MONO- AND POLYCHROMATIC PHOTOTHERAPY FOR PAIN CONTROL: EXPERIENCES IN OUR HOSPITAL

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Effective and consistent pain attenuation in acute and chronic pain patients remains a major goal for clinicians in the small hospital environment. In our own experience, we have found that phototherapy, at first with a helium-neon (HeNe) laser and subsequently (and currently) with a broad band polarized polychromatic visible red ~ near infrared light source has had good efficacy, both in acute pain types in addition to chronic pain patients: the latter, however, require more treatments. We report on two studies, one using general phototherapy for acute and chronic pain, and a smaller trial using irradiation of the area around the stellate ganglion as an alternative to conventional stellate ganglion anesthetic blockade. In the first and second trials, the immediate efficacy rates for acute pain patients were 87.5% and 100%, respectively. For chronic pain the immediate efficacy after the first treatment was 69% and 57.1%, and after the last treatment 82% and 89.5%, respectively. Phototherapy would therefore appear to have an interesting role to play in the treatment even of chronic pain. In addition to pain, phototherapy can be applied in a number of other areas, and some of these are listed. Phototherapy over the stellate ganglion is compared with conventional stellate ganglion anaesthetic block. Our studies were, however, only preliminary studies, and are limited by small patient populations and the lack of stratification of efficacy by pain aetiology. Larger studies are planned for the future, as we feel that phototherapy is an effective, safe and patient-friendly therapeutic modality, easily applied and well-tolerated by patients of all ages.

Key words: Polychromatic polarized light, acute pain, chronic pain

Introduction

Our hospital is a general private hospital with 168 beds accredited as a pain treatment facility and provides pain treatment programs for patients experiencing pains of various aetiologies including neuralgias and cancer pain. Our pain treatment programs include nerve block procedures, some stimulation therapies and medical treatments. However, in addition to the technical difficulties, these procedures are often associated with pain, invasiveness, adverse reactions and complications, resulting in difficulty in pain control.

Therapy with light sources, phototherapy, is easy to perform, pain free, non-invasive, and associated with few adverse outcomes and complications. Therefore, we have performed this therapy as one of pain treatment programs for patients suffering from pain in our hospital and expect it to offer a patient-friendly care for the 21st century.

Materials and Methods

Experiences with phototherapy in our hospital From 1986, we started to use helium-neon (HeNe) laser therapy, irradiating the area near the stellate ganglion. The depth of penetration and the efficacy were subsequently improved with increases in the output power of the laser system. Infrared energy is noted for much deeper penetration into tissue, however, so we have currently moved away from the HeNe laser to a linearly polarized visible red ~ near-infrared system, and this is what we now mainly use for phototherapy. The system is the SUPER LIZER 2200 (Tokyo Iken Co., Ltd), an iodine discharge lamp-based unit, which delivers 2.2 W of polarized polychromatic light over the visible red and near infrared waveband (600 nm ~ 1600 nm). Here we report the examples of use, efficacy and the
future prospects of the therapy based on our experiences over the past 5 years.

Total number of outpatients seen for the past 5 years
The mean number of outpatients per year is 2624 patients, indicating that IR phototherapy has been conducted in less than 10 outpatients per day on average. It is not profitable for us to conduct the therapy under the healthcare services provided by the Japanese health insurance scheme, since the amount the institution can collect per treatment is low. However, the publicity we get from using phototherapy, and more importantly the benefits which accrue to our patients as far as efficacy, satisfaction, patient-friendliness in any age group, ease of use and the lack of any adverse side effects have greatly encouraged us to continue with this very interesting phototherapeutic modality.

Evaluation
In our first five-month study, patients were assigned to either the acute or the chronic pain group as seen in Table 1. Efficacy of pain attenuation was evaluated using the visual analogue scale (VAS) technique using an 11-point score from zero to 10,\(^{(3)}\) where zero denotes complete absence of pain and 10 represents the worst possible pain. The pain score was expressed as a percentage reduction post-treatment, and patients were assigned to one of 4 grades, namely significant improvement, noticeable improvement, little or no improvement and exacerbation of the pain (Table 2). Results were tabulated and expressed graphically. The significant and noticeable scores were combined to give the overall efficacy in pain reduction.

Results of the First Trial
When the VAS score after treatment was compared with that at the baseline, 87.5% overall efficacy in pain attenuation was demonstrated in the acute pain group (Figure 1) after the first treatment, indicating a high immediate effect. In the chronic pain group (Figures 2 and 3), the mean frequency of treatment was significantly higher than that in the acute pain group, and the improvement (82% as the long-term effect) in VAS after the last treatment was higher than after the first treat-

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Table 1: Criteria of acute and chronic pain cases.

<table>
<thead>
<tr>
<th>Degree of improvement</th>
<th>Assessment grade</th>
</tr>
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<tbody>
<tr>
<td>71% ~ 100%</td>
<td>Significant improvement</td>
</tr>
<tr>
<td>31% ~ 70%</td>
<td>Noticeable improvement</td>
</tr>
<tr>
<td>0% ~ 30%</td>
<td>Little or no improvement</td>
</tr>
<tr>
<td>Minus value</td>
<td>Exacerbation of pain</td>
</tr>
</tbody>
</table>

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Table 2: VAS scoring and grading criteria.

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Fig 1: Efficacy grading of acute pain patients immediately after one single treatment session.
ment (69% as the immediate effect), showing that broad band polarized visible red ~ near infrared phototherapy holds promise for treating chronic pain. The exacerbation of the pain post-treatment is a well-recognized phenomenon due to the regression of the chronic pain to an acute phase. (4)

Irradiation Methods and Other Indications

Efficacy of phototherapy on the area near the stellate ganglion (5,6)

It is considered that light-induced changes in local and systemic sympathetic and parasympathetic nerve activity are involved in the action mechanism of phototherapy of the stellate ganglion, and it may help the maintenance of homeostasis since thermographically-assessed significant differences in body temperature variation were observed in patients with increased sympathetic tone (pathological condition, sympathetic dominance) following phototherapy compared with healthy volunteers.

The 30 patients in this group were clinically classified into the acute pain group (9 patients) and the chronic pain group (21 patients), as described above, and the efficacy was evaluated using VAS. When the VAS score after treatment was compared with that at the baseline, the acute pain group demonstrated 100% improvement in VAS after the first treatment, showing a high immediate effect. In the chronic pain group, the mean frequency of treatment was significantly high, and the improvement (89.5% as the long-term effect) in VAS after the last treatment was higher than after the first treatment, (57.1% as the immediate effect) showing that phototherapy has a promising role in the treat-
ment of chronic pain. Compared with conventional nerve block techniques, phototherapy applied to the area near the stellate ganglion can be easily performed, is less invasive and is associated with few adverse effects. We therefore believe that this treatment methodology should be more commonly performed in the outpatient setting.

The effects of laser irradiation on pain associated with herpes zoster
Herpes zoster (HZ) and postherpetic neuralgia (PHN) are associated with intractable pain and are one of the indications for conventional nerve block techniques. The incidence of PHN following HZ is much higher in more elderly patients, increasing concomitantly with age. It is thus accepted practice that a nerve block technique in combination with routine treatment during the early stage of HZ may prevent the occurrence of PHN. On the other hand, particularly in elderly patients, stellate ganglion blocks must be applied by an experience anesthesiologist, but even then there are documented risks and side effects such as possible perforation of the vertebral artery, induction of pneumothorax, residual hoarseness or tenderness in the injection site. Repeated applications are associated with recurrent paralysis of involved nerves. There are no such problems associated with phototherapy.

Because of these problems, the nerve block technique is sometimes avoided in general hospitals. On the other hand, phototherapy can be performed during the early stage of HZ without any complications, and improvement has been obtained using the laser irradiation method as laid out in Table 3. Note that there is a larger gap between the location of blisters (the cutaneous sensory field) and the level of the spinal nerve root to which phototherapy is applied in the lower part of the body.

Other indications for phototherapy
Refractory ulcers: bedsores (decubitus ulcers) and ulcers due to vascular insufficiency such as Raynaud’s syndrome
Orthopaedic diseases: osteoarthritis; omarthralgia; scapulo-humeral periarteritis; indications for pediatric rehabilitation; rheumatoid arthritis (RA); reflex sympathetic dystrophy (RSD); and complex regional pain syndrome (CRPS).
Dermatological application: An increasing number of reports indicate that phototherapy has been successfully conducted in patients with skin diseases including eczema, psoriasis atopic dermatitis and alopecia areata.
Cancer pain: Pain in cancer patients can be classified into those caused by the cancer itself, those associated with cancer treatment and those not directly related to cancer. Phototherapy is effective for treatment of postoperative pains and pain of neuromuscular origins. Reports have appeared in the international literature on the use of phototherapy for the preventive effect of radiotherapy on erosive ulcers in head and neck cancers and the preventive effect of phototherapy on chemotherapy-related stomatitis due to chemotherapy. In all cases, phototherapy has been seen as an effective measure for improvement of the QOL in cancer patients.

Comparison between phototherapy and conventional nerve block techniques in the outpatient setting
Phototherapy is not always a substitute for conventional nerve block techniques. It is therefore important to understand the usefulness of phototherapy, and the advantages and disadvantages of phototherapy are shown as follows based on the comparison with conventional nerve block techniques.

Advantages:
Less invasive and associated with few adverse reactions; requires no high technology; requires no man-power; and can be performed in more patients per day.

Disadvantages:
Has no or very minimal immediate effects; requires time to perform; low reimbursement fee; uses expensive equipment.
Based on these advantages and disadvantages as

Table 3: Site of herpes zoster and treatment protocol, with treatment parameters.

<table>
<thead>
<tr>
<th>Site of herpes zoster</th>
<th>Treatment Protocol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face (Area around the Trigeminal nerve)</td>
<td>1: Irradiation of the area over the stellate ganglion</td>
</tr>
<tr>
<td></td>
<td>2: Irradiation of the trigeminal nerve</td>
</tr>
<tr>
<td></td>
<td>i Supraorbital n.</td>
</tr>
<tr>
<td></td>
<td>ii Infraorbital n.</td>
</tr>
<tr>
<td></td>
<td>iii Mental n.</td>
</tr>
<tr>
<td>Body</td>
<td>1: Irradiation of the dorsal root entry and exit zones</td>
</tr>
<tr>
<td></td>
<td>2: Irradiation of the affected area(s)</td>
</tr>
</tbody>
</table>

Irradiation and duration parameters
SUPER LIZER 2200 set to full power
10 min / treatment area (comprising 2 sec irradiations with 4 sec inter-irradiation interval
well as the characteristics of phototherapy, it can be substituted for the following nerve block techniques.

- Stellate ganglion nerve block
- Trigger point block
- Some epidural blocks
- Superficial nerve block
- Some sympathetic nerve blocks

On the other hand, the following nerve block techniques are superior to phototherapy considering the depth of penetration and the latency of the effect of phototherapy.

- Trigeminal nerve block
- Celiac nerve block and visceral nerve block
- Nerve block with a neurolytic agent such as phenol intrathecally administered
- Cervical and lumbar sympathetic nerve block

We try to select an effective treatment that causes less pain, is less invasive and associated with few adverse reactions for patients. However, there is increasing evidence that phototherapy used in combination with conventional nerve block techniques offers unique synergistic advantages.

Conclusions

Our studies were only preliminary studies, and suffer from two major limitations. First, the size of the patient populations precludes any significant statistical analysis of our results. Second, we did not stratify phototherapeutic efficacy broken down by pain aetiology, again because of the low patient numbers. We plan to address these issues in future trials.

Phototherapy is performed as a patient-friendly care for patients suffering from pain, injuries and skin diseases in our hospital. As a part of palliative treatment, phototherapy is considered to be widely indicated not only for patients with pain but also for those with cancer since phototherapy causes few adverse reactions and is associated with stimulating the autoimmune system in immunoincompetent patients.

References