ORIGINAL ARTICLE

# Anxiety is associated with unfulfilled information needs and pain at the informed consent consultation of spine surgery patients: a longitudinal study

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## Abstract

**Purpose** Meeting the information needs of patients adequately is of high importance in informed consent consultations in surgery. However, information needs often remain unmet in the informed consent consultation. The aim of this study was to assess anxiety and pain in relation to the patients' information needs fulfillment perioperatively.

**Methods** We applied a question prompt list (QPL) for patients undergoing spine surgery (SN-QPL) before ($t1$) and a question answering list (SN-QAL) after ($t2$) the informed consent consultation. The patients additionally completed the "State-Trait Anxiety Operation Inventory" (STOA, cognitive and affective scale) at $t1$, as well as a pain numerical rating scale (NRS) at $t2$ and postoperative ($t3$). We analyzed (1) the association between anxiety, information needs and pain and (2) anxiety and pain scores regarding information needs fulfillment after the consent consultation.

**Results** A total of $n = 118$ patients was included. Affective and cognitive state anxiety was only reduced postoperatively (affective $p < .001$, cognitive $p < .05$). The higher trait anxiety was, the more patients longed for information at $t1$–$t3$ ($t1$: $r = .58/r = .74$, each $p < .001$), ($t2$: $r = .38/r = .49$, each $p < .001$) and ($t3$: $r = .29$, $p < .01/r = 34$, $p < .001$). Higher grades of trait anxiety resulted in lower information needs fulfilment. Higher state anxiety levels were associated with higher pain levels. Information needs more often remained unfulfilled in high trait and state anxiety patients.

**Conclusion** Patients' anxiety was associated with (un)fulfilled information needs. Meeting information needs should be optimized in the process of surgeon–patient communication. Adapting the information to the patients' anxiety levels seem to be an effective way to reduce anxiety.

**Keywords** Spine surgery · State and trait anxiety · Information needs · Pain · Question prompt list

## Introduction

Anxiety is a common reaction of patients facing surgical procedures of the spine. It is essential for surgeons to gain a better understanding of how to identify and reduce anxiety in their patients. For most patients, appropriate preoperative information about the surgical procedure, preoperative and postoperative experiences, pain relief, use of medication and length of hospital stay might be enough to calm them and reduce their anxiety [1]. Education is most effective if it is patient-centered, patient-specific and individual addressing the patients' need for information and emotional needs [2]. For patients with high levels of surgical anxiety, however, the standard preoperative patient education does not seem sufficient, and they are in need of specialized anxiety reducing patient education [3].

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In clinical practice, patients are confronted with communication barriers; for example, they forget to ask questions or are not sure whether it is legitimate to ask certain questions in a consultation [4]. Unfortunately, surgeon–patient communication can not only lead to the patients' dissatisfaction, misunderstandings and litigations [5] but may also reinforce pre- and postoperative anxiety [6]. A question prompt list (QPL) is a structured list of questions developed to enhance the information gathering process in medical communication processes [7]. Using a QPL may lead to an active participation in physician–patient interaction due to more in-depth and more extensive questions being asked and answered [8] and reduce patients' fear by revealing their information needs [9]. We recently developed a QPL for patients undergoing spine surgery [10]. Aim of our study was to assess the surgery-related anxiety as well as the pain level [11] in spine surgery patients in the context of the informed consent consultation and the fulfillment of patients' information needs.

## Methods

### Patients and data collection procedure

Patients were consecutively recruited for the study in the period June 2015 until June 2016. Inclusion criteria were: (1) planned spine surgery (excluding tumor resections and complex stabilizations), (2) minimum age 18, (3) legal capacity, (4) patients are able to understand and respond to questionnaires in German and (5) informed consent given by the patient.

Patients were assessed before ($t1$) and after ($t2$) informed consent consultation and at the end of the hospital stay ($t3$). They completed our spinal neurosurgery-QPL (SN-QPL) before the informed consent consultation and the "spinal neurosurgery question answer list" (SN-QAL) after the consultation in order to evaluate the fulfillment of information needs. Further, they filled out a trait and state ($t1$, $t2$, $t3$) anxiety inventory and numeric pain scales ($t1$, $t3$). The study was undertaken in concordance with national law, institutional ethical standards and the Helsinki Declaration, and the local ethics commission approved the study [No.: 837.097.15 (9865)].

### Measurements

#### SN-QPL and SN-QAL

Information needs at $t1$ were assessed with a question prompt list developed especially for the situation of the informed consent consultation for patients scheduled for spine surgery [10]. The Spine Neuro Question Prompt List (SN-QPL) consists of 27 items regarding spine surgery with four reliable subscales:

(1) SN-QPL-C: "complications and possible postoperative deficits" (8 items, Cronbach's $\alpha = 0.88$).
(2) SN-QPL-P: "prognosis and follow-up" (8 items, Cronbach's $\alpha = 0.86$).
(3) SN-QPL-I: "preoperative inpatient stay and organizational issues" (5 items, Cronbach's $\alpha = 0.75$).
(4) SN-QPL-S: "safety of the surgical procedure" (6 items, Cronbach's $\alpha = 0.84$).

The patients indicated the importance of the respective item with regard to their information needs on a 5-point Likert scale (1 = "not important" to 5 = "very important").

At $t2$, the patients completed the SN-QAL with items analogue to those of the SN-QPL. The questionnaire is rephrased with a fulfillment rating assessing whether the item was discussed during the informed consent consultation. For example, the information needs item 21 of the SN-QPL on $t_1$ applied before the consultation "It is important for me that the surgeon discusses during the informed consent. If my problem can come back despite successful surgery" (1 = *not at all, 5 = very*) has its SN-QAL need fulfilment counterpart "The surgeon discusses during the informed consent. If my problem can come back despite successful surgery" on $t_2$ after the consultation (1 = was not the case, 5 = was fully the case).

In order to evaluate information fulfillment, we calculated the difference between the QAL and QPL scores for each item and summed up the scores. According to Schuck [12], a gap of 0.5 between scales is substantial, representing under- or over-information. We defined information needs as "unfulfilled" (under-information) if the mean differences between meeting the information needs (all for SN-QAL scales on $t2$) after the consultation and information needs before the consultation ($t1$) [(mean SN-QAL) − (mean SN-QPL)] were lower or equal to − 0.5. If this score was above 0.5, it was defined as "over-information"; in this case, the patients received information above their needs level.

#### The state–trait operation anxiety

Using a common anxiety test like the STAI does not seem to be a sufficient instrument to measure anxiety in exceptionally distressing situation such as a surgery; for example, the State–Trait Anxiety Inventory used worldwide measures situations that threaten self-worth and is (thus) not suitable for the situation of surgical anxiety in patients. [13]. We therefore chose the inventory "State-Trait Operation Anxiety" (STOA) [14], which assesses (/evaluates) surgery-related anxiety separately as a comparatively stable personality trait (1 = hardly ever, 4 = almost always) and two kinds

of state anxiety: affective and cognitive (each 1 = not at all, 4 = very much). The differentiation between these two states is central, as sensitive indicators of state anxiety change in the perioperative period. Internal consistencies of all scales were highly satisfactory (Cronbach's $\alpha \geq 0.85$). We applied the trait scale at $t1$ to assess anxiety disposition and the two state scales to measure changes of the transient anxiety reactions at $t1$, before the consultation, at $t2$, directly after the consultation, and at $t3$, at the end of the hospital stay.

### Pain

We used an established pain numeric rating scale (NRS-11 [15]) with the endpoints defining extreme limits (0 = "no pain" and 10 = "the worst pain possible").

### Outcomes and statistics

The primary outcome was to analyze the association between fulfillment of information needs and the patients' state and trait anxiety.

Further, we examined the following secondary outcomes exploratively:

- association between patients' trait anxiety and state anxiety
- association between trait anxiety and state anxiety (affective and cognitive) and information needs at $t1$,
- association between trait anxiety and state anxiety (affective and cognitive) and pain,

The state anxiety level in the course of the hospital stay was analyzed by using the one-way analysis variance (ANOVA) for repeated measures ($t1$, $t2$, $t3$), followed by the Tukey's test (Bonferroni correction). In order to investigate the association between trait anxiety and state anxiety, the patients' means were split in high and low trait anxiety (median) and analyzed by the Student's t test. The associations between anxiety, pain levels and the level of information as though as diagnosis and surgery experience were likewise evaluated by the Student's $t$ test. Correlation analyses were conducted using Pearson's correlation test (low $r < 0.50$, moderate $0.50 \leq r \leq 0.75$, high $r > 0.75$). Level of significance was set to 5%.

## Results

### Sample

A total of $n = 118$ patients participated in the study. Most of the patients ($n = 84\%$) completed all the questionnaires ($t1$, $t2$, $t3$). More than half of the study participants were female (54%), and mean age was 64 (range 27-91). The main reasons for the surgery were spinal stenosis (45%) or disk herniation (38%). Only $n = 9$ (8%) had no previous inpatient treatment in history, and $n = 31$ had a spine surgery before ($n = 31$, 26%). A total of 60% ($n = 71$) of patients had physiotherapy ($n = 71$, 60%) and pain medication ($n = 66$, 56%). Details are provided in Table 1.

### Anxiety pre-($t1$, $t2$) and postoperative ($t3$)

Patients with high trait anxiety scored higher on the affective (a) and cognitive (c) state anxiety scales at all three measurement points than those with low trait anxiety ($t1a$ $p < 0.001$, $t1c$ $p < 0.001$, $t2a$ $p < 0.01$, $t2c$ $p < 0.001$, $t3a$ $p < 0.05$, $t3c$ $p < 0.01$). As provided in Table 2, affective anxiety level was only lower at the end of the hospital stay ($p < 0.001$) for both the high and the low trait anxiety patients. The cognitive anxiety level score increased in the low trait anxiety patients from pre- to post-consultation ($p < 0.001$) but remained the same in high trait anxiety patients. Affective and cognitive anxiety decreased after the informed consent consultation ($t2$) and the end of the hospital stay ($t3$) in the high ($t2a$–$t3a$ $p < 0.05$, $t2c$–$t3c$ $p < 0.01$) and low trait anxiety groups ($t2a$–$t3a$ $p < 0.05$, $t2c$–$t3c$ $p < 0.05$). Trait and state anxiety scores were significantly correlated at all measuring times, highest at $t1$ (affective $r = 0.58$ $p < 0.001$, cognitive $r = 0.74$, $p < 0.001$) and lowest at $t3$ (affective $r = 0.29$ $p < 0.01$, cognitive $r = 0.43$, $p < 0.01$). Patients' trait anxiety and state anxiety (pre- and postoperatively) did not differ dependent on the diagnosis (spinal stenosis vs. disk herniation) nor the instance if they had undergoing a revision surgery or had no surgery experience before (n. s.).

### Anxiety and information needs

Higher information needs in all subscales of SN-QPL were significantly associated with higher trait anxiety (see Table 3): The highest correlation was found for the interrelation between trait anxiety (STOA-T) and prognosis (SN-QPL-P: $r = 0.52$, $p < 0.001$) and organizational-related information needs (SN-QPL-I: $r = 0.51$, $p < 0.001$), and lower association coefficients were seen for complications (SN-QPL-C: $r = 0.39$, $p < 0.001$) and surgical procedure information needs (SN-QPL-S: $r = 0.39$, $p < 0.001$).

Furthermore, higher affective and cognitive state anxiety scores on $t1$ were associated with the higher information needs of the SN-QPL scales (except SN-QPL -S). The coefficients were the highest between cognitive state anxiety (STOA-S-C) and prognosis-related information needs (SN-QPL -P $r = 43$, $P < 0.001$) and organizational information needs (SN-QPL-I: $r = 0.40$, $p < 0.001$) and lowest between cognitive state anxiety and surgical procedure information needs (STOA-S-C/SN-QPL-S: $r = 0.24$, $p < 0.01$).

**Table 1** Sociodemographic and clinical data

|  | N=118* | % |
|---|---|---|
| **Age** M = 63,6 (27–91) | 117 |  |
| Gender |  |  |
| Female | 64 | 54.2 |
| Male | 53 | 44.9 |
| **Marital status** |  |  |
| Married | 73 | 61.8 |
| Single/living alone | 6 | 5.1 |
| Widowed | 16 | 13.6 |
| Divorced | 12 | 10.2 |
| In partnership | 9 | 7.6 |
| Living apart | 2 | 1.7 |
| **Graduation** |  |  |
| No | 3 | 2.5 |
| Primary school | 61 | 51.7 |
| Secondary/junior high school | 27 | 22.9 |
| University entrance diploma | 24 | 20.3 |
| Other | 2 | 1.7 |
| **Additional diagnoses** |  |  |
| 0 | 22 | 18.6 |
| 1–3 | 74 | 62.7 |
| 4–6 | 16 | 13.6 |
| 7–9 | 5 | 4.2 |
| **Inpatient treatment in history** |  |  |
| No | 9 | 8.0 |
| Yes, once | 19 | 69.5 |
| Yes, more than one | 89 | 23.7 |
| **Prior treatment for spinal diagnosis** |  |  |
| No treatment | 28 | 23.9 |
| Physiotherapy | 71 | 60.2 |
| Painkillers | 66 | 55.9 |
| Surgery | 31 | 26.3 |
| Bed rest | 11 | 9.3 |
| **Medication** |  |  |
| Psychotropic drugs | 13 | 11.0 |
| NSAIDs (as needed) | 39 | 33.1 |
| Opioids | 24 | 20.3 |
| Cortisone | 5 | 4.2 |
| **Diagnosis** |  |  |
| Disk herniation | 45 | 38.0 |
| Spinal stenosis | 53 | 45.0 |
| Others | 20 | 17.0 |

*Frequency deviations due to missing data

## Anxiety and pain

The higher cognitive state anxiety was at $t1$, and then, the higher NRS pain score was at $t3$ ($r = 0.43$, $p < 0.001$). The same was true for affective anxiety, however, to a lower degree ($r = 0.32$, $p < 0.01$). Interestingly, there was no correlation between pain at $t1$ and the state anxiety scores. We found a weak association between trait anxiety and pain at $t1$ ($r = 0.21$, $p < 0.05$) but not with pain at $t3$.

## Fulfillment of information needs and anxiety level

The patients with unfulfilled information needs had higher trait anxiety scores regarding all four subscales of the SN-QPL (see Table 4). The highest trait anxiety difference between individuals with unfulfilled ($u$) and fulfilled information needs ($f$) was found in the dimension SN-QPL -I "preoperative inpatient stay and organizational issues" ($u$: $M = 2.44$, SD 0.73, $f$: $M = 2.01$, SD 0.68; $p < 0.01$). Regarding affective and cognitive state anxiety at $t1$, the patients with unfulfilled information needs scored higher in the dimension SN-QPL-C ("complications and possible postoperative deficits"; each $p < 0.05$) and SN-QPL -P ("prognosis and follow up"; a: $p < 0.05$, c: $p < 0.01$,) than those whose information needs had been met after the informed consent consultation. Except for SN-QPL -C at $t2$, similar comparable results were found in the state anxiety scores (a: SN-QPL -P $p < 0.01$, c: SN-QPL -C $p < 0.01$, SN-QPL -P $p < 0.01$). At $t3$, cognitive state anxiety, but not affective state anxiety, was higher in patients with unmet information needs in the subscale SN-QPL -I ("preoperative inpatient stay and organizational issues"; $p < 0.05$).

## Fulfillment of information needs and pain level

The pain level at $t1$ and $t3$ did not differ depending on information needs of the study participants (see Table 4). Nearly, one-third (32%) of our sample reported no pain reduction, and 14% indicated increased pain at the end of the hospital stay.

## Discussion

We introduced a specific question prompt list to patients with scheduled spine surgery and found associations between information fulfillment and cognitive and affective state anxiety depending on pre- and postoperative trait anxiety. Further, we were able to show an association of anxiety and pain level with surgeons meeting the patients' information needs in the informed consent consultation.

In concordance with other studies, patients with higher trait anxiety were burdened more affective and cognitive state anxiety during the hospital stay than lower trait anxiety patients [16, 17], clearly identifying these patients as an emotionally at-risk group and as in need for specialized patient education. As expected, positive correlations between trait and state anxiety scores were found, which were highest before the consultations, reduced after the

**Table 2** Affective and cognitive state anxiety (STOA-S) correlations to trait anxiety (STOA-T) and dependent on trait anxiety level (ANOVA F-value, $t$ test) at $t1$, $t2$, $t3$

| $n$ | STOA-T | | STOA-T low ($t1$)* | | STOA-T high ($t1$) | | |
|---|---|---|---|---|---|---|---|
| | $r$ | $p$ | M SD $n=41$ | $p_t$ | M SD $n=43$ | $p_t$ | $p_{ac}$ |
| *Affective* | | | | | | | |
| F | | | 8.66 | .001 | 12.39 | <.001 | |
| $t1$ $n=119$ | .58 | <.001 | 1.80.54 | | 2.50.89 | | <.001 |
| | | | | n. s | | n. s | |
| $t2$ $n=102$ | .38 | <.001 | 1.96.73 | | 2.38.94 | | <.01 |
| | | | | .001 | | <.001 | |
| $t3$ $n=86$ | .29 | <.01 | 1.44.50 | | 1.75.73 | | <.05 |
| *Cognitive* | | | | | | | |
| F | | | 3.86 | .03 | 9.45 | <.001 | |
| $t1$ $n=119$ | .74 | <.001 | 1.92.63 | | 2.89.80 | | <.001 |
| | | | | <.05 | | n. s | |
| $t2$ $n=102$ | .49 | <.001 | 2.11.74 | | 2.72.85 | | <.001 |
| | | | | <.05 | | <.01 | |
| $t3$ $n=86$ | .34 | <.01 | 1.81.70 | | 2.25.85 | | <.01 |

*High and low separated using median split; $p_t$ between time, $p_{ac}$ between high and low anxiety; STOA: Inventory "State-Trait Operation Anxiety" ([14])

**Table 3** Correlations of trait and state anxiety to information needs and pain before and after informed consent and postoperatively ($t1$, $t2$, $t3$)

| | SN-QPL-C | SN-QPL-P | SN-QPL-I | SN-QPL-S | T1 pain NRS | T3 pain NRS |
|---|---|---|---|---|---|---|
| STOA-T | .39 <.001 | .52 <.001 | .51 <.001 | .37 <.001 | .21 <.05 | .10 n. s |
| STOA-S-A ($t1$)[1] | .31 <.001 | .39 <.001 | .39 <.001 | .17 n. s | .01 n. s | .32 <.01 |
| STOA-S-C ($t1$)[1] | .37 <.001 | .43 <.001 | .40 <.001 | .24 <.01 | .15 n. s | .43 <.001 |

[1]on $t1$; STOA: Inventory "State-Trait Operation Anxiety" ([14]), NRS: rating scale for clinical pain measurement ([15]); SN-QPL: Spine Neuro Question Prompt List ([10])

consultation and lowest at the end of the hospital stay. This might indicate an anxiety modulation effect of the informed consent consultation or other communication during the hospital stay. As hypothesized, the higher trait and state anxiety levels were, the more information patients required. The relation was highest regarding the prognosis after surgery and inpatient stay organizational issues. This may indicate the relevance of seeking information as a coping mechanism and thus underlines the importance of need-fulfilling surgeon–patient communication in order to enhance coping efforts. Aust et al. [18] found that monitoring-like patients rated educational conversation with the physician highest but blunting-like patients considered calming conversation more helpful than educational conversation. The individual contact between physician and patient seems to be the best way for reducing patients' anxiety and may be comparable to anxiolytic drugs [19]. In our study, after the informed consent consultation, affective and cognitive state anxiety was not reduced. Nevertheless, an enhancement of cognitive anxiety was observed, but only in the low state anxiety

group. Perhaps the surgeons were less reluctant to disclose anxiety-provoking information to low state anxiety patients as they did not give any indication that prompted the surgeon to be exceptionally cautious with upsetting information. Previous studies already found surgeon–patient communication to be an anxiety-provoking factor [20, 21].

The patients with unfulfilled information need after the informed consent consultation had stronger trait anxiety affecting all four information needs fulfillment score categories relating to complications, prognosis, inpatient stay and surgical safety collected after the consultation. Related to the cognitive and affective state anxiety at $t1$ and $t2$, the difference could be seen for the complication (except $t2$) and prognosis-related information needs but not for inpatient stay and surgical safety topics. An explanation might be that the high anxiety group gave the impression to the surgeon that they were unable to handle fear-provoking information. On the other hand, it may be possible that these patients were too nervous to ask the surgeon for potentially threatening complication and prognosis information, it being easier

**Table 4** Anxiety and pain level in relation to fulfillment of information needs (scale means and SD)

| | Information needs fulfilment status | | | | | | | | | | | |
| | Complications | | | Prognosis | | | Inpatient stay | | | Safety | | |
| | u | f | P | u | f | p | u | f | p | u | f | p |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *STOA-trait* | | | | | | | | | | | | |
| *t*1 | 2.33 .74 | 1.98 .67 | .05 | 2.36.71 | 1.90 .64 | .05 | 2.44 .73 | 2.01 .68 | .01 | 2.34 .71 | 1.94 .59 | .05 |
| *n* | 65 | 24 | | 71 | 14 | | 50 | 38 | | 61 | 21 | |
| *STOA-State affective* | | | | | | | | | | | | |
| STOA-S-a *t*1 | 2.26 .83 | 1.88 .69 | .05 | 2.23 .81 | 1.75 .58 | .05 | 2.22 .82 | 2.10 .81 | n. s. | 2.16 .83 | 2.08 .82 | n. s. |
| *n* | 65 | 24 | | 71 | 14 | | 50 | 38 | | 61 | 21 | |
| STOA-S-a *t*2 | 2.21 .93 | 1.87 .60 | n. s. | 2.23 .89 | 1.79 .45 | .01 | 2.14 .90 | 2.13 .85 | n. s. | 2.11 .85 | 2.25 .90 | n. s. |
| *n* | 65 | 24 | | 71 | 14 | | 50 | 38 | | 61 | 21 | |
| STOA-S-a *t*3 | 1.59 .71 | 1.53 .45 | n. s | 1.64 .71 | 1.32 .33 | n. s | 1.65 .75 | 1.49 .52 | n. s | 1.60 .67 | 1.44 .44 | n. s |
| *n* | 56 | 20 | | 62 | 11 | | 42 | 35 | | 49 | 19 | |
| *STOA-State Cognitive* | | | | | | | | | | | | |
| STOA-S-c *t*1 | 2.52 .86 | 1.93 .63 | .01 | 2.50 .87 | 1.94 .61 | .05 | 2.54 .89 | 2.23 .79 | n. s | 2.41 .85 | 2.26 .77 | n. s |
| *n* | 65 | 24 | | 71 | 14 | | 50 | 38 | | 61 | 21 | |
| STOA-S-c *t*2 | 2.51 .87 | 1.93 .63 | .01 | 1.65 .71 | 1.32 .33 | .01 | 2.45 .90 | 2.27 .81 | n. s. | 2.35 .89 | 2.29 .89 | n. s. |
| *n* | 65 | 24 | | 62 | 11 | | 50 | 38 | | 61 | 21 | |
| STOA-S-c *t*3 | 2.06 .83 | 1.86 .67 | n. s. | 2.05 .83 | 1.74 .50 | n. s. | 2.14 .93 | 1.79 .56 | .05 | 2.07 .87 | 1.84 .63 | n. s. |
| *n* | 56 | 20 | | 62 | 11 | | 42 | 35 | | 49 | 19 | |
| *Pain* | | | | | | | | | | | | |
| NRS t*1* | 6,21 2.87 | 5.33 2.73 | n. s. | 5.96 2.86 | 5.71 2.73 | n. s. | 6.21 2.95 | 5.17 2.88 | n. s. | 5.93 2.85 | 5.05 2.86 | n. s. |
| *n* | 61 | 24 | | 67 | 14 | | 48 | 36 | | 59 | 20 | |
| NRS *t*3 | 3.87 2.30 | 3.83 2.28 | n. s. | 3.88 2.11 | 3.80 2.49 | n. s. | 3.87 2.34 | 3.61 2.09 | n. s. | 3.85 2.91 | 3.78 2.39 | n. s. |
| *n* | 53 | 18 | | 58 | 10 | | 39 | 33 | | 46 | 18 | |

*u* unfulfilled information need (SN-QPL mean more than 0.5 higher than SN-QAL mean), *f* fulfilled information need (SN-QPL mean more than 0.5 lower than SN-QAL score), *STOA* Inventory "State-Trait Operation Anxiety" ([14]), NRS: rating scale for clinical pain measurement ([15])

for them to ask about organizational and safety-related issues. In comparison, Montgomery and colleagues [22] found a high level of unfulfilled information needs in anxious and depressed cancer patients in the consent procedure. Precarious questions from these groups of patients remain partially unanswered because the surgeons failed to identify the information needs, an effect well known in the literature [23]. Regardless of the fact that most of our patients were undergoing revisions, our results let us assume that many of them still have unanswered questions or the consent situation raised new topics. Thus, anxious patients seem to be a risk group for having information gaps.

At the end of the hospital stay, affective state anxiety was completely independent of the postoperative information need fulfillment status, and only patients with unmet organizational information needs showed higher cognitive state anxiety levels. This may be due to the fact that the patients had overcome the fear provoked by surgery with the uncertainty about leaving the hospital now coming to the fore. According to Davies et al. [24], discharge was found to cause high levels of anxiety in spine surgery patients if they did not know what to expect.

In this study, we were unable to verify that fulfilling information needs depends on preoperative pain levels or leads to higher postoperative pain levels, perhaps due to the fact that pain levels were highly variable. Consistent with other studies [25, 26], we found that the patients' trait anxiety correlated positively with the preoperative pain

level to a lower degree and with the postoperative pain level with the state anxiety at the end of the hospital stay to a higher degree. Moreover, pain might induce diffuse uncertainty about the surgery's success and provoke anxiety and worries at the end of the hospital stay. Informed consent consultation in our study seems to have no influence on those interrelationships. Implementing a QPL and handing it out to the surgeons before the informed consent consultation may optimize the interaction in terms of adapting the process to the patients' individual information needs.

## Limitations

We were unable to record the complete number of patients approached by the study members and how many of them declined to participate. This represents a selection bias of the study as, for instance, patients with high anxiety levels are more likely to refuse study participation. With the small sample size, the generalizability of our single-center study results is limited. Due to the fact that we did not record the patient–surgeon dialogues, it remains unknown in how far the surgeons analyzed the patient's questions and whether they ascertained that all the patients' questions had been verbalized and answered.

## Conclusions

The informed consent consultation before spine surgery is demanding, and patients' anxiety levels vary individually. Meeting information needs should be optimized in the process of surgeon–patient communication. Patients at risk for high anxiety levels should be identified routinely before the informed consent consultation. Best care and attention should be established to assess and fulfill their information needs. Adapting the information to the patients' anxiety levels seems to be an effective way to reduce anxiety.

## Declarations

**Conflict of interest** The authors declare, that they have no conflict of interest.

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