Risks and Causes of Cervical Cord and Medulla Oblongata Injuries due to Acupuncture

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Key words
- Acupuncture
- Injury
- Medulla oblongata

Abbreviations and Acronyms
- CAT: Computed axial tomography
- 3D-CTA: Three-dimensional computed tomographic angiography
- MRI: Magnetic resonance imaging

INTRODUCTION
Acupuncture is a traditional East Asian medical technique in which needles are inserted at particular points on the body to treat a wide range of diseases. At present, acupuncture has become one of the most popular alternative medicines worldwide (12). To our knowledge, 25 cervical cord or medulla oblongata injuries due to acupuncture needles have been reported. We report such a case and discuss the risks and causes of cervical cord or medulla oblongata injuries due to acupuncture.

CASE PRESENTATION

History of Present Illness and Physical Examination
A 47-year-old, Japanese man subjected himself to self-acupuncture for more than 10 years due to his persistent headaches and neck stiffness. The patient repeatedly used a disposable, fine acupuncture needle made of stainless steel and would regularly place the needle into his neck after taking a bath. However, during one occasion, the acupuncture needle accidentally broke and remained in the patient's neck. The patient discovered the broken needle, but he was unable to remove it. Out of fear that the needle might travel too far into his head, he presented to our emergency room for its removal. The patient's past medical and family history were unremarkable. On physical examination, the patient had normal vital signs and showed no neurological deficits. Ecchymosis, erythema, and abnormal skin findings were not present. The patient only complained of a constant, dull discomfort around the area where he stuck the needle.

Hospital Course
Immediate skull roentgenograms (Figure 1A) and computed axial tomography (CAT) scans (Figure 1B) demonstrated that the needle passed between the skull base and the atlas, and then, penetrated into the medulla oblongata through the foramen magnum. Three-dimensional computed tomographic angiography (3D-CTA) revealed that the needle passed just beside the left vertebral artery as shown in Figure 1C. Although preoperative ultrasound and fluoroscopy were also performed, the needle was too fine to be visualized on the display. Follow-up skull roentgenograms on the fifth hospitalization day revealed deeper penetration and location of the needle. An emergency operation was subsequently performed, because the patient strongly wished to remove the needle out of fear of its further migration.

RESULTS: Previously reported cases of 25 patients, in addition to our patient, who suffered from cervical or brain injuries due to acupuncture needles, were retrospectively studied. Embedded needles were the most frequent cause of the injuries and comprised 15 patients (57.7%). Accidentally broken needles came in second, comprising 11 patients (42.3%). Five cases (19.2%) were attributed to self-acupuncture. Sixteen (61.5%) patients developed symptoms more than 30 days after the accident. Twenty-three (88.5%) patients complained of sensory deficits, whereas 11 (42.3%) presented with motor weakness. Surgical removals were performed in 21 patients (80.8%), and 10 patients showed signs of recovery. On the other hand, no patients showed improvements in conservatively treated cases.

CONCLUSIONS: Embedded needles in the brain should be urgently removed if possible. Both embedded needle acupuncture and self-acupuncture are extremely dangerous and hazardous to health.
We took a left lateral suboccipital approach to expose the space between C1 and the foramen magnum. Repeated intraoperative skull roentgenograms were taken to narrow the location of the needle. The needle was not detected in the epidural or subdural spaces. A small subpial hemorrhage was finally found on the surface of the left cerebellar tonsil. The posterior end of the needle happened to be revealed when retracting the cerebellar tonsil. The needle was completely embedded and appeared only when retracting the tonsil (Figure 2A).

The needle was extracted with great care as not to cause any further damage to the cerebellum or brainstem. No apparent secondary gliosis, arachnoiditis, cavities, or other abnormal findings were observed. The retrieved needle was bent, but not rusted, and measured about 4.5 cm in length (Figure 2B). The operation was completed without any complications.

The patient’s postoperative course was uneventful and unremarkable. Postoperative magnetic resonance imaging (MRI) showed no apparent brainstem damages. The patient was discharged without any signs of neurological deficits.

DISCUSSION

Complications

Complications with acupuncture needles are not rare. Pneumothorax (6), cardiac tamponade (8), and transverse myelopathy (25) due to acupuncture needles have been reported. Reviewing cases of the previous cervical or brainstem injuries in addition to our report, as shown in Table 1 (1, 5, 7, 9-11, 13-18, 21-24, 26, 27, 29), the age of patients ranged from 18 to 73 years, and the mean and standard deviation were 50.3 years and 14.1 years, respectively. Eighteen (69.2%) of the patients were predominantly female, and generally, had more musculoskeletal or neuralgic pain symptoms.

Intentionally embedded needle therapy was mostly performed in Japan for chronic pain, and at least 32 accidental injuries due to the therapy have been reported in Japan [19]. Although intentionally embedded needle treatment had been discouraged by The Japan Society of Acupuncture and Moxibustion in 1976, some acupuncturists still continued the practice of intentionally placing embedded needles (30).

The injuries due to self-acupuncture were not uncommon either. Eight adverse events due to accidental breakage of the...
needle by self-acupuncture were reported in Japan (28). It is not clear how many people perform self-acupuncture throughout the world. At present, acupuncture needles are easily available for purchase online. Surprisingly, some acupuncturists in the United States prescribe self-acupuncture kits to patients so that they can perform self-acupuncture between treatments.

Location

The neck was reported to be the predominant region of the neurological complications due to acupuncture (4). This is probably because neck stiffness is one of the most frequent complaints among patients seeking acupuncture, and patients often tend to move their neck during acupuncture treatment. The space between the atlas and the axis was the most frequently injured site, comprising 10 patients (38.5%). This is most likely due to the popular acupuncture points termed Tenchu and Fuchi, which are located in the nucha between the trapezius muscle and the mastoid process (Figure 3). These two points are well known as effective acupuncture points for headaches and neck stiffness. Our patient inserted the needle toward the skull base around the Fuchi point. Surprisingly, the patient habitually stuck the needle into his neck as deeply as he could, although the recommended placement is 10 to 20 mm deep into the acupuncture points (20).

Etiology

Intentionally embedded needles comprised 15 patients (57.7%) and were the most frequent causes of nerve injuries in the reported cases. Several needles are usually embedded in muscle or subcutaneous tissue at a given time during acupuncture treatment. Embedded needle treatments correlated with motor deficits, which were shown in 9 of 15 treated patients (60%). In addition, embedded acupuncture treatments caused motor deficits in more patients than broken needle incidents (n = 26; P = 0.033). Many incidents related to embedded-needle acupuncture have been reported, especially since the 1970s, and their potential risks and consequences have been alarming. Many acupuncturists still intentionally embed needles in their patients’ bodies, although the method is considered to be old-fashioned and dangerous. Miyamoto et al. (19) reported that symptoms developed more than 1 month after the procedure in 75% of the injuries due to intentionally embedded needles, and surgical removals were often difficult due to the scattering of the fine needles in deep anatomical locations. In 34.4% of their reviewed cases, needles were left intact in the body (5).

The breakage of needles comprised 11 patients (42.3%) and was the second most frequent cause. The breakage occurred not only in self-acupuncture (5 patients), but also in professional treatments (6 patients). The cause of the breakage was assumed to be inadvertent handling or overuse of needles. At present, most of the needles are disposable, made of stainless steel, and believed to be harder to break. However, even stainless steel needles can break, if they are repetitively overused, as in our case report. The risk of repetitive usage of disposable needles must be made known to the public.

Latent Periods and Symptoms

The latent period ranged from immediacy to 21 years, and its mean was 3 years 2 months. Patients can be classified into two groups based on the latency period: 1) an acute onset group (within 30 days) and 2) a delayed onset group (more than 30 days).

The acute onset group (10 patients, 38.5%) comprised those who had neurological symptoms immediately or within 1 month after the accidents. Direct injuries due to needles were the most likely cause of the acute onsets. Embedded, broken needles do not usually cause immediate neurological deficits by themselves. Needles, however, easily stray deeper with neck movements in a few days, as in our case incident. The investigators surmise that the migration of needles into the brain with neck movements injures nerve fibers and results in acute neurological deficits.

The delayed onset group (16 patients, 61.5%) developed symptoms in months or even several years after acupuncture treatment. Although symptoms were generally assumed to be caused by secondary gliosis (27), cavity formation (11, 24), infection (2), or granuloma (3) around the migrated needle, the cause of the delayed onset remains to be cleared. Insufficient sterilization or repetitive overuse of disposable needles may result in infection. In any case, future patients should be given warnings of potential symptoms and monitored closely for an extended period of time for any signs of damage to the nervous system.

The patients in the acute onset group demonstrated a better outcome that was statistically significant than those in the late onset group (Pearson’s χ² test: P = 0.0479). This may be because patients in the acute onset group received earlier and more effective treatment, such as surgery. Twenty-three patients (88.5%) complained of sensory disturbances due to broken or embedded acupuncture needles. Sixteen patients (61.5%) complained of numbness; 10 (38.5%) developed decreased temperature sensation; and 6 patients (23.1%) suffered from pain. Of these, four patients (15.4%) presented with Brown-Séquard syndrome. The symptoms were explained by the injuries in the lateral spinothalamic tract, the fasciculus gracilis, and the fasciculus cuneatus, which run in the lateral or the dorsal portion of the cervical spinal cord.

Motor disturbances were less common and seen in 11 patients (42.3%). Of these, nine patients underwent surgery: one fully recovered, and eight patients showed some
### Table 1. Summary of cervical spinal cord or medulla oblongata injuries due to acupuncture

<table>
<thead>
<tr>
<th>Pt #</th>
<th>First author (reference)</th>
<th>Year of publication</th>
<th>Pt’s Age</th>
<th>Pt’s Sex</th>
<th>Injury site</th>
<th>Latent period (days)</th>
<th>Initial signs and symptoms</th>
<th>Motor deficits</th>
<th>Operation</th>
<th>Outcome</th>
<th>Acupuncturist</th>
<th>Etiology</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Kataoka (13)</td>
<td>1958</td>
<td>60</td>
<td>F</td>
<td>C1/C2</td>
<td>2</td>
<td>Hypesethesia and paresthesia on the right side of the body</td>
<td>-</td>
<td>+</td>
<td>Recovered</td>
<td>Pro</td>
<td>Embedded</td>
</tr>
<tr>
<td>2</td>
<td>Kondo (16)</td>
<td>1979</td>
<td>62</td>
<td>F</td>
<td>C1/C2</td>
<td>913</td>
<td>Diminished sensation of pain and temperature on the right side of the body below the C2/C3 dermatome</td>
<td>-</td>
<td>+</td>
<td>Improved</td>
<td>Pro</td>
<td>Broken</td>
</tr>
<tr>
<td>3</td>
<td>Shiraishi (26)</td>
<td>1979</td>
<td>30</td>
<td>F</td>
<td>C2</td>
<td>183</td>
<td>Weak left leg; Brown-Séquard syndrome (complete loss of pain and temperature sensation below the level of C4 on the right) and Horner’s sign (hyperemia of the palpebral conjunctiva, miosis, ptosis, and hypohidrosis of the face and body on the left)</td>
<td>+</td>
<td>+</td>
<td>Improved</td>
<td>Pro</td>
<td>Embedded</td>
</tr>
<tr>
<td>4</td>
<td>Kojima (15)</td>
<td>1981</td>
<td>40</td>
<td>F</td>
<td>C2/C3</td>
<td>7</td>
<td>Numbness and pain in both arms</td>
<td>-</td>
<td>+</td>
<td>Recovered</td>
<td>Pro</td>
<td>Broken</td>
</tr>
<tr>
<td>5</td>
<td>Kojima (15)</td>
<td>1981</td>
<td>39</td>
<td>F</td>
<td>C3/C4</td>
<td>365</td>
<td>Pain and motor weakness in the right arm</td>
<td>+</td>
<td>+</td>
<td>Improved</td>
<td>Pro</td>
<td>Embedded</td>
</tr>
<tr>
<td>6</td>
<td>Kojima (15)</td>
<td>1981</td>
<td>42</td>
<td>F</td>
<td>C2/C3</td>
<td>150</td>
<td>Decreased temperature sensation below the level of C4 on the left side of the body</td>
<td>-</td>
<td>-</td>
<td>No changes</td>
<td>Pro</td>
<td>Embedded</td>
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<tr>
<td>7</td>
<td>Kojima (15)</td>
<td>1981</td>
<td>60</td>
<td>F</td>
<td>C4/C5</td>
<td>7655</td>
<td>Decreased temperature and tactile sensations in the right arm; motor disturbance in the right arm</td>
<td>+</td>
<td>+</td>
<td>Improved</td>
<td>Pro</td>
<td>Embedded</td>
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<tr>
<td>8</td>
<td>Goto (7)</td>
<td>1982</td>
<td>48</td>
<td>F</td>
<td>C3/C4</td>
<td>0</td>
<td>Pain, paresthesia and motor weakness in the left leg</td>
<td>+</td>
<td>+</td>
<td>Improved</td>
<td>Pro</td>
<td>Broken</td>
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<tr>
<td>9</td>
<td>Noumi (21)</td>
<td>1984</td>
<td>61</td>
<td>M</td>
<td>C0/C1</td>
<td>365</td>
<td>Numbness in the left-sided tongue and cheek</td>
<td>-</td>
<td>+</td>
<td>Recovered</td>
<td>Self</td>
<td>Broken</td>
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<tr>
<td>10</td>
<td>Noumi (21)</td>
<td>1984</td>
<td>63</td>
<td>F</td>
<td>C1/C2</td>
<td>0</td>
<td>Nuchal heavy sensation</td>
<td>-</td>
<td>+</td>
<td>Recovered</td>
<td>Self</td>
<td>Broken</td>
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<tr>
<td>11</td>
<td>Okuiizumi (23)</td>
<td>1990</td>
<td>73</td>
<td>M</td>
<td>C3/C4</td>
<td>730</td>
<td>Sensory disturbances in the right upper and lower extremities</td>
<td>-</td>
<td>+</td>
<td>Recovered</td>
<td>Pro</td>
<td>Embedded</td>
</tr>
<tr>
<td>12</td>
<td>Tomonaga (27)</td>
<td>1984</td>
<td>61</td>
<td>F</td>
<td>C3/C4</td>
<td>730</td>
<td>Numbness and weakness on the left side of the body</td>
<td>+</td>
<td>-</td>
<td>No changes</td>
<td>Pro</td>
<td>Embedded</td>
</tr>
<tr>
<td>13</td>
<td>Sasaki (24)</td>
<td>1984</td>
<td>18</td>
<td>M</td>
<td>C1/C2</td>
<td>0</td>
<td>Brown-Séquard syndrome (diminished temperature sensation below C4 in the left and weakness in the right upper and lower extremities)</td>
<td>+</td>
<td>+</td>
<td>Improved</td>
<td>Pro</td>
<td>Embedded</td>
</tr>
</tbody>
</table>

*indicates our case. Pt, patient; M, male; F, female; Pro, professional acupuncturists; Self, patients; Embedded, embedded needles; Broken, broken needles.
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<th>Operation</th>
<th>Outcome</th>
<th>Acupuncturist</th>
<th>Etiology</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>Isu (11)</td>
<td>1985</td>
<td>18</td>
<td>M</td>
<td>C1/C2</td>
<td>940</td>
<td>Brown-Séquard syndrome (reduction of muscle strength of the right leg and reduction in temperature and pain sensations below C4 on the left side of the body)</td>
<td>+</td>
<td>+</td>
<td>Improved</td>
<td>Pro</td>
<td>Embedded</td>
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<tr>
<td>15</td>
<td>Isu (11)</td>
<td>1985</td>
<td>35</td>
<td>F</td>
<td>C5/C6</td>
<td>120</td>
<td>Decrease in the sensations of temperature and pain below C6 on the right side of the body</td>
<td>-</td>
<td>-</td>
<td>No changes</td>
<td>Pro</td>
<td>Embedded</td>
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<td>16</td>
<td>Maruoka (17)</td>
<td>1986</td>
<td>49</td>
<td>M</td>
<td>C2/C3</td>
<td>30</td>
<td>Paresthesia in the left palm</td>
<td>-</td>
<td>+</td>
<td>Recovered</td>
<td>Pro</td>
<td>Broken</td>
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<tr>
<td>17</td>
<td>Kida (14)</td>
<td>1988</td>
<td>48</td>
<td>F</td>
<td>C1/C2</td>
<td>1</td>
<td>Left-sided impaired temperature and pain sensations below T7; right Horner syndrome</td>
<td>-</td>
<td>+</td>
<td>Improved</td>
<td>Pro</td>
<td>Embedded</td>
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<tr>
<td>18</td>
<td>Hasegawa (10)</td>
<td>1990</td>
<td>57</td>
<td>F</td>
<td>C1/C2</td>
<td>4380</td>
<td>Left Horner syndrome; left Brown-Séquard syndrome (spastic left-sided hemiplegia and diminished temperature and pain sensations below the right-side of the neck)</td>
<td>+</td>
<td>-</td>
<td>Deteriorated</td>
<td>Pro</td>
<td>Embedded</td>
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<tr>
<td>19</td>
<td>Matsui (18)</td>
<td>1991</td>
<td>45</td>
<td>F</td>
<td>C1/C2</td>
<td>0</td>
<td>Pain and decreased sensations in the right extremities</td>
<td>-</td>
<td>+</td>
<td>Recovered</td>
<td>Self</td>
<td>Broken</td>
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<tr>
<td>20</td>
<td>Gi (5)</td>
<td>1994</td>
<td>45</td>
<td>M</td>
<td>C1/C2</td>
<td>14</td>
<td>Dysuria</td>
<td>-</td>
<td>+</td>
<td>Recovered</td>
<td>Pro</td>
<td>Broken</td>
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<tr>
<td>21</td>
<td>Yasuho (29)</td>
<td>1995</td>
<td>62</td>
<td>F</td>
<td>Medulla</td>
<td>4380</td>
<td>Sensory disturbances and mild weakness in the right upper extremity</td>
<td>+</td>
<td>+</td>
<td>Improved</td>
<td>Pro</td>
<td>Embedded</td>
</tr>
<tr>
<td>22</td>
<td>Abumi (1)</td>
<td>1996</td>
<td>60</td>
<td>F</td>
<td>Medulla</td>
<td>6570</td>
<td>Motor loss and decreased sensations of pain and temperature in the right upper extremity</td>
<td>+</td>
<td>+</td>
<td>Recovered</td>
<td>Pro</td>
<td>Embedded</td>
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<tr>
<td>23</td>
<td>Oka (22)</td>
<td>1996</td>
<td>63</td>
<td>F</td>
<td>C2/C3</td>
<td>1825</td>
<td>Numbness in the bilateral fingers and lower extremities; pains in the left upper extremity and bilateral lower extremities</td>
<td>-</td>
<td>+</td>
<td>Improved</td>
<td>Pro</td>
<td>Embedded</td>
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<tr>
<td>24</td>
<td>Oka (22)</td>
<td>1996</td>
<td>52</td>
<td>F</td>
<td>C1/C2</td>
<td>60</td>
<td>Difficulty in neck movements; pains in upper extremities; paresthesia in lower extremities</td>
<td>+</td>
<td>+</td>
<td>Improved</td>
<td>Self</td>
<td>Broken</td>
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<tr>
<td>25</td>
<td>Hama (9)</td>
<td>2004</td>
<td>70</td>
<td>M</td>
<td>Medulla</td>
<td>365</td>
<td>Left facial paresthesia</td>
<td>-</td>
<td>-</td>
<td>No changes</td>
<td>Pro</td>
<td>Broken</td>
</tr>
<tr>
<td>26</td>
<td>Miyamoto*</td>
<td>2009</td>
<td>47</td>
<td>M</td>
<td>Medulla</td>
<td>0</td>
<td>Discomfort in nuchal area</td>
<td>-</td>
<td>+</td>
<td>Recovered</td>
<td>Self</td>
<td>Broken</td>
</tr>
</tbody>
</table>

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improvement. Two patients did not undergo operation because of the patient’s refusal of surgery or technical difficulty in the surgical removal of the embedded or broken needle. One patient showed no changes (25), and the other developed some deterioration (10) of her symptoms.

**Management**

Surgical interventions were performed in 21 cases (80.8%). Ten patients (38.5%) showed recovery, and 11 patients (42.3%) demonstrated some improvement. In non-surgery groups, no improvements were shown: one patient (3.8%) deteriorated and four patients (15.4%) showed no changes. The patients who underwent surgeries had a better outcome that was statistically significant than the patients who did not (Pearson’s χ² test, P < 0.0001). Many surgeons recommend immediate removal of needles that have penetrated into the brain (5, 18, 24), as long as the patient agrees, or as long as the needles are not completely embedded inside the brain. The investigators agree with the immediate removal needles, however, the surgeons should perform thorough preoperative studies including neurological examinations and imaging studies, such as skull roentgenograms and 3D-CTA. The imaging studies should be performed right before the surgery lest the needle migrates before the surgery begins. The surgeons should also prepare intraoperative imaging devices as well as a navigation system, if available. In addition, the surgeons should always keep in mind that there are risks of failure in needle retrieval and in brain damage due to the removal, therefore they must obtain a well-informed consent from the patient. Skull roentgenograms and CAT scans should be the first postoperative imaging studies to be performed to make sure that the needle has been completely removed. MRJ is the best follow-up imaging study to detect any minor bleeding, infections, or brain damage as long as the complete removal of the needle is confirmed.

Acupuncture needles are extremely fine, therefore exploration with insufficient preoperative work-up will easily bring failure in retrieval. Needles are usually made of stainless steel, therefore MRJ is contraindicated. In our patient, it was extremely difficult to pinpoint where the end of the needle was located during the operation with the guidance of only preoperative CAT scan and 3D-CTA. Intraoperative fluoroscopy (18) or ultrasound (23) was reported to be helpful, although neither was able to detect the needle preoperatively in our patient. Whether or not a needle can be visualized may depend on its anatomic location, direction, and the material or composition of the needle, as well as the specification of the ultrasound sound. Repetitive skull roentgenograms during the surgery were very informative in our patient. Finding an acupuncture needle is by far more difficult than locating nails or sewing needles. Furthermore, great care must be paid not to potentiate further migration of the needle by inadvertent intraoperative maneuvers that could damage the brainstem.

**CONCLUSION AND PERSPECTIVE**

Although self-acupuncture is legally prohibited in Japan, five cases (19.2%) were attributed to self-acupuncture. Our patient purchased acupuncture needles from an Oriental medical bookstore. Acupuncture needles are also freely available by various routes, including the Internet. It is, needless to say, dangerous for laypersons to stick needles into their own bodies without adequate knowledge and technique. Embedded needle acupuncture is also dangerous and hazardous to health, even if there is potential medical efficacy. Preventative measures to prohibit the public from purchasing acupuncture needles and to discourage acupuncturists from embedding needles should be immediately considered.

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**REFERENCES**


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