# Regional Anesthesia and Pain

# Total spinal anesthesia provides transient relief of intractable pain

## *[La rachianesthésie totale permet un soulagement passager de la douleur rebelle]*

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**Purpose:** Intentional total spinal anesthesia (TSA) has been used for intractable pain treatment. However, the long-term effect of pain-relief is controversial. We investigate the short- and long-term effects of pain-relief by TSA.

**Methods:** Twelve patients with intractable pain participated in a crossover study. All participants received two different treatments in random order at a 30-day interval: *iv* infusion with 300 mg of lidocaine (*iv*-Lido), and TSA with 20 mL of 1.5% lidocaine (TSA-Lido). Pain level at rest was scored with the visual analogue scale (VAS: 0–100), and blood pressure and heart rate were measured before and at two hours, 24 hr, seven days, and 30 days after treatment. Plasma lidocaine concentrations were measured at 0.5, one, and two hours.

**Results:** Heart rate and mean arterial pressure during or after TSA-Lido were similar to those before TSA-Lido. Plasma lidocaine concentrations were similar between the two treatments. No significant difference in any value occurred in the *iv*-Lido treatment. VAS were similar before both treatments (87 ± 6 for TSA-Lido; 86 ± 7 for *iv*-Lido). After TSA-Lido, VAS decreased significantly until day seven (two hours, 17 ± 22, $P < 0.01$; 24 hr, 43 ± 20, $P < 0.01$; seven days, 66 ± 16, $P < 0.01$). However, VAS returned to the pre-block values 30 days after TSA-Lido.

**Conclusion:** Intractable pain was decreased significantly for several days after TSA, but pain-relief was not sustained.

***Objectif :*** *La rachianesthésie totale (RAT) intentionnelle est utilisée comme traitement de la douleur irréductible même si son effet analgésique à long terme est controversé. Nous avons exploré les effets analgésiques de courte et de longue durée produits par la RAT.*

***Méthode :*** *Douze patients souffrant de douleurs rebelles ont participé à un essai croisé. Tous les participants ont reçu deux traitements différents, selon un ordre aléatoire, à 30 jours d'intervalle : une perfusion iv avec 300 mg de lidocaïne (Lido-iv) et une RAT avec 20 mL de lidocaïne à 1,5 % (Lido-RAT). Le niveau de douleur au repos a été coté selon l'échelle visuelle analogique (EVA : 0–100), et la tension artérielle (TA) et la fréquence cardiaque (FC) ont été mesurées avant, puis deux heures, 24 h, sept jours et 30 jours après le traitement. Les concentrations plasmatiques de lidocaïne ont été mesurées à 0,5, une et deux heures.*

***Résultats :*** *La FC et la TAM, pendant et après la Lido-RAT, ont été similaires à celles d'avant la Lido-RAT. Les concentrations plasmatiques de lidocaïne ont été similaires pour les deux traitements. Aucune valeur n'a affiché de différence significative avec le traitement à la Lido-iv. Les cotes de l'EVA étaient comparables pour les deux thérapies (87 ± 6 avec la Lido-RAT et 86 ± 7 avec la Lido-iv). Après l'administration de Lido-RAT, les résultats de l'EVA ont baissé significativement jusqu'au septième jour (deux heures, 17 ± 22, $P < 0,01$; 24 h, 43 ± 20, $P < 0,01$; sept jours, 66 ± 16, $P < 0,01$). Toutefois, 30 jours après la Lido-RAT, les valeurs de l'EVA sont revenues à celles du pré-traitement.*

***Conclusion :*** *La RAT a permis de réduire significativement la douleur rebelle pendant quelques jours, mais cet effet analgésique n'a été que passager.*

GENERALLY, total spinal anesthesia (TSA) is known as a complication of epidural block. Intentional TSA, however, has been used for the treatment of

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Support was provided solely from departmental sources.

*Accepted for publication May 27, 2002.*

*Revision accepted July 11, 2002.*

intractable pain.[1–4] Especially in Japan, this technique is a pain-relief therapy approved by the Ministry of Health and Welfare.[2] However, the mechanism by which TSA reduces intractable pain is not clear, and the long-term effect of pain relief after TSA is controversial. The purpose of this study is to investigate the short- and long-term effects of pain-relief by TSA.

## Materials and methods

Institutional and Ethics Committee approval was obtained and all participants gave informed consent. A crossover study was conducted in 12 patients with intractable pain for more than one year at an intensity greater than 70 on a visual analogue scale (VAS: 0–100, where 0 is no pain and 100 is the most extreme pain) at rest. Patients had already received analgesics, nerve blocks, and physiotherapy, but their suffering had not diminished. The patient's data are summarized in Table I.

All participants received two different treatments in random order at 30-day intervals: *iv* injection of lidocaine (*iv*-Lido), and TSA with lidocaine (TSA-Lido). Atropine, 0.5 mg *im*, was given for premedication, and acetate Ringer's solution was infused in the operating room. A monitor for automated measurements of blood pressure was used and electrocardiogram, pulse-oxymetry ($SpO_2$), expiratory $CO_2$ (via face mask or laryngeal mask) were monitored and recorded continuously during treatment. VAS was obtained immediately before the treatment (zero hour).

For TSA-Lido, participants were placed in the lateral position. A 25-gauge spinal needle was inserted into the $L_3$–$L_4$ subarachnoid space, and 1.5% lidocaine, 20 mL, was injected in 30 sec. Participants were placed in the supine position and the operating table was tilted into the head-down position immediately after the intrathecal injection to allow the injected lidocaine to spread cephalad. Thiopental, 100 mg *iv*, was given to avoid any uncomfortable sensation at the beginning of TSA and 40% oxygen in air was given via face mask. After the patient became unconscious and paralyzed, and dilation of pupils and loss of light reflex was observed, a laryngeal mask was inserted without muscle relaxants. Then, the lungs were ventilated mechanically with 40% oxygen in air to maintain the end-tidal carbon dioxide tension between 35 and 40 mmHg. After spontaneous breathing recovered, the laryngeal mask was removed, and 40% oxygen in air was administered via face mask.

For *iv*-Lido, participants received an *iv* injection of 60 mg of lidocaine followed by 100 mg of thiopental; then a continuous infusion of lidocaine at a rate of 160 $mg \cdot hr^{-1}$ was administered for 1.5 hr as *iv*-Lido (total dose of lidocaine: 300 mg). During *iv*-Lido, 40% oxygen in air was given via face mask.

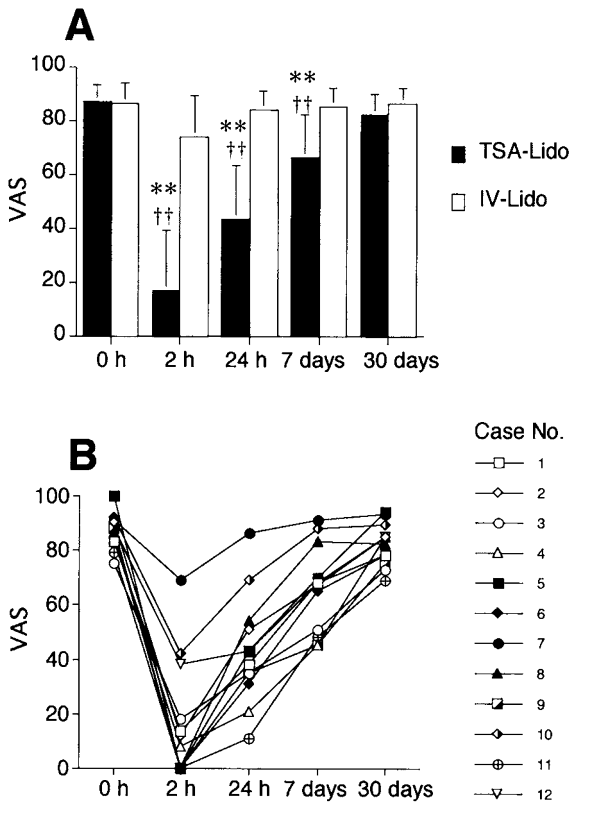


FIGURE A, Changes in mean visual analogue scale (VAS) during both treatments. VAS were similar before both treatments. There were no significant changes after *iv*-Lido. After TSA-Lido, VAS decreased significantly. These values were also significantly lower than those of *iv*-Lido ($P < 0.01$). Mean values ± SD are shown. $**P < 0.01$ *vs* zero hour, $††P < 0.01$ *vs iv*-Lido. TSA-Lido = total spinal anesthesia with lidocaine; *iv*-Lido = *iv* injection with lidocaine. B, Changes in individual VAS during TSA treatment.

During treatment, ephedrine was given if systolic blood pressure decreased to < 80 mmHg, and atropine if heart rate decreased to < 50 $beats \cdot min^{-1}$. At 0.5, one, and two hours after the start of treatment, blood samples were collected to measure plasma lidocaine concentration, and VAS at rest was checked at two hours, 24 hr, seven days and 30 days after both treatments.

Pain assessment was performed by VAS at rest and the percentage of pain-relief. The percentage of pain-relief was calculated using the following formula: % pain-relief = (1 - VAS after treatment/VAS before treatment) × 100%.

TABLE I Patient data

| *Patient No.* | *Sex* | *Age (yr)* | *Weight (kg)* | *Height (cm)* | *Diagnosis* | *Region* | *Duration of pain (yr)* |
|---|---|---|---|---|---|---|---|
| 1 | F | 56 | 52 | 159 | PHN | Abdomen | 1.2 |
| 2 | M | 62 | 60 | 167 | Whiplash syndrome | Head, upper extremity | 2.1 |
| 3 | F | 45 | 52 | 159 | CRPS (postoperation) | Upper extremity | 1.2 |
| 4 | M | 55 | 60 | 162 | Multiple operative back | Low back, lower extremity | 1.8 |
| 5 | M | 67 | 62 | 161 | Whiplash syndrome | Entire body | 2.8 |
| 6 | M | 32 | 59 | 174 | CRPS (injury) | Upper extremity | 2.3 |
| 7 | F | 69 | 48 | 152 | PHN | Lower extremity | 1.9 |
| 8 | M | 46 | 65 | 170 | Whiplash syndrome | Neck, upper extremity | 1.3 |
| 9 | M | 42 | 61 | 172 | CRPS (postoperation) | Upper extremity | 1.4 |
| 10 | F | 65 | 59 | 160 | PHN | Lower extremity | 2.0 |
| 11 | F | 28 | 46 | 159 | CRPS (injury) | Lower extremity | 1.1 |
| 12 | F | 42 | 49 | 155 | Multiple operative back | Low back, lower extremity | 1.7 |

CRPS = complex regional pain syndrome; PHN = postherpetic neuralgia.

TABLE II Changes in heart rate, mean arterial pressure, and plasma lidocaine concentration

| | *Treatment* | *0 hr* | *0.5 hr* | *1 hr* | *2 hr* | *24 hr* | *7 days* |
|---|---|---|---|---|---|---|---|
| Heart rate | TSA-Lido | 76 ± 11 | 74 ± 11 | 72 ± 11 | 74 ± 9 | 74 ± 8 | 73 ± 9 |
| (beats·min$^{-1}$) | *iv*-Lido | 76 ± 10 | 74 ± 9 | 74 ± 9 | 74 ± 9 | 75 ± 9 | 77 ± 10 |
| Mean arterial pressure | TSA-Lido | 93 ± 10 | 83 ± 13 | 86 ± 11 | 88 ± 7 | 91 ± 8 | 91 ± 9 |
| (mmHg) | *iv*-Lido | 93 ± 11 | 89 ± 10 | 90 ± 10 | 89 ± 9 | 91 ± 9 | 92 ± 9 |
| Lidocaine concentration | TSA-Lido | - | 3.0 ± 0.5 | 2.3 ± 0.3 | 1.6 ± 0.3 | - | - |
| (μg·mL$^{-1}$) | *iv*-Lido | - | 2.7 ± 0.5 | 2.1 ± 0.3 | 1.8 ± 0.3 | - | - |

Values are mean ± SD; $n$ = 12; VAS = visual analogue scale; TSA-Lido = total spinal anesthesia with lidocaine; *iv*-Lido = *iv* injection with lidocaine.

Plasma lidocaine concentrations were measured with an enzyme immunoassay method (EMIT; Syva, a Syntex Company, Palo Alto, CA, USA) by an automatic analyses system (Aca Star; Dade International Inc., Wilmington, DE, USA).

*Statistical analysis*

Data are expressed as mean ± SD. The Kruskal-Wallis test followed by Dunn's procedure was used to compare variables. Values were considered statistically significant at $P < 0.05$.

## Results

For each variable examined, the value before TSA-Lido treatment was similar to that before *iv*-Lido treatment. In the *iv*-Lido treatment, no significant changes were found in any values. Plasma lidocaine concentrations were similar between the two groups (Table II). During TSA-Lido, loss of consciousness and cessation of spontaneous breathing were observed within three minutes, and dilation of pupils and loss of light reflex were observed within eight minutes in all participants. The duration of mechanical ventilation was 58 ± 10 min. All patients were awake by 90 min after the start of TSA-Lido. At two hours, sensory and motor disturbances were not observed, and no patient remembered insertion of the laryngeal mask. Heart rate and mean arterial pressure during or after TSA-Lido were similar to those before TSA-Lido (Table II). However, ephedrine (4–8 mg) was required in four of 12 patients, and atropine (0.25 mg) was used in two patients during TSA-Lido. At two hour after the start of TSA-Lido, VAS had decreased in all patients (Figure A, B). Five of 12 patients reported no pain and VAS was still decreased significantly at 24 hr. At seven days, VAS was decreased significantly, but nine patients reported more than 50 of VAS and three patients reported more than 80. At 30 days, VAS returned to the pre-block values. Diagnosis, region, or duration of pain did not affect the changes of VAS (Figure B). The percentages of pain-relief after TSA were 81 ± 24% at two hours, 51 ± 22% at 24 hr, 25 ± 16% at seven days, and 5 ± 5% at 30 days, respectively.

## Discussion

Our results show that *iv* lidocaine was not effective while TSA was associated with intractable pain-relief for a week. However, pain relief was not sustained at 30 days.

Tsumura *et al.*[1] reported that TSA is effective for whiplash syndrome and symptoms, including pain, disappeared in nearly 100% of patients without organic changes within one week and the effect continued for one month in nearly 50%. These authors administered steroids with local anesthetics for TSA. Yamashiro *et al.*[3] reported a case of severe herpetic neuralgia treated with TSA and, also, administered steroids with local anesthetics. Recently, Kotani *et al.*[5] reported that intractable postherpetic neuralgia was reduced for a prolonged period with the intrathecal injection of steroids. Although previous reports did not mention the importance of steroids during TSA, steroids may play an important role on long-term pain-relief after TSA. However, the mechanism by which TSA (without steroids) induces short-term pain-relief, as observed in our study, remains unclear.

TSA blocks the vagus and the sympathetic nervous system.[6] Consequently, the balance between sympathetic and parasympathetic nervous activity may be preserved. Hence, heart rate, which reflects the net effect between sympathetic and parasympathetic nervous activities[3] was not altered (only two patients required atropine).

A prior report noted that repetition of TSA is more effective for pain-relief in some patients.[5] Further studies are required to elucidate the mechanisms by which TSA reduces intractable pain, to determine the kind(s) of pain that can be appropriately treated by TSA and the optimal treatement modalities.

## References

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