The Analgesic Effect of the Hyperbaric Oxygen Therapy

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The Analgesic Effect of the Hyperbaric Oxygen Therapy

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Abstract

Aim: This observational study is a comparison between standard medications for acute soft tissue injuries versus the same treatments with the addition of hyperbaric treatment cycles, in order to evaluate whether hyperbaric oxygen therapy reduces analgesic consumption during 9 days of treatment.

Method: Eighty patients were retrospectively assigned to either the traditional care group comprising several medications (Group “base”) or the alternative treatment group, comprising several medications as well as 14 cycles of hyperbaric oxygen therapy (Group “hyp”). Pain scores, painful restricted movement and analgesic consumption were evaluated in the same manner.

Results: We observed a clear analgesic effect and a significant reduction in the assumption of Paracetamol (p < 0.01) in group “hyp”. The analgesic effect of such hyperbaric treatment increased significantly during the entire observational period of 9 days.

Conclusions: Although the best way to investigate a possible relationship between hyperbaric oxygen exposition and reduction of pain would be a perspective randomized clinical trial, in our retrospective analysis, the hyperbaric oxygen therapy seems to reduce both pain and Paracetamol consumption. In our opinion vasoconstriction caused by such hyperbaric treatment, reducing post-traumatic edema of tissues and determining low releasing of acute inflammatory agents such as lactates and H+, could supply analgesic effect on acute pain. This clinical intuition, if confirmed by perspective randomized studies, could lead to new multimodal modalities for management of acute pain in case of traumatic injuries during disasters. So, if a hyperbaric oxygen chamber is available, not only you should use it for healing but also for pain management. Thus, our intent is only to stimulate further clinical investigation.

Introduction

Background:
From 2005 to 2012 we took part into several peace-keeping operations abroad. In particular during our military medical deployment in Bosnia Herzegovina, in Kosovo, in Thciad (Africa), in Haiti and in Afghanistan as well, we had the opportunity to acquire a lot of clinical experience in management of pain subsequent to traumatic injuries.
These evidences may suggest a clear role of hyperbaric cycles in reducing acute pain. In fact, when we were involved as medical Officers during several massive disasters, we had the opportunity to notice a clear role of this therapy also in the management of pain. That’s the reason why we intended to investigate this analgesic effect through a statistical analysis. So, in this study we retrospectively analyzed this clinical aspect and we tried to quantify a possible analgesic effect. This should encourage new modalities of intervention for the management of acute pain when a hyperbaric chamber is available, and our intent is to stimulate the research for further investigations. Obviously our aim is also to emphasize the utility of hyperbaric therapy in disaster medicine.

**Goals of this investigation:**
Because of the size and the entity of the soft tissue injuries selected, associated with a starting visual analogue scale value of 2-4 before the first medication (baseline), the goal of our investigation was to retrospectively assess a clinically significant difference in Paracetamol consumption between the two groups.

**Methods**

**Study design, Selection of participants and Setting, methods of measurement.**
In our analysis we examined 38 females and 42 males aged from 16 to 67 years, who presented various acute soft tissue injuries exclusively located to their limbs and a variable initial 2-4 VAS pain score requiring Paracetamol. The visual analogue scale (VAS) is a reliable and valid method for measurement of acute pain [10]. We made a retrospective analysis from our database in which we collected 420 cases of soft tissue injuries from 2005 to 2012. The patients selected were divided into either a special treatment group comprising several different medications and 14 cycles of hyperbaric oxygen therapy (Group “hyp”), or into a classic treatment group comprising several normal medications (Group “base”). With the intent of making a comparison between two similar groups, we chose only patients who were similar with respect to wound localization and initial level of pain (presenting a 2-4 VAS level of pain before the first treatment as we said before). During their medications, they were treated in the same manner using a mixture of “Hypericum perforatum oil” plus “Neem oil” plus “Olive oil”, normal solutions of NaCl 0.9% to clean the wounds, Betadine and topical antibiotics. Naturally, during their treatment they also received systemic antibiotics. All the patients underwent one medication every three days starting from hospital admittance (day 0, day 3, day 6, day 9), consisting in overview, cleaning and disinfection. Patients in Group “hyp” additionally received hyperbaric oxygen therapy treatment (1h of duration – 2.4 – 2.8 ATA) twice a day from day 1 to day 5 and once a day from day 6 to day 9. After each medication, analgesia was provided with Paracetamol 1000 mg e.v. as needed (maximum 3000 mg each day); daily drug consumption was recorded. Before starting the medication we also recorded the VAS score (“visual analogue scale” comprising scores from 0 to 10; VAS 0 = at the arrival; VAS 1 = at day 3; VAS 2 = at day 6; VAS 3 = at day 9) and, at the same time, the limitation in the movement of the limb involved (classified into three grades: 2= restricted, 1= fair and 0= free).

**Primary data analysis**
Statistical data was analyzed by STATISTICA 6.0 (StatSoft, Inc., Tulsa, OK 74104, USA). The group treated only with the administration of Paracetamol was called “base” while the group exposed to the hyperbaric therapy was called “hyp”. The anthropometric differences between the two groups were tested by a Student’s T test for independent samples. To analyze the effect of the treatment for the VAS, the assumption of Paracetamol and level of movement restriction, we performed the ANOVA test for repeated measures with one factor. For post-hoc comparisons we used a Tukey’s Test with a significativity level of \( p < 0.01 \).

**Results**

The description of the two groups is shown in table 1. There were no differences in the anthropomorphic variables as for the percentage of male subjects or the localization of the wounds (arms or legs). The analysis of variance for the VAS indicated a significant effect of the treatment \( F_{1,78}=12.0; \ p < 0.01 \) and the interaction between treatment and time (the repeated factor) \( F_{2,156}=1597.8; \ p < 0.01 \). Post hoc analysis revealed a significant difference between the two groups only at the 9th day (figure 1). The effect of the treatment was significant as far as paracetamol assumption is concerned \( F_{1,78}=183.5; \ p < 0.01 \). However, this main effect of the treatment was influenced by the repetition of the treatment along the days \( F_{2,156}=10.0; \ p < 0.01 \). Post hoc tests revealed that the interaction between treatment and time was evident from the 3rd day until the end of treatment (figure 2). The treatment did not affect patients’ mobility. The...
analysis of variance for the level of restriction was not significant: \( F_1, 78=0.1; p=0.8 \). The computation reported only the effect of time: \( F_2,156=166.7; p<0.01 \), to demonstrate a spontaneous recovery of mobility during treatment, as shown in figure 3.

**Discussion**

In this study, patients presenting soft tissue injuries to their limbs, experienced less pain if exposed to hyperbaric oxygen treatment, and this effect was clearly time related. There were no significant differences between the two groups in terms of painful restricted movement of the limbs.

From several studies we can extrapolate that in order to promote wounds healing, hyperbaric oxygen therapy is definitely a reasonable therapeutic tool for the treatment of patients presenting acute soft tissue injuries. However, nobody has ever verified the possible influence of such treatment over several days on the acute pain mechanisms associated with this kind of injuries.

In this study, overall Paracetamol consumption and pain scores both were found to be significantly lower in the “hyp” group.

In conclusion, we observed better analgesia in those patients treated with hyperbaric oxygen therapy and its addition to normal medications seemed to promote better pain management, or at least, it did so over an observational period of 9 days.

**Conclusion**

In our retrospective analysis, during an observational time of 9 days of treatment, hyperbaric oxygen therapy seemed to reduce both pain and Paracetamol consumption.

Also if the best way to investigate the relationship between hyperbaric exposition and reduction of pain would be a perspective randomized clinical trial, in our clinical observation we can extrapolate some relevant conclusions. In fact, in our opinion vasoconstriction caused by such hyperbaric treatment, reducing post-traumatic edema of tissues and determining low releasing of acute inflammatory agents such as lactates and H+, could supply analgesic effect on acute pain. This clinical intuition, if will be confirmed by perspective randomized studies, could lead to new modalities for management of acute pain even in disaster medicine. Thus, our intent is only to stimulate further clinical investigation.

**References**

Illustrations

Illustration 1

Table 1: Patient and initial data.

<table>
<thead>
<tr>
<th></th>
<th>base (n=40)</th>
<th>hyp (n=40)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex (male)</td>
<td>50%</td>
<td>45%</td>
</tr>
<tr>
<td>Age (yr)</td>
<td>37.0 ± 13.4</td>
<td>37.4 ± 14.6</td>
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<tr>
<td>Weight (kg)</td>
<td>67.0 ± 11.6</td>
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<tr>
<td>Height (cm)</td>
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<td>170.0 ± 11.3</td>
</tr>
<tr>
<td>Localization (Arms/Legs)</td>
<td>19/21</td>
<td>20/20</td>
</tr>
</tbody>
</table>
Illustration 2

Figure 1: VAS score.

Vas score for the two experimental groups during the treatment. Spreads indicate the standard error. *Tukey's test p<0.01.
Illustration 3

Figure 2: Paracetamol assumption.

Paracetamol assumption (g) for the two experimental groups during the treatment. Spreads indicate the standard error. *Tukey’s test p<0.01
Illustration 4

Figure 3: Level of restriction.

Level of restriction for the patients of the two experimental groups during the treatment. Spreads indicate the standard error. Time was significative: $F_{2,156}=166,7; \ p<0,01$. 
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