Long-Term Psychosocial Outcomes after Intraoperative Awareness with Recall

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BACKGROUND: Posttraumatic stress disorder, a common psychiatric disorder in the general population, may follow a traumatic experience of awareness with recall during general anesthesia. PTSD, with trauma-reexperiencing, avoidance, and hyperarousal-related symptoms, is a well-known psychiatric disorder after a PTE. The initially reported PTSD lifetime prevalence of 7.8% in the epidemiological National Comorbidity Survey in the United States was recently verified to be 8.0%. In the Finnish adult population, the Health 2000 Survey reported the 12-month prevalence of anxiety disorders to be 4.1%, but this study was not focused on PTSD. Awareness during anesthesia may be a significant risk factor for PTSD. PTE may also precede other psychiatric conditions, such as major depressive disorder (MDD), or harmful alcohol use.

METHODS: We conducted a matched cohort design with 9 subjects after intraoperative awareness with recall during general anesthesia. A psychiatric diagnostic interview and questionnaire were performed on 9 matched controls and 9 subjects, a median of 17.2 years from their documented awareness episode. The subjects and the matched controls completed a battery of questionnaires related to psychosocial well-being, after which they participated in a diagnostic Structured Clinical Interview for Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition Axis I Disorders.

RESULTS: Patients with awareness did not seem to differ from their matched controls in subsequent psychosocial outcome, psychiatric morbidity, or quality of life.

CONCLUSIONS: We found no indication that intraoperative awareness with recall had any deleterious long-term effects on patients’ psychosocial outcome. (Anesth Analg 2014;119:86–92)

Intraoperative awareness, although a rare (estimated incidence 0.1%–0.2%) adverse outcome of general anesthesia, is psychologically a potential traumatic event (PTE) that can lead to posttraumatic stress disorder (PTSD). PTSD, with trauma-reexperiencing, avoidance, and hyperarousal-related symptoms, is a well-known psychiatric disorder after a PTE. The initially reported PTSD lifetime prevalence of 7.8% in the epidemiological National Comorbidity Survey in the United States was recently verified to be 8.0%. In the Finnish adult population, the Health 2000 Survey reported the 12-month prevalence of anxiety disorders to be 4.1%, but this study was not focused on PTSD. Awareness during anesthesia may be a significant risk factor for PTSD. PTE may also precede other psychiatric conditions, such as major depressive disorder (MDD), or harmful alcohol use.

Screening of subjects with intraoperative awareness for psychological distress is in many cases incomplete even though there are several brief screening instruments. Furthermore, the timing of the interview and psychiatric diagnostic procedures and the estimation of psychiatric morbidity vary markedly among studies. Therefore, more evidence is needed regarding subsequent psychological well-being of individuals who have experienced intraoperative awareness.

In this study with a matched control design, we investigated the prevalence of PTSD and other mental disorders and psychosocial outcome among subjects who experienced intraoperative awareness by using extensive self-report questionnaires and structured psychiatric interviews. We hypothesized that there would be a higher prevalence of psychiatric disorders, such as PTSD, and distress in the group with an intraoperative awareness experience than in the control group.

METHODS

Study Design and Power Analysis

Previous studies suggest that the lifetime prevalence of PTSD in the general adult population (including the control group of this study) is 8%. In patients who experienced intraoperative awareness, we estimated that 60% would fulfill the criteria for PTSD at the time of interview. Power analysis showed that 13 case-control pairs would be needed to test the hypothesis with a significance level of 5% and a power of 90%. After the study had been approved by the Ethics Committee of Helsinki University Hospital, an invitation and information letter with a consent form were sent to individuals who had earlier participated in our studies evaluating intraoperative awareness and had definite explicit recall of a period of general anesthesia (Fig. 1). All were adults at the time of their awareness experience. Written informed consent was obtained from all subjects. The patient selection was initially all patients scheduled for an operation in 1 tertiary level hospital and 2 secondary level hospitals in southern Finland (between June 1992 and December 1998) and is described in detail in earlier studies. Of the 26 subjects who had experienced definite awareness with recall, 17 were excluded from the study. Eleven were deceased.
and 6 could not be interviewed because they were not willing to participate (n = 3), had a medical condition (n = 2), or could not be reached, despite several invitation letters and phone calls (n = 1). Thus, we were left with 9 subjects and their 9 matched controls to be interviewed.

As controls, we selected subjects of the same gender, age group (± 5 years), time of operation (± 3 months), and type of anesthesia (cardiac/other). We first selected all possible controls for each awareness case from those interviewed during the original studies and who had not experienced awareness during anesthesia. Of the possible matched controls, we randomly selected a maximum of 10 subjects for this study. For these cases, and for the 26 definite awareness cases, we requested their current addresses from the Population Register Center of Finland. The available controls for each awareness case were then contacted one-by-one, and the first subject able and willing to participate was selected as the control case. For 1 case-control pair (a relatively young female cardiac surgery subject), we relaxed the matching criteria for the time of operation from ±3 months to ±2 years, because otherwise we would have been unable to find any matching control. Eighteen individuals were interviewed (9 in the study group and 9 in the control group).

**Psychiatric Diagnoses**

A structured psychiatric interview of all participants was conducted by a clinical psychologist trained in Structured Clinical Interview for Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) Axis I Disorders (SCID-I), by the psychiatrists of this study (KS, MHe, TL). Research interviews took place in hospital outpatient settings or at the interviewee's home between September 2011 and June 2012. In the study group, the time from the operation with awareness to the study interview was a median of 17.2 years (range 13.0–19.7 years, mean 16.7 years) and in the control group from the general anesthesia to the study interview a median of 17.3 years (range 13.2–18.6 years, mean 16.7 years). The initial awareness experience and patient perceptions are described with the Michigan Awareness Classification Instrument.21

Preceding the structured interview, subjects completed the structured forms of the general health questionnaire (GHQ),22,23 Beck Depression Inventory (BDI),24 Alcohol Use Disorders Identification Test (AUDIT),25 WHO Quality of Life-BREF (“BREF” is French and means BRIEF) (WHOQOL-BREF),26,27 and, if a PTE was present, the Trauma Screening Questionnaire (TSQ).17 The interviewer filled in both current and lifetime history of DSM-IV-TR criteria by using the Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-I) and the Social
and Occupational Functioning Assessment Scale (SOFAS), included in DSM-IV-TR. Personality disorders (SCID-II) were not included in the assessment. At the beginning of the interview, the interviewer was blinded with respect to the group of the interviewee, but during the interview was inevitably informed about PTEs. All participants were offered a psychiatric consultation if needed by a study group psychiatrist after the interview (TL), as described in the study invitation letter. The SCID interview was independently rated by psychiatrists (TL, KS) blindly to each other. The second rater (KS) was blind regarding whether the interviewee was among the cases or controls. A consensus of all SCID diagnoses was achieved in a meeting with a third psychiatrist (MHe).

Statistical Analysis

Variables in the study group (with awareness during anesthesia) and the control group, socioeconomic factors, and psychosocial well-being were analyzed with SURVO MM, version 3.33. Pearson $\chi^2$ test was used in cross-tabling and the Mann-Whitney $U$ test in comparing medians. Results are presented in Table 1. An exact $P$ value of 0.05 or below was considered to indicate a statistically significant difference. Logistic regression was performed with STATA stepwise forward and stepwise backward with Table 1 items and also with items dichotomized as near to the median as possible.

RESULTS

The study group with subjects who had experienced awareness during general anesthesia and the control group did not seem to significantly differ in their later psychosocial well-being, as evaluated by using the structured questionnaires GHQ, BDI, AUDIT, and WHOQOL and the SCID interview. None of the subjects in either the awareness or the control group was found to have a diagnosis of PTSD. Median age, educational and marital status, follow-up time, and results from GHQ, BDI, AUDIT, SOFAS, and WHOQOL-BREF are presented in Table 1. For the interviewed awareness patients and those who refused to be interviewed, patient demographics and perceptions during intraoperative awareness are described in Table 2 by the Michigan Awareness Classification Instrument. Three patients refused to be interviewed. These 3 patients were classified in class 1, 2, and 4 by the Michigan Awareness Classification Instrument. The classification did not differ significantly from the classification of the interviewed patients. In the logistic regression by forward selection, no variable was selected as significant from those included in Table 1. Stepwise backward found 3 items for the model (SOFAS: OR = 1.68, 95% CI, 0.978–2.870; WHOQOL-BREF: OR = 0.416, 95% CI, 0.159–1.090; and WHOQOL-BREF Psychological: OR = 0.339, 95% CI, 0.864–1.330).

When items of Table 1 were dichotomized for logistic regression as nearly to the median as possible, only the Environment part of the WHOQOL-BREF scale was significant ($P = 0.027$).

Structured Psychiatric Diagnoses

In the study group, 1 current major depressive disorder (MDD) and 1 lifetime panic disorder with agoraphobia were observed in the structured psychiatric SCID interview. In the control group, 1 current MDD, 1 current other depressive disorder, and 1 lifetime MDD were observed.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Study group, $N = 9$, median and range</th>
<th>Control group, $N = 9$, median and range</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at interview</td>
<td>57.3, min 40.9 max 65.1</td>
<td>59.2, min 36.1 max 66.9</td>
<td>0.4126</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic level</td>
<td>$N = 1$ (11.1%)</td>
<td>$N = 1$ (11.1%)</td>
<td>0.9684</td>
</tr>
<tr>
<td>Middle level</td>
<td>$N = 5$ (55.6%)</td>
<td>$N = 4$ (44.4%)</td>
<td>0.9847</td>
</tr>
<tr>
<td>Graduated</td>
<td>$N = 3$ (33.3%)</td>
<td>$N = 4$ (44.4%)</td>
<td>0.9847</td>
</tr>
<tr>
<td>Marital status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married/cohabiting</td>
<td>$N = 7$ (77.8%)</td>
<td>$N = 8$ (88.9%)</td>
<td>0.2265</td>
</tr>
<tr>
<td>Divorced</td>
<td>$N = 2$ (22.2%)</td>
<td>$N = 1$ (11.1%)</td>
<td>0.2265</td>
</tr>
<tr>
<td>General health questionnaire (GHQ)$^a$</td>
<td>0.0, min 0.0 max 2.0</td>
<td>1.0, min 0.0 max 11.0</td>
<td>0.3456</td>
</tr>
<tr>
<td>Beck depression inventory (BDI)$^a$</td>
<td>4.0, min 0.0 max 10.0</td>
<td>4.0, min 0.0 max 15.0</td>
<td>0.4655</td>
</tr>
<tr>
<td>Alcohol use disorders identification test (AUDIT)$^b$</td>
<td>3.0, min 0.0 max 9.0</td>
<td>4.0, min 1.0 max 9.0</td>
<td>0.1255</td>
</tr>
<tr>
<td>Social and occupational functioning assessment scale (SOFAS)$^b$</td>
<td>83.0, min 74.0 max 90.0</td>
<td>83.0, min 67.0 max 89.0</td>
<td>0.6544</td>
</tr>
<tr>
<td>WHOQOL physical health$^b$</td>
<td>14.9, min 10.9 max 19.4</td>
<td>15.4, min 10.3 max 17.7</td>
<td>0.4824</td>
</tr>
<tr>
<td>WHOQOL psychological health$^b$</td>
<td>15.3, min 12.0 max 17.3</td>
<td>16.0, min 10.0 max 17.3</td>
<td>0.6214</td>
</tr>
<tr>
<td>WHOQOL social relationships$^b$</td>
<td>16.0, min 12.0 max 20.0</td>
<td>16.0, min 9.3 max 60.214</td>
<td>0.3456</td>
</tr>
<tr>
<td>WHOQOL environment$^b$</td>
<td>15.2, min 11.5 max 19.0</td>
<td>17.0, min 13.7 max 18.5</td>
<td>0.1255</td>
</tr>
<tr>
<td>Follow-up time (y)</td>
<td>17.2, min 13.0 max 19.7</td>
<td>17.3, min 13.1 max 18.6</td>
<td>0.6544</td>
</tr>
</tbody>
</table>

$^a$None of the subjects in either the awareness group or the control group was found to have a diagnosis of posttraumatic stress disorder in the Structured Clinical Interview for DSM-IV Axis I Disorders (SCID).$^b$GHQ-12 range 0 to 12 points, with lower scores denoting mental well-being; BDI range 0 to 63 points, with lower scores denoting no depressive symptoms; AUDIT range 0 to 40 points, with lower scores denoting no alcohol use problems; SOFAS range 0 to 100 points, with higher scores denoting better functioning; and WHOQOL range 4 to 20 points, with higher scores denoting higher quality of life.

The control subject with lifetime MDD had some posttraumatic symptoms during the lifetime and scored 6 points in the TSQ, which is considered the cutoff for PTSD, but in the SCID interview PTSD diagnostic criteria were not fully met. In the study group with awareness with recall, no one described awareness during anesthesia as a potentially traumatic event in the structured psychiatric SCID interview. Respondents in the study or control group other than those described above did not complete the TSQ.

Psychotic disorders or bipolar disorder, dysthymia, social phobia, generalized anxiety disorder, obsessive-compulsive disorder, PTSD, specific phobia, somatiform disorders, eating disorders, and alcohol or other substance use disorders were not observed in any of the interviewed subjects.

DISCUSSION

Main Findings

Contrary to some reports of a high incidence of PTSD,$^{1,14,16}$ we found no cases indicating PTSD by using extensive
**Table 2. Description of Patient Demographics and Perceptions During Intraoperative Awareness by Using the Michigan Awareness Classification Instrument**

<table>
<thead>
<tr>
<th>Sex</th>
<th>Interviewed patients</th>
<th>Age</th>
<th>Body mass index</th>
<th>Operation</th>
<th>Perceptions during intraoperative awareness</th>
<th>Michigan awareness instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>44</td>
<td>22</td>
<td>Vaginal hysterectomy</td>
<td>Heard voices, felt hands around her when positioned, felt intubation, tried to speak, felt paralyzed, intubation was painful, no pain intraoperatively, anxiety.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>49</td>
<td>32</td>
<td>Thoracotomy</td>
<td>Difficult to breathe during the operation, no pain, no anxiety</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>30</td>
<td>27</td>
<td>Gynecological laparoscopy</td>
<td>Felt pain that she could not localize as she felt “like an outsider.”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>36</td>
<td>33</td>
<td>Gynecological laparoscopy</td>
<td>Heard discussions and felt vaginal manipulation; pain in the abdomen, either intra- or postoperatively</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>23</td>
<td>25</td>
<td>Knee arthroscopy</td>
<td>On awakening, felt the intubation tube in her throat</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>29</td>
<td>16</td>
<td>Gynecological laparoscopy</td>
<td>Could not breathe on awakening</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>45</td>
<td>23</td>
<td>CABG</td>
<td>Felt the opening of her chest, but this was not painful. She also heard her doctor saying, “This won’t take long.” After this, she had no recall of operation.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>44</td>
<td>24</td>
<td>CABG</td>
<td>Felt a scraping sensation on his chest twice. This sensation persisted for only a few seconds, and the patient thought that, apparently, the operation had begun. He felt no pain, did not consider this sensation alarming.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>47</td>
<td>30</td>
<td>CABG</td>
<td>The patient underwent a second operation because of postoperative bleeding 6 hours after the primary operation. The patient recollects being unable to open his eyes, shortness of breath, and the utmost anxiety. Then remembers falling asleep again.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patients who could not be contacted</td>
<td>Male</td>
<td>54</td>
<td>28</td>
<td>CABG</td>
<td>Suffered from serious mental depression before the operation, and antidepressive medication was started a week before the operation. Recollects waking with much pain in his chest “like the chest was opened with a saw.” Observed people moving around him and heard women laughing. Felt also pain in his neck. Believes that he was aware of what was going on around him for 2 to 3 hours.</td>
<td></td>
</tr>
<tr>
<td>Patients who could not be interviewed due to medical condition</td>
<td>Male</td>
<td>49</td>
<td>20</td>
<td>CABG</td>
<td>Felt the opening of his sternum starting from the upper end. There was no pain. He also heard women voices but could not recall what was said. He did not perceive this as unpleasant and felt confident in his doctors throughout. He also dreamed of cartoons.</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>71</td>
<td>27</td>
<td>CABG</td>
<td>Recollects hearing a rattling noise, which he attributed to the sawing of his sternum. Recollects thinking that one should not hear this.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patients who refused the interview</td>
<td>Female</td>
<td>28</td>
<td>34</td>
<td>Lumbar disk</td>
<td>Heard voices and conversation about the positioning after induction, felt the endotracheal tube, tried to cough, difficult to breathe, felt helplessness, anxiety, no pain</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>36</td>
<td>20</td>
<td>Hysteroscopy</td>
<td>Heard voices, could not recall what was said. Saw nurses and doctors. Recognized one of the doctors and, after checking anesthesia records, identified him. No pain, no anxiety.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>53</td>
<td>30</td>
<td>Transposition of tendons in right leg</td>
<td>On awakening, felt the intubation tube in her throat</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CABG = Coronary artery bypass grafting.

Self-report questionnaires and structured psychiatric interviews among subjects with previous intraoperative awareness after a median of 17.2 years from general anesthesia. This may be because none of our 9 subjects with awareness reported their intraoperative awareness incident as a potentially traumatic event, possibly due to our long follow-up time, because psychological reactions to potentially traumatic events usually diminish during the first days and weeks, unless stress disorders or other psychiatric symptoms develop. Our result may also be due to our recruitment method. In addition, considering other psychiatric disorders or quality of life, the study group and control group did not seem to differ statistically or clinically. In further statistical analyses with items dichotomized as near to the median as possible, the Environment subscale of WHOQOL-BREF reached statistical significance. However, we regard this finding as clinically nonsignificant.

**Psychological Sequelae after Awareness with Recall**

There are marked variations in the reported incidence of postawareness PTSD and other psychological sequelae.
among studies. Described incidences of general psychological sequelae vary from 20% to 84% and those with a formal diagnosis of PTSD between 0% and 71%\(^\text{1,4,11,13-16,28-31}\). The differences between the incidences of PTSD may have been due to study design (e.g., prospective or retrospective and inclusion or lack of a control group), the size and composition (demographics and type of surgery) of the cohort, recruitment method, criteria for fulfilling the diagnosis of PTSD, and follow-up time or timing and mode of the interview. The incidence of psychological reactive symptoms after a potentially traumatic event is generally high in the first weeks and then decreases.\(^\text{17}\) The diagnosis of PTSD should be based on a structured interview with predefined criteria, and the interview should be conducted by an experienced professional familiar with the disorder.\(^\text{39}\)

Regarding other medical conditions, 12% of patients who experienced anaphylactic shock fulfilled the diagnostic criteria for full PTSD.\(^\text{32}\) Among general intensive care unit survivors, the median point prevalence of questionnaire-ascertained “clinically significant” PTSD symptoms was 22%.\(^\text{33}\)

Our results are in contrast to that of Osterman et al.\(^\text{14}\) who had a similarly long period (mean 17.9 vs our mean of 16.7 years) between the incident of awareness and the interview. Osterman et al.\(^\text{14}\) used 16 awareness cases and 10 controls matched only for age. In their study, 9 (56%) of the 16 awareness subjects met the PTSD diagnostic criteria. Their criteria were similar to ours since they used Clinician-Administered Posttraumatic Stress Disorder (PTSD) Scale, which is based on SCID, the latter being used in our cohort. However, the diagnostic interview of Osterman et al.\(^\text{14}\) was targeted to the most stressful aspect of the surgical period not solely to awareness. It is also of note that Osterman et al.\(^\text{14}\) recruited their subjects with advertisements in newspapers, fliers in hospitals, and print and television news stories, with 1 subject referred to the study by an anesthesiologist. Therefore, in their cohort, there was a potential bias for overrepresentation of those experiencing their awareness as more traumatic. They did not report the extent of psychosocial support offered to study subjects after their awareness experience. In addition, the time elapsed since surgery was not comparable between their groups, being significantly shorter in controls than in awareness cases (mean 1.4 vs 17.9 years).

As a secondary outcome of the prospective B-Aware trial, 7 of the 13 confirmed awareness patients were interviewed, and 5 (71%) of those interviewed fulfilled the criteria for PTSD compared with 12% of controls at the time of interview.\(^\text{11}\) Four (80%) of the 5 aware patients who developed PTSD reported pain in their description of the awareness episode. Two of the 9 subjects in the present study felt pain and were thereby stratified into class 3 with the Michigan Awareness Classification Instrument. In addition, 4 other patients were stratified into class 4. However, none of these 6 subjects fulfilled the criteria of PTSD at the time of interview. The median time of 5.3 years from the day of awareness in the Leslie et al.\(^\text{11}\) patients is considerably shorter than ours. Also the awareness patients in the Lenmarken et al.\(^\text{16}\) study were interviewed about 2 years after surgery, with 44% having severe late psychological sequelae. We cannot exclude that earlier than 17 years after awareness PTSD or other serious psychological sequelae had occurred in some of our patients, although lifetime DSM-IV axis I psychiatric disorders are part of the structured psychiatric SCID interview. However, whether or not this was the case, our results suggest that the experience of awareness was not sufficiently traumatic to be detected 17 years later as PTSD or other serious conditions compared with controls. This is in accordance with observations in nonsurgical patients after a long-term follow-up of their PTEs.\(^\text{34}\)

Recently, Kent et al.\(^\text{35}\) analyzed 56 patients’ self-reported persistent psychological sequelae due to intraoperative awareness during general anesthesia. These reports were drawn from the Anesthesia Awareness Registry and confirmed with a medical record review. Eighty-two percent of patients reported long-term serious symptoms. Forty-two percent reported being diagnosed with PTSD as a result of their experience, although this diagnosis was not independently confirmed from medical records. This kind of database might over-represent patients willing to report due to a more severe experience but may under-represent those having the most traumatic exposure, with these patents refusing the interview to avoid reliving traumatic memories.\(^\text{16}\) In any case, the experience of pain or the inability to communicate during paralysis, among others, could serve as factors of further research in relation to psychological outcomes after an awareness with recall experience.

Originally, the patients in our study were part of a group recognized as experiencing the complication of intraoperative awareness with recall. They were offered appropriate psychosocial support and services and received explanations for their memories and symptoms from anesthesiologists. All these factors might have helped them to integrate the awareness and recall experience as part of their personal history, diminishing later psychiatric morbidity related to this PTE.

**Limitations of the Study**

Our study sample comprised all patients scheduled for operations in 1 tertiary and 2 secondary level hospitals in southern Finland. Some subjects in our previous studies\(^\text{1,8-20}\) and 6 awareness with recall subjects in the present study were not interviewed, due to their medical condition (n = 2) or unwillingness to participate (n = 3), or because they could not be contacted (n = 1). We cannot exclude that some of these patients were unwilling to communicate because they have or earlier had psychiatric symptoms, because it has been described that subjects with psychiatric consequences after awareness with recall are not necessarily willing to receive care.\(^\text{36}\) However, although our study size was small, the original description of the memories from the time of general anesthesia did not seem be very different between those awareness patients interviewed and those unwilling to be interviewed as measured by the Michigan Awareness Classification Instrument. We were able to recruit only 9 case-control pairs instead of the 13 pairs suggested by power analysis. Therefore, our sample is clearly underpowered with respect to our hypothesis of a high prevalence of PTSD in patients who had experienced awareness and the prevalence of PTSD of 0% may have been due to chance. However, considering the zero prevalence in both groups, we believe that increasing the sample size would not have resulted in a different conclusion.
Implications for the Future Studies
While in the present long-term follow-up study no adverse psychological sequelae were found, some other studies have clearly shown that PTSD may follow after traumatic intraoperative awareness. We emphasize that it is of utmost importance to try to prevent intraoperative awareness, and when recognized, potentially traumatized individuals should be offered support according to evidence-based guidelines. In conclusion, our results indicate that intraoperative awareness with recall does not necessarily affect long-term psychosocial outcome in the form of psychiatric disorder or distress.

DISCLOSURES
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Attestation: Tanja Laukkala approved the final manuscript and attests to the integrity of the original data and the analysis reported in this manuscript.
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