Nerve Blocking Techniques for Pain Clinic

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Pain Clinic에서의 神經遮斷法

日本 東京 關東 遞信病院 Pain Clinic

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The Department of pain clinic, the Kanto Teishin Hospital began practice 28 years ago. Since then, we have performed more than 500,000 nerve blocks, and nerve block has been considered to be the most important therapeutic measure of our department.

Among various nerve blocks, sympathetic nerve block has the widest range of application. This block is used not only for pain relief, but also for the treatment of diseases mainly involving sympathetic hyperreactive symptoms. We have devoted every efforts to contrive a blocking technique that is easy to perform without causing complications.

During this process, we reconsidered the conventional technique of nerve block. And introduced the concept of compartment block.

I would like to describe nerve blocks actually performed at our hospital.

The Nerve Blocks and the Diseases encountered in our Pain Clinic

From 1964 to 1990, we performed 578, 886 nerve blocks on patients suffering a variety of diseases.

Stellate ganglion blocks were the most frequently performed at 377,302 times (65%), becaues of their wide range of indications. The next largest number of applications was for single epidural blocks at 52,158 times (9.0%), followed by facial nerve blocks at 16,929 times. Trigeminal nerve blocks with alcohol were performed 14,498 times, and Gasserian ganglion blocks with alcohol were performed 917 times.

Gasserian ganglion blocks, thoracic sympathetic ganglion blocks, lumbar sympathetic ganglion blocks, and celiac plexus blocks were all performed with the aid of fluoroscopy at the Department of Radiology. These blocks were all permanent blocks performed using pure alcohol. To date we performed 1,210 thoracic sympathetic ganglion blocks, 1,719 lumbar sympathetic ganglion blocks, and 479 celiac plexus blocks (Table 1).

A total of 40,980 patients underwent nerve blocks mainly because of facial spasm, facial palsy, headache, facial pain, trigeminal neuralgia, herpes zoster, and low back pain. Nine hundred fifty-five patients were treated with nerve block because of cancer pain(Table 2).

The largest number of inpatients that received nerve block were herpes zoster, and then application frequencies in decreasing order

Table 1. Classification of the Nerve Blocks

NERVE BLOCK	No. of Nerve b.	%
Stellate gang. b.	377,302	65.2
Facial nerve b.	16,929	2.9
Trigeminal nerve b.(alcohol)	14,498	2.5
Trigeminal gang. b.(alcohol)	917	0.2
Glossopharyngeal nerve b.	659	0.1
Single epidural b.	52,158	9.0
Continuous epidural b.	4,887	0.8
Thoracic sympathetic gang. b.(with alcohol)	1,210	0.2
Celiac plexus b.(with alcohol)	479	0.1
Lumbar sympathetic gang. b.(with alcohol)	1,719	0.3
Intrathecal phenolglycerol b.	1,372	0.2
Total spinal b.	1,313	0.2
Suprascapular nerve b.	2,154	0.4
Occipital nerve b.	432	0.1
Spinal root b.	1,789	0.3
Facet b.	1,601	0.3
Thermocoagulation	572	0.1
Other peripheral nerve b.	73,330	12.7
Intraarthral injection	1,727	0.2
Intradiscal injection	945	0.2
Peridurography	1,283	0.2
Percutaneous nucleotomy	20	0.0
Others	22,055	3.8
Total	578,886	

The Kanto Teishin Hospital, Dept. of Pain Clinic. Dec. 1990. gang: Ganglion, b: block

were low back pain, trigeminal neuralgia, cancer pain, and peripheral vascular disease. Recently, nerve blocks used for the treament of hyperhydrosis have rapidly increasd in number with the improvement of a technique for thoracic sympathetic ganglion block. A total of 182 blocks were performed because of hyperhydrosis, and 50 of them were undertaken in the last year.

Between 1978 and 1990, nerve blocks performed under fluoroscopic monitoring totaled 12,966, including 1,338 maxillary nerve blocks, 1,320 mandibular nerve blocks, and 675 Gasserian ganglion blocks. Other than these, 1,600 facet blocks, 1,602 spinal root blocks, and 878 intradiscal injections were performed. Spinal root thermocoagulations, facet rhizotomies with thermocoagulation, and thermocoagulatios on miscellaneous nerve were respectively performed 191, 219, and 140 times(Table 3).

It seems appropriate that nerve block techniques should be classified into two groups. First is the nerve block in a narrow sense. The second is compartment block method.

The nerve block in a narrow sense was performed with needle insertion to the nerve trunk or ganglion and injection of the agent.

Compartment block was performed with

Table 2. Classification of Disease

Disease	No. of patients	%
Facial spasm	6,515	15.9
Facial palsy	5,485	13.4
Headache and facial pain	3,893	9.5
Trigeminal neuralgia	3,365	8.2
Allergic rhinitis	4,377	10.7
Low back pain	4,416	10.8
Herpes zoster	3,113	7.6
Neck, shoulder pain	2,570	6.3
Cancer pain	955	2.3
Blepharospasm	437	1.1
Chest and back pain	465	1.1
Cervico-omo-brachial syndrome	554	1.4
Disease of ENT	389	0.9
Peripheral vascular disease	447	1.1
Post traumatic syndrome	388	0.9
Sinusitis	231	0.6
Reflex sympathetic dystrophy	342	0.8
Visceral pain	147	0.4
Disease of eye	92	0.2
Glossopharyngeal neuralgia	73	0.2
Others	2,725	6.6
Total	40,980	100.0

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Table 3. The Nerve Block under the Fluoroscopic Control

Nerve block	
Maxillary nerve block	1,338
Mandibular nerve block	1,320
Gasserian gang.block	670
Thoracic symp. gang. block	1,115
Lumbar symp. gang. block	1,230
Coeliac plexus block	419
Facet block	1,600
Spinal root block	1,602
Spinal root thermocoagulation	191
Facet thermocoagulation	219
Thermocoagulation of lumbar symp. gang.	16
Thermocoagulation of other nerves	140
Percutaneous nucleotomy	20

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agent injection into the compartment that includes the nerve or the ganglion.

Distinctive points of the nerve block in a narrow sense were paresthesia occurring when the needle reached the target point, and positive views of the nerve or the ganglion were seen when contrast medium was injected. Maximum effects were achieved with minimum dose of agent.

On the contrary, no paresthesia occurred in compartment block, because the needle tip did not hit the nerve or ganglion, rather the needle tip was in the compartment that included the nerve or ganglion.

The effect were depended on the dose of agent injected(Table 4).

Another nerve block classification was according to the target nerves. Sensory nerve block was the most common nerve block. Motor nerve block was useful for facial spasm or other spastic disease. Facial nerve block and spinal nerve block with phenol were applied to those diseases.

Sympathetic ganglion block has a wide range of indications. Facial pslsy, peripheral vascular disease, and hyperhydrosis were treated with sympathetic ganglion block.

A nerve block can be performed with local anesthetics, neurolytics, high temperature, and low temperature. Pure alcohol, phenol in glycerin and phenol in water were used for neurolysis.

Radiofrequency thermocoagulation was applied to Gasserian ganglion block, percutaneous cordotomy, DREZ-tomy, facet rhizotomy, spinal root block, and sympathetic ganglion block. Cryoanalgesia was performed using Spembly's apparatus. This apparatus generated down to −80 centigrade on the tip of the probe. This

block is applied to intercostal nerve blocks or trigeminal branch block.

Nerve blocks with local anesthetic were performed with no roentgenographical control. But a majority of nerve blocks with neurolytics were performed under fluoroscopy with contrast medium(Table 5).

Technique of Sympathetic Ganglion Block

A sympathetic ganglion block is done with a neurolytic agent under fluoroscopic monitoring using an overtube table or C-arm image. Since roentgenography should be performed in two directions to determination the needle tip location, a second X-ray tube is necessary for a fixed-type table. The stellate ganglion, thoracic sympathetic ganglion, lumbar sympathetic ganglion, and celiac plexus are all in contact with a vertebral body or rib; therefore, a needle tip is moved forward into a compartment based on the locational relationship between vertebral body and the needle determined under fluoroscopic monitoring and by the feel of the needle touching the bone, and then a water-soluble contrast medium is poured into the compartment. After frontal and lateral radiographs indicating adequate location of the needle are obtained, a neurolytic is injected into the compartment[1,2].

1) Stellate ganglion block

Although this blocking technique is not new to us, there have been many theories on needle tip location. The reason for this is that a surgeon makes an attempt to insert a needle directly into the stellate ganglion because of a lack of the concept of compartment block. With this in mind, we reconsidered our technique of stellate ganglion block based on contrast-enhanced radiographic features as well as CT images.

The stellate ganglion is located on the ventral side of the base of the transverse process of the 7th cervical vertebra. The longus colli muscle runs on the ventral side of this transverse process and is covered with the prevertebral fascia. The carotid artery runs anteromedially to the fascia, the jugular vein runs laterally, and the vagus nerve runs dorsally between these blood vessels. They are bound together by the carotid sheath. The stellate ganglion is located between the carotid sheath and the prevertebral fascia (Fig. 1).

When contrast medium is injected through the needle tip touching the base of the transverse process of the 7th cervical vertebra, the medium spreads to encircle the longus colli muscle, and then it further extends into the stellate ganglion and sympathetic nerve fiber surrounding the vertebral artery, indicating that the ganglion and nerve fiber can be blocked. The carotid sheath prevents the medium from spreading into the vagus nerve(Fig. 2).

If a needle tip is pulled 5 mm from the site where the tip touches the transverse process, as stated in conventional textbooks, the needle tip enters the carotid sheath, resulting in a risk of vagus nerve block. The carotid artery is completely compressed laterally with the index and middle fingers of the surgeon's hand, and all of the organs between the skin and the longus colli muscle are kept out of the way of the needle by additional compression. Under this condition, the tip of a 25 mm 25 G needle can be safely introduced into the proper site if the needle follows the direction of the base of the transverse process. Because the distance between the skin and the transverse process is only 5~10 mm. There is no need for the use of a long needle. Although it has been required by the conventional technique. It is unnecessary to pulling

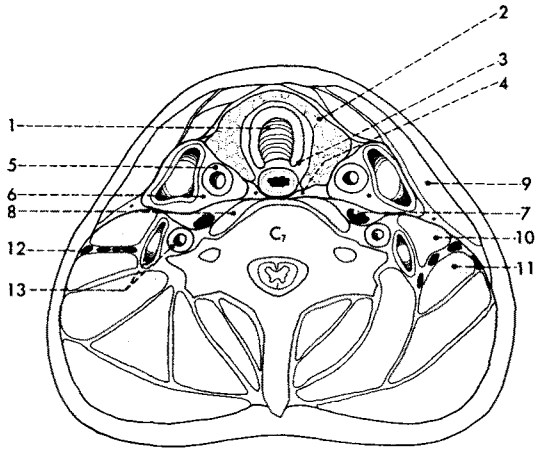

Fig. 1. Schema of stellate ganglion.
(cross section of the body at the level of C7)

1. Trachea
2. Thyroid gland
3. Esophagus
4. Recurrent laryngeal nerve
5. Carotd arery and vein
6. Vagus nerve
7. Stellate ganglion
8. Longus colli muscle
9. Sternocleidomastoid muscle
10. Scalenus anterior muscle
11. Scalenus medius and posterior muscle
12. Brachial plexus
13. Vertebral artery and vein

back the needle, after making contact with the transverse process, because it creates an unstable setting for agent injection.

2) Thoracic sympathetic ganglion block

The location of the sympathetic ganglions change from the dorsal to the ventral side of the vertebral body, descending from the neck to the buttocks. They are located at the base of the transverse process of the vertebra in the neck and at the insertion of the radiate ligament, that is the junction between the transverse process and the rib. Ganglions are located at the middle portion of the vertebral body in the lower thoracic region and on the ventral side of the vertebral body in the lumbar region.

Fig. 2. Spread of contrast medium with stellate ganglion block.

If the approach to upper sympathetic ganglion block is considered with these anatomical features in mind, it would seem to be almost impossible to perform a block through a direct puncture of the sympathetic ganglion(Fig. 3).

However, we proposed pouring an agent into a compartment containing a sympathetic ganglion through a needle, which was placed in a site where the needle tip could be securely fixed. Thus, we made an attempt to fix the needle tip on the radiate ligament. Since the anterior surface of this ligament is enclosed by the parietal pleura, an agent injected through a needle fixed on the vertebral insertion of the radiate ligament can reach a thoracic ganglion through spaces between the ligament and the parietal pleura(Fig. 4).

Blocking was performed under anteroposterior fluoroscopic monitoring. The transverse process and rib were visualized, therefore preventing the occurrence of pneumothorax. Furthermore, pneumothorax was also prevented by maintaining contact between the needle tip and the vertebral body.

The needle tip was fixed so that a part of the needle tip was stuck to the radiate ligament; therefore, the injected contrast medium spread posterolaterally along with the ligament and

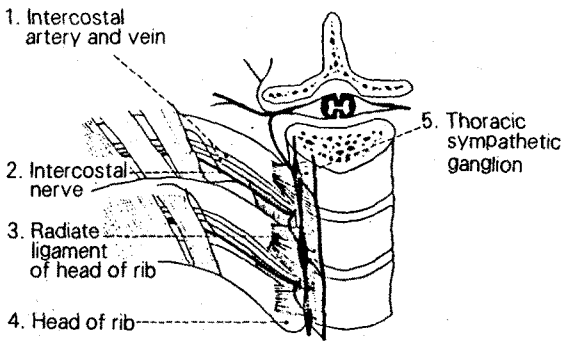

Fig. 3. Right thoracic sympathetic ganglion.

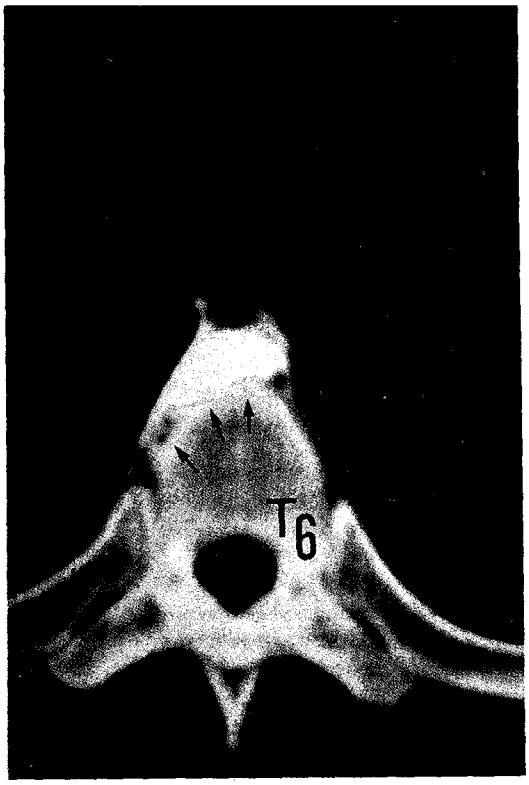

Fig. 4. Spread of contrast medium with thoracic sympathetic ganglion block.

then reached the sympathetic ganglion.

Thus we took special care to place the needle tip not in the sympathetic nerve, but in the site where the needle tip was securely fixed and allowed an agent to run through the space between the ligament and the parietal pleura into the layer(compartment), in which the sympathetic nerve was present.

3) Lumbar sympathetic ganglion block

This block is the most frequently used among sympathetic ganglion blocks with alcohol.

The nerve blocking effect of lumbar sympathetic ganglion block is not obtained through the introduction of a regional anesthetic or neurolytic into the lumbar sympathetic ganglion by means of puncture of the ganglion. Because the locations of ganglia in this region very greatly, it is impossible to block them in such a way.

The needle tip is inserted into a compartment containing the sympathetic ganglion, sympathetic trunk, communicating rami, lumbar vein, and lumbar artery, and then a regional anesthetic or neurolytic is injected into this compartment to attain a blocking effect(Fig. 5).

A part of the left sympathetic trunk is covered with the aorta, and the right trunk is covered with the inferior vena cava. The lumbar artery and vein cross the sympathetic trunk between the sympathetic trunk and the vertebral body and run transversely at almost the middle of the vertebral body. There are four lumbar arteries and four veins on the right and left sides.

The lumbar veins communicate with the ascending lumbar vein, which runs longitudinally on the ventral side of the transverse process. Because these lumbar veins and the ascending lumbar vein are in contact with the vertebral body, these veins are sometimes punctured by a blocking needle at the time of a lumbar sympathetic ganglion block(Fig. 6).

The blocking of a sympathetic nerve, which regulates the lower extremity, can be attained by blocking the sympathetic ganglion, sym-

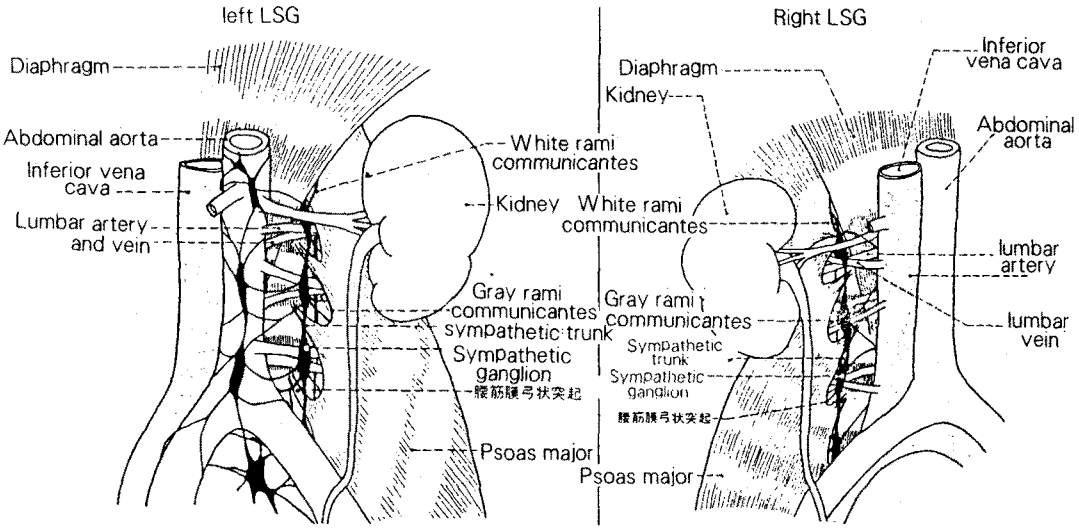

Fig. 5. Lumbar sympathetic ganglion. (LSG)

Fig. 6. Accidental Intra lumbar vein injection.

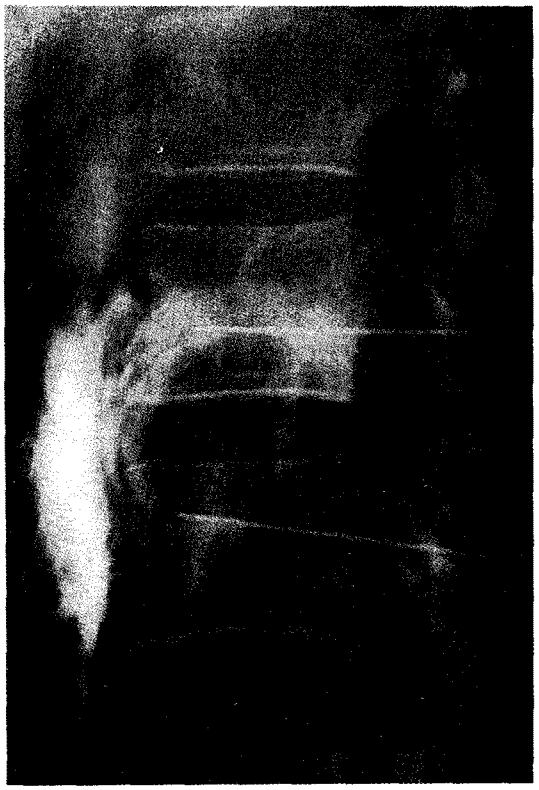

Fig. 7. Spread of contrast medium with lumbar sympathetic ganglion block.

pathic trunk, white rami communicantes, and gray rami communicantes. These elements can be blocked at the same time because they exist within the same compartment. If the blocking needle is present within this compartment, the injected contrast medium spreads along the lumbar vein, which directly touches the vertebral body, resulting in the visua-lization of the relief of the lumbar vein on a X-ray film(Fig. 7).

A key to successful blocking is to place the needle tip in the site which provides a complete relief of the lumbar vein.

SUMMARY

A total of 578,886 nerve blocks were performed during a period of 28 years. Based on our experience, we introduced the concept of compartment block, and then improved our technique of nerve blocking. If the location of a compartment was defined by injecting a contrast medium under fluoroscopic monitoring, the effect of nerve block could be estimated. As a result, we can safely perform nerve blocks with alcohol within a short period of time.

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