Complications in tissue expansion: A logistic regression analysis for risk factors

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\textbf{ABSTRACT}

Background: Tissue expansion is frequently used in reconstructive surgery. Although the surgical procedure is typically considered simple, reported complication rates of tissue expansions exceed 40\%. There is little evidence concerning risk factors for complications in tissue expansion in body regions other than breast. The aim was to determine risk factors for complications in non-breast tissue expansion.

Methods: 34 patients treated with subcutaneous tissue expanders between 2005 and 2014 were analyzed. Demographic data, body-mass index (BMI), mean arterial blood pressure (MAP), treatment indications, expansion site, previous expansion therapies in the same body region, smoking history, as well as expander characteristics (shape, volume, and filling mechanism) were ascertained. Complications were assessed and ranked according to severity based on the Clavien-Dindo classification. Binary logistic regression analysis adjusted for clinical characteristics was used. A \(p<0.05\) was considered as statistically significant.

Results: Complications were observed in 26 out of 71 expanders analyzed (36.6\%), of whom 10 led to therapy failure. Expanders used in the limbs, female gender, and high expander volume turned out as significant risk factors. Patients with both a high MAP and low BMI developed tissue necrosis significantly more often (\(p=0.002\)). The use of tissue expansion after a burn was not associated with an increased risk for complications.

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1. Introduction

Burns are common and devastating injuries and often result in significant scarring benefiting from skin resurfacing procedures [1,2]. Over the past decades, tissue expansion has become an important tool for skin resurfacing in reconstructive surgery [3-7]. Invented by Neumann in the late 1950s and pioneered by Radovan, Lapin and Austrud, it soon became an established technique among surgeons [7]. The procedure takes advantage of the natural phenomenon that occurs when living soft tissues undergo stress from an external force or tension. A synthetic balloon is placed underneath the skin and gradually inflated over time. As a consequence, healthy skin from adjacent areas moves toward the area of tension. Moreover, the proliferation of the skin overlying the expander is stimulated [3]. While reconstruction of soft tissue defects with split-thickness skin grafts bears the risk of unpleasant scarring and poorly aesthetic outcomes, skin expansion enables use of donor skin with similar texture, color and sensation as the lesion to be covered [3,7]. In addition, local tissue expansion is usually associated with a lower donor site morbidity compared to other flaps [7]. Primary indications for local tissue expansions are reconstructive procedures including scar release surgery, especially in burn victims [3,5,7,8]. In soft tissue defects around the ear, adequate reconstruction by tissue expansion may simply enable wearing of hearing aids [9]. Soft tissue defects after tumor resection can also be covered by using tissue expansion [4,6,10].

Although the surgical procedure seems to be simple, tissue expansion is associated with complication rates of up to 48% [6]. Risk factors predicting complications following soft tissue expansion treatments in the limbs or the face/neck area are poorly described in medical literature. Hence, this study aims at identifying risk factors for surgical complications in tissue expansion.

2. Patients and methods

The study had been approved by Institutional Review Board (No. 27-298 ex 14/15). 34 patients treated with a subcutaneous tissue expander at our institution between January 1st, 2005 and December 31st, 2014 were included in this study. Expanders for breast reconstruction were not included in the current analysis. We retrospectively ascertained different parameters from admission including age, gender, smoking history, body-mass index (BMI), American Society of Anesthesiologists (ASA) status, prevalence of diabetes mellitus or autoimmune diseases, and mean arterial pressure (MAP).

Indications for treatment were divided into three groups: burn scars, posttraumatic defects (skin defects of other origin than burns) and congenital defects (e.g., congenital nevus, cleft lip and palate). Expansion sites were subdivided into four groups: scalp; face/neck; trunk and limb. Previous expander therapies in the same body region as the one investigated in this study were recorded. Therapy-related parameters included expander shape and volume, the number of expanders implanted during a single procedure and the filling mechanism (internal/external valve, osmotic). Observed complications included: dehiscence, necrosis, infection, seroma and hematoma as well as expander leakage. The Clavien-Dindo classification was used to determine severity of complications (Table 1) [11]. The impact of complications on therapy was divided into the three possible outcomes: therapy failure (when the expander had to be removed before any skin expansion could be achieved), partial therapy success (the expander had to be removed prematurely, skin expansion was...

Table 1 – Clavien-Dindo classification of surgical complications.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Definition</th>
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</thead>
<tbody>
<tr>
<td>I</td>
<td>Any deviation from the normal postoperative course without the need for pharmacological treatment or surgical, endoscopic and radiological interventions. Allowed therapeutic regimens are: drugs as antiemetics, anti-pyretics, analgesics, diuretics and electrolytes and physiotherapy. This grade also includes wound infections opened at the bedside.</td>
</tr>
<tr>
<td>II</td>
<td>Received pharmacological treatment with drugs other than such allowed for grade I complications.</td>
</tr>
<tr>
<td>III (a + b)</td>
<td>Received surgical, endoscopic or radiological intervention (a=not under general anesthesia, b=under general anesthesia).</td>
</tr>
<tr>
<td>IV (a + b)</td>
<td>Life-threatening complication (including CNS complications) undergoing ICU/ICU-management (a=single organ dysfunction, b=multi organ dysfunction).</td>
</tr>
<tr>
<td>V</td>
<td>Death of patient.</td>
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</tbody>
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