Preoperative stress and anxiety in day-care patients and inpatients undergoing fast-track surgery

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Background. To investigate preoperative levels of stress and anxiety in day-care patients and inpatients undergoing surgical interventions.

Methods. Before induction of anaesthesia, the degree of stress and anxiety was assessed in 135 patients using stress and anxiety questionnaires, bio-feedback, physiological measures, and serum levels for stress variables. Questionnaire responses and physiological measures such as arterial pressure, heart rate, skin conductance, cortisol, and catecholamine levels were compared for day-care patients and inpatients.

Results. Significant preoperative anxiety was reported by 34 (45.3%) inpatients and 23 (38.3%) day-care patients. Personal responses in stress and anxiety questionnaires and mean values of arterial pressure and heart rate did not differ significantly in day-care patients when compared with inpatients. Correlation between deviations in plasma cortisol concentrations from normal diurnal distribution and anxiety scores and stress scores was also similar, and the relative increase in preoperative stress variables and measures observed in day-care patients and inpatients was also comparable. Bio-feedback measurements revealed significantly higher preoperative skin conductance ($P<0.001$) in day-care patients than in inpatients, indicating increased vegetative stress responses.

Conclusions. Preoperative anxiety and stress are common in surgical patients. Questionnaires and bio-feedback measurements may help to assess the degree of patients’ burdens. Surgeons should be aware of the personal anxiety of patients and consider patient preferences when deciding who should undergo fast-track surgery in day-care.


Keywords: anaesthesia, day-case; stress; surgery, day-case

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Stress response in humans is an important means of adapting to altered environmental conditions and a prerequisite for responding to potential threats.1 Haemodynamic stress responses such as increased heart rate and arterial pressure are triggered by endocrine regulatory mechanisms and the autonomic nervous system involving corticotropin-releasing hormone, adrenocorticotropic hormone, cortisol, epinephrine, norepinephrine, dopamine, prolactin, cytokines (interleukin-6), tumour necrosis factor-α, and acute-phase proteins (C-reactive protein, leptin), to mention only some.1 2 When an efferent sympathetic nervous burst reaches the skin, the palmar and plantar sweat glands secrete water and electrolytes and skin resistance decreases. This is shown as an increase in electric skin conductance in bio-feedback measurements.3 4

Emotional stress and anxiety in surgical patients, for instance, are reflected in perioperative tachycardia and hypertension after sympathetic nervous system stimulation.5 6
Opioids and benzodiazepines are used for premedication because of their inhibitory effects on the release of cortisol, but benzodiazepines may presumably even attenuate stress response.7

Preoperative anxiety and stress are common in patients awaiting surgical procedures.8 9 In particular, anxiety of postoperative pain, intraoperative awareness, waiting for operation, appearing foolish, and venous cannulation are common anxieties in the preoperative period.9 Fast-track surgery aims to expose patients to minimal strain, but, so far, little attention has been paid to the preoperative stress responses of day-care patients.8 9 The aim of our study was to measure preoperative levels of stress and anxiety in fast-track surgical patients and to determine whether patients differ from day-care patients regarding preoperative levels of anxiety and stress.

Methods

Study design

A prospective, clinical investigation was carried out in patients who consecutively underwent fast-track surgery in the day-care surgery department of Innsbruck University Hospital between July and October 2007.

Inclusion criteria were: age 18–80 yr, ASA score I–III, scheduled either for non-emergency trauma surgery (e.g. arthroscopy, osteotomy, neurolysis, carpal tunnel release, ...) in one theatre or plastic surgery interventions in the neighbouring theatre and presumptive duration of operation not exceeding 2 h. In order to limit the confounding effects of diurnal variation, all patients undergoing surgical interventions commencing during morning hours (8:00–12:00) were included in the study. Midazolam (Dormicum® Roche Pharmaceuticals, Vienna, Austria) prescribed by the premedicating anaesthetist and administered orally 30 min before surgery in doses of either 3.75 or 7.5 mg was the sole drug used for premedication. No additional non-pharmacological method, for example, music via head phones, various hypnosis, or relaxation techniques, was offered. Exclusion criteria were: emergency operation, reduced mental status of the patient, history of psychiatric disorder, chronic sedative medication, revision of previous operation, patients undergoing long-lasting treatment, rejection by patient, and failure to grant written and informed consent. Investigations were carried out in all patients when still in their beds. Warming with Bair Hugger blankets was not initiated until the patients were placed on the theatre table and covered with surgical drapes.

Factors known to influence the feeling of anxiety and preoperative stress such as friendly ambience, calm, and open attitude were kept comparable in all patients.

Procedures followed were approved by the University Ethics Committee. Written and informed consent was obtained from all patients. Participation was voluntary and based on the understanding that results would be published in medical journals.

Patient characteristics

Age, sex, weight, height, and patient’s routine medications, in particular administration of beta-blocking drugs, clonidine, calcium antagonists, and angiotensin-2 receptor inhibitors, were recorded from hospital records. Distance from the patient’s residence to Innsbruck University Hospital was determined using a web-based route planner. Patients were asked who made the decision for either day-care or inpatient status, and the date of the anaesthetist’s visit was recorded.

Psychometric testing

The Spielberger State-trait Anxiety Inventory (STAI) questionnaire for evaluation of state anxiety (20 items) and trait anxiety (20 items) using a four-point scale (1, not at all/never; 2, somewhat/sometimes; 3, moderately so/often; 4, very much so/almost always)10 was used. The Amsterdam Preoperative Anxiety and Information Scale (APAIS) questionnaire for the assessment of anxiety status when feeling all alone with personal worries before operation (six items) using a five-point Likert scale (1, never; 2, low; 3, moderate; 4, strong; 5, extreme)11 12 was used. A cut-off level >13 was regarded significant for preoperative anxiety.12

The Anaesthesia- and Surgery-dependent Preoperative Anxiety (ASPA) questionnaire was designed for evaluation of anxiety related to both anaesthetic and surgical procedure (eight items) using a five-point Likert scale (1, never; 2, low; 3, moderate; 4, strong; 5, extreme). ASPA is a local questionnaire, comparable with APAIS, not currently validated, but more specific in its questions (Appendix).

Fear was ascertained with a fear thermometer [100 mm visual analogue scale (VAS); yellow] similar to a VAS to evaluate the level of current fear on a scale from 0 mm (none) to 100 mm (panic).13 Similarly, a stress thermometer (100 mm VAS, red) was used to assess stress on a scale from 0 mm (none) to 100 mm (maximum).13

Psychometric testing was performed within 1–2 h after admission to the hospital in inpatients and within half an hour after the arrival to the hospital in day-care patients and was repeated within half an hour before induction of anaesthesia. All psychometric tests were performed right after each other in the sequence STAI trait, APAIS, ASPA, followed by VAS, monitoring, and bio-feedback on admission, and again in the sequence STAI state, VAS, monitoring, and bio-feedback immediately before transfer from the preoperative holding area to the theatre. Average duration of measurements per patient was 15–20 min on admission and 5–10 min before operation.
Preoperative stress and anxiety

Monitoring

Heart rate, non-invasive arterial pressure, and pulse oximetry were recorded from an anaesthesia monitor (Datex Ohmeda Cardiocap, WI, USA) before surgical intervention. The sensor for peripheral oxygenation was always placed on the participant’s left ring finger.

Bio-feedback

The Comesa iSense bio-feedback device (Comesa, Vienna, Austria) was always applied to the patient’s left ring finger. Skin conductance and temperature were recorded after 30 s each and recorded on a Siemens personal computer (Pentium IV, 1 GHz; Windows XP). Environmental temperature in the preoperative holding area was constantly kept at 23°C.

Plasma levels of neurohormones, catecholamines, and benzodiazepine

Morning hour blood specimens were obtained via a newly placed venous catheter (OPTIVA® i.v. catheter radiopaque, Johnson & Johnson, New Brunswick, NJ, USA) and kept in a red 2.7 ml Sarstedt Monovette EDTA K tube (SARSTEDT AG & Co., Nuremberg, Germany), before any drugs or i.v. fluids were administered through the catheter. Blood samples were immediately forwarded for laboratory investigation. Treatment was performed in a refrigerated centrifuge within 5 min of arrival. Three aliquots of the plasma were put in Eppendorf vials, deep-frozen, and stored at −22°C for later analysis.

Cortisol

was determined by competitive radioimmunoassay using a coated tube technology and commercial kit (Spectria® CORTISOL RIA; Orion Diagnostics, Espoo, Finland). Radioactivity was counted for 60 s with an automated gamma counter (Berthold LB2104 Multi-Crystal Counter, Bad Wildbad, Germany). Plasma cortisol levels were compared with standard cortisol values from a cortisol diurnal profile of healthy individuals. Differences between measured and standard cortisol plasma levels were recorded.

Catecholamines

plasma levels were determined using a commercial radioimmunoassay kit (TriCAT RIA; DRG Instruments GmbH, Marburg, Germany). Briefly, epinephrine, norepinephrine, and dopamine were extracted using a cis-diaryl-specific affinity gel, acylated to N-acyladrenaline, N-acetylnotadrenaline, and N-acyldopamine and then during the detection procedure were converted enzymatically to N-acetylmetanephrine, N-acetyl normetanephrine, and N-acyl-3-methoxytyramine.

Benzodiazepines

semi-quantitative determination of midazolam was performed using an ELISA (Benzodiazepine EIA-1495; DRG Instruments, Marburg, Germany). A standard curve using dilutions of 100, 75, 50, and 25 ng ml⁻¹ midazolam was obtained for the calculation of benzodiazepine plasma concentrations (Nycomed, Linz, Austria).

Definitions

Anxiety: an unpleasant emotional arousal in anticipation of threatening situations, demands, or dangers, not including anxiety as mental disorder or illness.

State anxiety: current emotion, dependent on the individual experience of a dreadful situation. It refers to a palpable reaction or process taking place at a given time and a certain level of intensity.

Trait anxiety: the baseline tendency to respond with anxiety related to the individual personality. It refers to individual differences in reactions.

Fast-track surgery: interdisciplinary, multimodal concept focusing on preoperative patient education, atraumatic, and minimal-invasive access to the operative field, avoidance of tubes and drains, optimized anaesthesia and analgesic therapy sparring high systemic doses of opioids, and with emphasis on postoperative patient mobilization.

Stress: response to a critical event and transactional encounter between a person and a situation. A stress response does not necessarily induce anxiety.

Statistical methods

Software used for analysis was SPSS 15.0 (SPSS Corp., Chicago, IL, USA). Assumed null hypothesis was: day-care patients do not differ from inpatients with regard to preoperative stress or anxiety. The sample size was calculated to detect a mean difference >1.5 in VAS with a statistical power exceeding 80% and an α-value of 0.05.

A minimum of 120 patients, 60 patients in day-care patients group and inpatients group, was regarded as sufficient for adequate power. Metric data were tested for normal distribution. Variables for both groups were compared with the Mann–Whitney U-test for ordinal variables. The changes within the groups were analysed with the Wilcoxon signed ranks test. Results were deemed significant at P<0.05.

Results

Patient characteristics

During the 4 month study period, 575 patients were undergoing elective fast-track surgery; 211 (37%) were day-care patients and 364 (63%) were inpatients. Of these, 135 patients met the inclusion criteria and were enrolled in our study. None refused to give written and informed consent. Data were incomplete in five patients [the procedure was cancelled (n=3); the investigator failed to contact the patient, when transferred to the surgical suite (n=1); and one patient did not want to complete the STAI (state) before operation]. Chronic administration of beta-blockers, clonidine, calcium antagonists, and angiotensin-2 receptor inhibitors did not differ between the groups.
Inpatients appeared to be slightly older, with some more females and significantly higher BMI ($P=0.046$) and ASA score II rather than I ($P=0.043$) (Table 1). The decision on whether the patient was admitted to day-care or inpatient setting was made by the surgeon in 75 (100%) inpatients and in 50 (83.3%) day-care patients, whereas it was based on personal decision in 10 (16.7%) day-care patients.

### Assessment of stress and anxiety

No significant differences in the assessment of stress or anxiety levels were observed when using the STAI, except in three items. Scores were significantly higher for inpatients in state Item 8: ‘I feel rested’ ($P=0.003$), Item 15: ‘I am relaxed’ ($P=0.008$), and Item 19: ‘I feel happy’ ($P=0.005$). Responses did not differ significantly between the groups when evaluating according to the APAIS, the ASPA, or the VAS (Table 2).

When applying a cut-off level of APAIS $>13$, preoperative anxiety was reported by 34 (45.3%) inpatients and 23 (38.3%) day-care patients. Twenty-two patients (10 inpatients and 12 day-care patients) indicated VAS=0 in all four assessments of stress and anxiety.

In day-care patients, correlations between results obtained with the fear thermometer and with ASPA Item 1 ($P<0.001$) were significantly stronger in day-care patients ($P=0.023$).

### Physiological variables, bio-feedback, and endocrine responses

Heart rate was significantly higher in inpatients on admission ($P=0.013$), but no difference was observed between inpatients and day-care patients before operation. Endocrine responses and plasma levels of midazolam in day-care patients did not differ significantly from those in inpatients. Preoperative skin conductance was significantly higher in day-care patients ($P<0.001$), indicating higher vegetative stress response (Table 3). Correlations between skin conductance and STAI state Item 12 (‘I feel nervous’; $P=0.003$) and state Item 15 (‘I am relaxed’; $P=0.036$) were significantly greater in day-care patients.

### Discussion

The increasing need to cut total costs to health insurance carriers has led to a preference for day-care surgery for elective procedures in the past few years. It is generally appreciated by patients that they can sleep at home and come to the clinic only a few hours before the procedure takes place. Other advantages like fewer hospital-related infections might also be positive arguments for ambulatory surgery. However, stress in day-care patients may result from time pressure experienced before arriving at the hospital. In day-care patients, correlations between results obtained with the fear thermometer and with ASPA Item 1 ($P<0.001$) were significantly stronger in day-care patients ($P=0.023$).
the hospital (e.g. fear of oversleeping and missing the hospital appointment, the possibility of a traffic jam in the morning rush hour, and the stress of recruiting someone for the trip to the hospital and back) and also limited time during admission, preoperative activities, and during hospital transport. Tachycardia was observed to be more pronounced in day-care patients during induction of anaesthesia. In contrast to this high-stress scenario, the preparations inpatients undergo before surgery may have a more calming effect.

Interestingly, when compared with our ambulatory collective, our inpatient group showed a significantly higher BMI and significantly higher ASA scores. As allocation to either day-care or inpatient treatment was generally made by the surgeon rather than the patient, this might be due to the surgeon’s clinical intuition and the knowledge that, for example, obesity is a major contributing factor to perioperative complication rates. General patient health, BMI, and age seem to be more important criteria for the decision to admit a patient on an inpatient basis than are distance to hospital, procedure, or patient’s preference. Some patients argued that they were not informed of the possibility to have ambulatory surgery and accordingly were not asked for their preference.

Our study shows that day-care patients experience significantly higher levels of preoperative stress and anxiety than do inpatients, as indicated by the significantly increased skin conductance ($P<0.001$). Surprisingly, with regard to perioperative stress, day-care surgery may not only offer patients advantages, but may also create adverse effects that raise questions about the ubiquitous application of shortened hospitalization.

Amazingly, the patients’ own assessment of their mental stress and anxiety in the questionnaires and by means of VAS did not correspond with measurements of vegetative stress obtained with bio-feedback. Travel stress was comparable in patients in both groups as they were contacted immediately after arrival to hospital, no significant differences were detectable immediately before operation. The STAI and the APAIS are well-established questionnaires for evaluating preoperative anxiety and stress. It can be presumed that questionnaires are an inappropriate survey means in the preoperative setting, especially STAI is time-consuming and of limited practicability in assessing preoperative anxiety. VAS is quick to use in patients who acknowledge their own anxiety, but the numerous patients quoting zero in both VAS assessments did not permit discrimination between day-care and inpatients either. The exceptional preoperative situation might have influenced the patients’ willingness to comply with instructions and may have favoured denial of stress and fear. On the other hand, not even one patient refused to participate in the study. Most patients appreciated the interest in their feelings before operation.

Midazolam is routinely used as an anxiolytic drug for premedication. In ~70% of our patients, levels of more than 25 ng ml$^{-1}$ midazolam were detected. Some patients with low levels of midazolam might have taken the drug immediately before being transferred to the theatre. Serum levels of cortisol, epinephrine, norepinephrine, and dopamine showed no significant differences in the two groups. Midazolam might have attenuated the endocrine response in some of them.

In our study, we detected lack of relation between findings in bio-feedback and patients’ perception. In addition, $VAS=0$ in 22 patients in all four assessments might indicate that some patients were reluctant to indicate their current level of anxiety and fear before operation. We assume that some patients did not verbally express their fears when asked about them immediately before surgery.

Although anxiety prevailing in outpatient surgery subjects was verified by demonstrating high skin conductivity, bio-feedback is a new methodology in the assessment of stress and it may need further validation regarding its practicability in the perioperative setting. Gjerstad and colleagues investigated skin conductance as a measure of increased stress during painful intervention. The authors observed better correlations between skin conductance fluctuations and the modified COMFORT sedation score compared with heart rate and arterial pressure. Storm reported skin conductance sensitivity of about 90% and specificity up to 74%. Increased skin conductance after changes in emotions was regarded a consequence of induced acetylcholine action on muscarine receptors causing increased secretion of sweat. This implies that bio-feedback may differ in patients with dysautonomic disorders, for example, diabetes, due to modified skin conductance reactivity. Results of animal research confirm that peripheral nervous system function and electrophysiological activity parameters are affected by hyperglycaemia. Furthermore, diabetes is associated with pathophysiological changes of the skin, including a reduced hydration state of the stratum corneum and decreased sebaceous gland activity. However, in our study, the number of patients with diabetes was comparable in day-care patients and inpatients.

Limitations of our study arise from the fact that restrictions in organizational routine made it not feasible to conduct the study in a blinded manner. Nevertheless, in order to limit bias, only one investigator was assigned to each group for collection of patient information. Cortisol and catecholamines were measured as neuroendocrine stress variables in plasma and interpreted according to diurnal changes in the normal distribution. There were no abnormal findings in these single measurements, demonstrating hormonal peaks as potential causes of stress reactions. However, such increases in plasma hormones may have been missed, because sequential blood samples were not drawn in order to limit the invasiveness of the study. Detection of cortisol, epinephrine, norepinephrine, and dopamine from 24 h urine collection was regarded as
 unacceptable for patients. Our study was not designed to continuously measure skin conductance. In addition, post-interventional behavioural and physiological outcome was also not compared, and the impact of individual factors, for example, age, gender or surgeon/anaesthesiologist–patient relationship, was not evaluated. In addition, we did not evaluate the dropout rate of patients missing their operation for whatever reason. No statement can be made on day-care patients treated in other surgical departments, for example, gynaecology, urology, ENT, during the study period. Follow-up studies with a larger number of patients are needed to verify the significance of this type of pre-operative management on an outpatient basis.

Preoperative anxiety and stress are common in surgical patients. Questionnaires and bio-feedback measurements may help to assess the degree of patients’ burdens. We recommend that the stress and anxiety profile of patients suitable for day-care needs to be assessed and surgeons should perform a short screening procedure to test pre-operative anxiety using either APAIS or ASPA questionnaires. Patients in whom higher levels of preoperative anxiety are anticipated should preferably not be assigned to day-care facilities.

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Appendix
Anaesthesia- and Surgery-dependent Preoperative Anxiety
Please select the answer that at the moment best describes your fear of certain conditions:

1. none; 2. slight; 3. moderate; 4. strong; 5. extreme.

How pronounced is your fear of...

1) I am worried about the anaesthetic
2) The anaesthetic is on my mind actually
3) I would like to know as much as possible about the anaesthetic
4) I am worried about the procedure
5) The procedure is on my mind actually
6) I would like to know as much as possible about the procedure

The Amsterdam Preoperative Anxiety and Information Scale
Please select the answer that at the moment best describes your fear of certain conditions:

1, none; 2, slight; 3, moderate; 4, strong; 5, extreme.

1) I am worried about the anaesthetic
2) The anaesthetic is on my mind actually
3) I would like to know as much as possible about the anaesthetic
4) I am worried about the procedure
5) The procedure is on my mind actually
6) I would like to know as much as possible about the procedure

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