significant difference: ***p<0.001 *vs.* respective controls.

Results

The distribution of contrast medium by cervical and thoracic root block performance is shown in Figure 1, 2.

Cervical root block

Intervention was performed in the supine position of patient. The measurement results from the planning scan are transferred to the patient, with the optimal puncture site determined, the puncture angle and the distance from the puncture site to the target

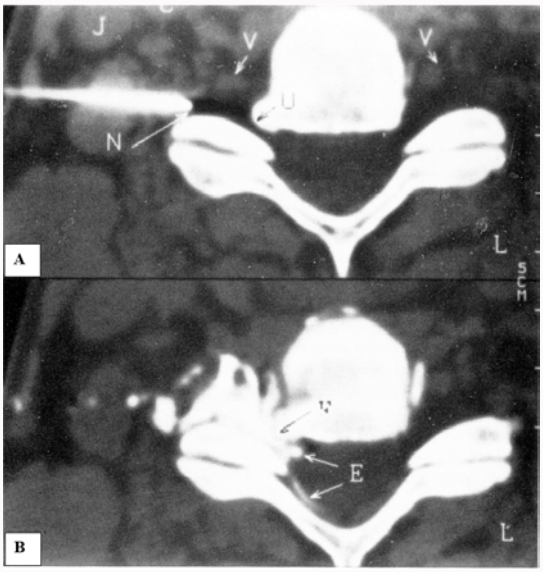

Figure 1: CT-assisted cervical root block (at C5/C6 level). A: Upper image: The picture shows the positional relationship of the cannula to the jugular vein (J), vertebral artery (V), and nerve root (N). B: Lower image: Contrast agent in the epidural space and neural foramen.

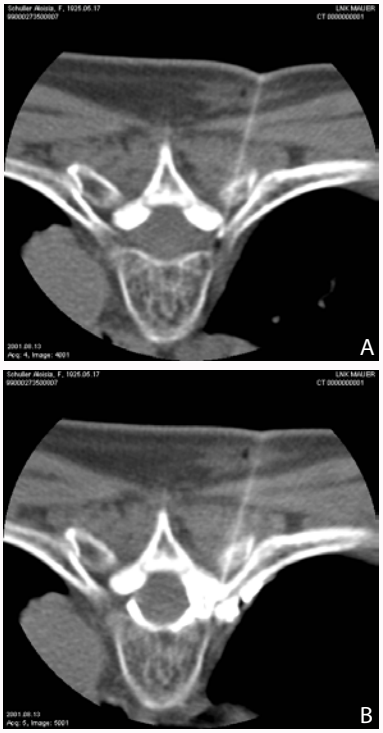

Figure 2: Thoracic CT assisted root block. The tip of the cannula is in the area of the neuroforamen (A). Contrast medium is distributed in the neuroforamen and throughout the epidural space and subpleural (B).

point (neuroforamen) helping to place the cannula correctly. It is particularly important to ensure that the vertebral artery, which is in the immediate vicinity of the neuroforamen, is not punctured. After inserting the cannula, another scan is carried out (Figure 1A) in order to be able to assess the position of the cannula. If the tip of the cannula is in a favorable position, 2 ml of contrast medium is instilled and the distribution of the contrast medium is thus assessed before the instillation of the therapeutic agent (Figure 1B). Care must

Table 1: Evaluation of pain relief by patients after cervical blockages using Visual Analogue Scale (VAS). Number of patients is given in the parenthesis. Student's t-test was used for the significance ***p<0.0001 *vs.* respective control.

Patient	VAS			
	Before block	After 1st block		After 2nd block
	0 week	2 weeks	4 weeks	2 weeks
All patients (320)	6.377 ± 0.059 (320)	3.302 ± 0.066 (320)***		
Patient with positive effect after 1st block (285)	6.504 ± 0.060 (285)	3.051 ± 0.056 (285)***	3.038 ± 0.060 (255)***	
			4.367 ± 0.146 (30)	
Patient with negative effect after 1st block (35)	5.342 ± 0.140 (35)	5.371 ± 0.137 (35)		3.981 ± 0.179 (32)***
		32 patient for 2nd block and 3 patient non 2nd block		3.640 ± 0.156 (25)*** 5.200 ± 0.292 (7)

Table 2: Evaluation of pain relief by patients after thoracic blockage using Visual Analogue Scale (VAS). Number of patients is given in the parenthesis. Student's t-test was used for the significance ***p<0.0001 *vs.* respective control.

Patient	VAS			
	Before block	After 1st block		After 2nd block
	0 week	2 weeks	4 weeks	2 weeks
All patients (65)	6.269 ± 0.127 (65)	3.569 ± 0.168 (65)***		
Patient with positive effect after 1st block (51)	6.461 ± 0.149 (51)	3.029 ± 0.125 (51)***	3.042 ± 0.130 (48)***	
			5.667 ± 0.601 (3)	
Patient with negative effect after 1st block (14)	5.642 ± 0.199 (14)	5.571 ± 0.195 (14)		3.786 ± 0.276*** (14)
		14 patients for 2nd block		3.363 ± 0.152*** (11) 5.333 ± 0.601 (3)

be taken to ensure that blood does not flow out of the cannula either spontaneously or after aspiration. Instillation can only take place when this is also ensured [9]. Patients expressed positive effect after treatment.

Thoracic root blocks

In a manner comparable to cervical CT blockade, a scanogram was performed in the prone or lateral position at the level of the clinically suspected or imaging-determined affection. After the planning values have been transferred, a needle was introduced to the neuroforamen (Figure 2A) in order to avoid iatrogenic damage (e.g., pneumothorax, spinal cord lesion) [10]. Even in the case of thoracic blockages, we usually do not dispense with the application of contrast medium. The administration of contrast medium (Figure 2B) shows us the subsequent distribution of the cortisone and we can better recognize a vascular puncture. The contrast series was only dispensed with if there was a known allergy to the contrast agent and thereafter a periradicular instillation of cortisone was applied. Patients reported significant relive of pain.

Efficacy of treatment - Evaluation of blockages - Retrospective study

Cervical blockages 320 patients were submitted for cervical block, after two weeks patients reported reduction of pain, the effect was significant and VAS was reduced by ca 48% from 6.377 ± 0.059 to 3.302 ± 0.066 (Table 1). One-way ANOVA analysis of VAS of all patients before block and after two weeks of block revealed statistically significant differences F=1198.03384, P=0.0000; Student's t-test was t= -34.61263, p=0.0000. By 285 patients of 320 (89%) the application was successful and the pain was reduced by 53%. While by 35 patients among 320 nonreduction of pain was reported. One-way ANOVA analysis of VAS by 285 patients before and after 1st block revealed strong significant differences F=1744.099472, P=0.000; Student's t-test was significant, too, t= -41.76236, p=0.000, while one-way ANOVA analysis of VAS by 35 patients before and after 1rst block revealed no significant differences, F=0.02132, P=0.88433 and Student's t-test was not significant, too, t=0.14602, p=0.88433. Four weeks after the 1st block, by 255 of 285 patients, no change of the symptoms was reported and by 30 patients an occurrence of moderate pain symptomatic was observed (Table 1). One-way ANOVA analysis of VAS of 255 patients between 2 and 4 weeks, i.e., 3.051 ± 0.056, (N=285) *vs.* 3.038 ± 0.060, (N=255), respectively, showed no significant differences F=0.02711, P=0.86928 and Student's t-test was not significant, too, t=0.16465, p=0.86928. While by 30 patients the VAS value at 4 weeks was increased to 4.367 ± 0.146 and one-way ANOVA analysis between both patient groups (N=255 *vs.* N=30) revealed significant differences, F=53.04017, P=3.2524E-12.

By 255 patients the pain was reduced by average of 53% and by 30 patients of 33%, at 4 weeks after the 1st block.

Unfortunately, 35 of 320 patients reported no pain relief, two weeks after the 1st block, these patients received consultation and 32 of 35 patients have decided to have 2nd block and 3 patients refuged additional treatment (Table 1). Two weeks after the 2nd block, 25 of 32 patients reported positive effect and the VAS was reduced by ca 32.2%, one-way ANOVA analysis of VAS between 1st and 2nd block, revealed significant effect, F=39.01689, P = 3.63356E-8, Student's t-test was significant, too, t= -6.24635, p=3.63356E-8. However, by 7 patients no improvement of pain was seen and VAS was 5.200 ± 0.292 (7). One-way ANOVA analysis of VAS between group with positive (N=25) and negative (N=7) effect, after 2nd block, revealed significant difference, F=21.77004, P=5.97587E-5, Student's t-test was significant, too, t=4.66584, p=5.97587E-5.

Thoracic blockages

As shown in Table 2 thoracic block was performed successfully by 65 patients and the effect was positive and statistically significant.

One-way ANOVA analysis of VAS before and after two weeks of block revealed statistical significant differences F=164.39129, P=0.0000; Student's t-test was t=12.82152, p=1.02254E-24. By 51 of 65 patients the reduction of pain was by 53% (Table 2). One-way ANOVA analysis of VAS before and after two weeks of block revealed statistical significant differences F=310.72443, P=0; Student's t-test was significant, t= -17.62738, p=1.9167E-32. While by 14 of 65 patients no improvement of symptoms was reported, and one way ANOVA analysis of VAS values revealed no statistically significant differences before and after first block, F=0.6566, P=0.79979 and Student's t-test was not significant different, t= -0.25624, p=0.79979 (Table 2). Furthermore, by 48 of 51 patients the positive effect was reported four weeks after of 1st block as well, and ANOVA analysis of VAS value between 2 and 4 weeks was not statistically different i.e., F=0.00464, P=0.94583; Student's t-test was t=0.06812, p=0.94583, while by 3 of 51 patients worsening of symptoms was reported. One way ANOVA analysis of VAS between group with positive (N=48) and negative (N=3) effect after 4 weeks revealed significant differences, F=23.78391, P=1.17852E-5, Student's t-test was t=4.87687, p=1.17852E-5.

By 14 patients with negative effect a second thoracic block was recommended. As can be seen in Table 2 by 11 of 14 patients the effect was successful and ca 32% of pain reduction was observed, one-way ANOVA analysis of VAS revealed significant differences F=27.92096, P=1.59047E-5, while 3 patients reported still pain, VAS was 5.333 ± 0.601 (3). One-way ANOVA analysis between group with positive (3.363 ± 0.152, N=11) and negative (5.333 ± 0.601, N=3) effect revealed significant differences F=23.28893, P=4.14896 and Student's t -test was significant, too, t=4.82586, p=4.1489E-4.

In most cases the performed blockages were successful by 80% and additional block application(s) increased the positive effect mostly to ca 95% of treated patients. No serious complications were registered. In some cases, a cortisone flush was observed after cortisone administration or some allergic reactions probably from the contrast administration or collapse after treatment occurred.

Discussion

The treatment of radicular pain in herniated discs, in foramen stenosis or in inflammatory affections of the nerve root in the context of a herpes-varicella infection by root blockages was hardly carried out in the pre-CT era because of the high risk of iatrogenic complications [11,12]. With the possibility of imaging the anatomical conditions using Computer Tomography (CT), Magnetic Resonance Imaging (MRT) or ultrasound, but above all with the increasing availability of CT devices, the need to optimize the "old blockade techniques" through modern imaging grew in general in order to use them alternatively or adjuvantly, to be able to offer people plagued by pain with greater certainty.

CT-supported blockages were and are often addressed by various colleagues as "unnecessary technical overkill" and began to discredit this meanwhile generally accepted method with arguments such as "no evidence for an improvement of the method". We know from many observations that the result of CT or image assisted interventions is more predictable, especially if the distribution of the contrast medium is checked before the instillation of the analgesic agent (LA, corticoid). In particular, the safe conditions through the use of CT to make a controlled "attack" on sensitive parts of the body gives the staff and the patient a sense of security that is worth seeing.

Evaluation of the pain treatment using blockages in our clinic revealed significant effect in 95% of cases. And, the effect of pain reduction was seen by average of 50%. Our data are in the line with others publication [2,4].

For cervical and thoracic root blockades, we have always considered the CT controlled technique to be a lower-risk method for safety reasons. A root blockade, in which the therapeutic result is used to make a diagnostic statement about the pain etiology i.e., diagnostic blockade, should, in our experience, be performed in a controlled manner using CT or at least an image converter and the distribution of the contrast medium must always be assessed include. With more than 400 cervical infiltrations per year, not a single case occurred with a serious complication. This is not least due to the fact that we refrained from administering the local anesthetic and only applied cortisone or occasionally tramadol 50 mg in cases of cortisone intolerance [5,13].

Thoracic root blocks were mainly performed in the case of acute herpes zoster infestation or persistent zoster neuralgia. This intervention is only rarely indicated for thoracic intervertebral disc lesions, as these cause purely radicular pain symptoms much less frequently [14].

Since 1989 with an average of 1,500 patients per year all nerve root blocks and periradicular corticosteroid instillations have been performing exclusively under CT control [6,8,15]. We have not register serious complications, but in some cases, we observed a cortisone flush after cortisone administration or some allergic reactions likely due to the contrast administration or transient paraparesis due to accidental administration of local anesthetic (intrathecal) or just collapse after treatment probably due to fear.

We believe that the high efficiency of treatment was due to very good management of pain treatment for years. Furthermore, apart from the good equipment available including CT and only for use in pain management, most importantly, the same team of medical assistants and doctors who performed the blocks for years guaranteed a very satisfactory result for all.

Summary

In recent years, the treatment of pain by using blockages has gained immense, positive therapeutic effect, thanks to technical development and the possibility of using CT in controlled procedures. In addition, it should be noted that the positive result of the therapy is primarily influenced by the work of the entire team and well-organized equipment in rooms intended only for blockages. The output of treatment of chronic radicular pain using cervical and thoracic blockages was high and significant but it is in some cases transient, too. In the future it would be valuable to verify the reason of the reduction of positive effect of the pain treatment in order to prolong the satisfaction by patient and to avoid an awareness of pain again.

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Authors Contribution

The blockages were applied by P. Kalina and B. Kepplinger

and collection of data was made by B. Kepplinger. Calculation and evaluation of results was made by H. Baran, B. Kepplinger and P. Kalina. The first draft of manuscript was written by B. Kepplinger and H. Baran. The manuscript was corrected and accepted by all authors.

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