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ORIGINAL SCIENTIFIC REPORT

Preoperative Anxiety is Associated With Postoperative Complications in Vascular Surgery: A Cross-Sectional Study

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Abstract

Background Preoperative anxiety is associated with increased morbidity and/or mortality in surgical patients. This study investigated the incidence, predictors, and association of preoperative anxiety with postoperative complications in vascular surgery.

Methods Consecutive patients undergoing aortic, carotid, and peripheral artery surgery, under general and regional anesthesia, from February until October 2019 were included in a cross-sectional study. Anesthesiologists assessed preoperative anxiety using a validated Serbian version of the Amsterdam Preoperative Anxiety and Information Scale. Patients were divided into groups with low/high anxiety, both anesthesia- and surgery-related. Statistical analysis included multivariate linear logistic regression and point-biserial correlation.

Results Of 402 patients interviewed, 16 were excluded and one patient refused to participate (response rate 99.7%). Out of 385 patients included (age range 39–86 years), 62.3% had previous surgery. High-level anesthesia- and surgery-related anxieties were present in 31.2 and 43.4% of patients, respectively. Independent predictors of high-level anesthesia-related anxiety were having no children (OR = 0.443, 95% CI: 0.239–0.821, $p = 0.01$), personal bad experiences with anesthesia (OR = 2.294, 95% CI: 1.043–5.045, $p = 0.039$), and time since diagnosis for ≥ 4 months (OR = 1.634, 95% CI: 1.023–5.983, $p = 0.04$). The female sex independently predicted high-level surgery-related preoperative anxiety (OR = 2.387, 95% CI: 1.432–3.979, $p = 0.001$). High-level anesthesia-related anxiety correlated with postoperative mental disorders ($r_{pb} = 0.193$, $p = 0.001$) and pulmonary complications ($r_{pb} = 0.104$, $p = 0.042$). Postoperative nausea ($r_{pb} = 0.111$, $p = 0.03$) and postoperative mental disorders ($r_{pb} = 0.160$, $p = 0.002$) correlated with high-level surgery-related preoperative anxiety.

Conclusions Since preoperative anxiety affects the postoperative course and almost every third patient experiences anxiety preoperatively, routine screening might be recommended in vascular surgery.

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Introduction

Although the concept of preoperative anxiety, as an unpleasant feeling of uneasiness or worry in patients awaiting surgical treatment [1], has been known for more than half a century [2], it still represents a common problem in perioperative settings. A recent cross-sectional study, which included more than 3000 participants, showed that only 7.4% of surgical patients do not feel anxious at all during the perioperative period [3]. Besides the fact that it can negatively influence patients' satisfaction with surgical care [4], it has been suggested that preoperative anxiety may lead to increased morbidity and/or mortality rate in cardiac surgery [5, 6], general surgery [7], neurosurgery [8] and in cancer patients [9]. This explains why it remains the focus of interest of numerous studies.

When it comes to vascular surgery, contemporary literature data are limited. Although Liu and colleagues investigated the incidence and risk factors of preoperative anxiety in patients undergoing aortic repair [10], the impact of preoperative anxiety on the postoperative course in vascular patients remains unknown. We sought that the complexity of these patients and the association of preoperative anxiety with adverse outcomes described in other surgical specialties call for further investigation.

Thus, the present study aimed to investigate the incidence of preoperative anxiety, to determine factors associated with its occurrence, and to assess its relationship with postoperative complications in vascular surgery.

Material and methods

Following approval of the Ethics Committee of the Faculty of Medicine, University of Belgrade, Serbia (No 1550/V-18) we conducted a single-center cross-sectional study. Written informed consent was obtained from all of the study participants.

The study included consecutive patients who underwent surgery of the abdominal aorta, carotid, and peripheral arteries, under both general and regional anesthesia, from February until October 2019. Patients who had an anxiety disorder diagnosed preoperatively, previous vascular procedure, with whom meaningful communication could not be established and those who refused to voluntarily participate in the study were excluded.

A power analysis was performed and determined that a sample of 321 patients will be sufficient to obtain valid conclusions. Taking into account that 20% of patients may refuse to participate, the final sample size calculated was 385.

Demographic data of interest were collected in personal interviews. Other relevant clinical data (comorbidities, data regarding current procedure and anesthesia—including surgery postponement, postoperative short-term (in-hospital) mortality, and data related to postoperative complications) were obtained from the database implemented in daily practice and patients' medical records. Any event (of interest for the study) that required medical and/or surgical treatment, from the end of the surgery until hospital discharge, was considered as a postoperative complication. Postoperative outcomes of interest, along with the definitions of certain complications used in the present study are presented in Table 1 [11–13].

Preoperative anxiety was assessed using a previously validated Serbian version [14] of the APAIS scale [15]. The Serbian version of APAIS consists of two subscales, APAIS-anesthesia (APAIS-a) and APAIS-procedure (APAIS-p), which separately measure anesthesia- and procedure-related anxieties. Preoperative anxiety was evaluated through interviews with doctors from the Anesthesia Department one day before the planned procedure. Based on the level of preoperative anxiety, patients were divided as follows: low anesthesia-related anxiety (APAIS-anesthesia score ≤ 9), high anesthesia-related anxiety (APAIS-anesthesia score > 9), low surgery-related anxiety (APAIS-procedure score ≤ 8), and high surgery-related anxiety group (APAIS-procedure score > 8).

Statistical analysis

Methods of descriptive statistics were used to characterize the sample. Continuous variables are presented as means ± standard deviation (SD), while categorical variables are reported as absolute numbers (n) with percentages (%). Cross tabs, t-test, the Mann–Whitney-U test, ANOVA, and the Kruskal–Wallis test were applied where appropriate, depending on the type and the normality of the data. Multivariate logistic regression analysis was applied to identify variables associated with high-level preoperative anxiety, and the model included all variables that were statistically significant in univariate analysis (at the level of significance of $p \leq 0.1$). The association between preoperative anxiety and postoperative complications was analyzed by point-biserial correlation. Statistical analyses were performed using SPSS 22.0 (Chicago, IL, USA) and a p-value <0.05 was considered statistically significant.

Results

The response rate was 99.7%. A total of 402 questionnaires were distributed, one patient refused to voluntarily participate and 16 patients were excluded: five have already

undergone some kind of vascular surgical intervention and 11 have had an anxiety disorder diagnosed preoperatively.

Out of 385 patients included in the study, the majority of patients were males (n = 305, 79.2%), married (n = 271, 70.4%) with more than one child (n = 331, 86%), with an average age of 67.1 years (range 39–86 years). Pathological process of the carotid artery was the reason for surgery in 157 patients (40.8%), 85 patients (22.1%) were operated on due to peripheral arterial disease, and the remaining 143 (37.1%) have had surgery of the abdominal aorta. Regional anesthesia techniques were applied in 225 patients (58.4%), while 160 patients (41.6%) were operated on under the conditions of general endotracheal anesthesia. Half of the patients were smokers (50.1%), while 170 patients (44.2%) reported regular anxiolytics consumption (in the treatment of conditions other than anxiety disorders). Nearly 62% of patients have already undergone some kind of surgical intervention, while 2.9% of them have had bad experiences with surgery and 8.6% with anesthesia. The median time since the initial diagnosis to the current surgery was 120 days, and the current procedure was postponed in 47 patients (12.2%). (Table 2).

The majority of patients (68.8%) had a low level of anesthesia-related anxiety (APAIS-a score $\leq$ 9). Significantly more patients who have never had any children had high-level anesthesia-related anxiety, compared to the group with low anesthesia-related anxiety (22.5 vs. 10.2%, p = 0.001). In the group with high anesthesia-related anxiety, significantly more patients had previous bad experiences related to anesthesia (13.3 vs. 6.4%, p = 0.025), and significantly more patients' relatives also had prior bad anesthesia experiences (9.2 vs 3.8%, p = 0.031). In the high anesthesia-related anxiety group, there were significantly more smokers, compared to the low anxiety group (62.5 vs. 44.5%, p = 0.004).

High-level surgery-related anxiety (APAIS-p score $>$ 8) was present in 43.4% of patients. Based on the results of univariate analysis, the risk factors for the occurrence of high-level surgery-related anxiety were female sex and chronic kidney disease. In the high surgery-related anxiety group, significantly more patients belonged to the female sex (29.3 vs 14.2%, p = 0.001) and had chronic kidney disease (20.0 vs 6.0%, p = 0.037). As for anesthesia-related anxiety, no significant differences were noted when high/low surgery-related anxiety groups were compared according to other demographic and clinical characteristics (Table 3).

The multivariate logistic regression model for APAIS-a included the following seven variables: number of children, previous surgery, personal and patients' relatives' previous bad experiences related to anesthesia, time since the initial diagnosis, surgery postponement, and smoking status. Independent predictors of high-level preoperative anxiety related to anesthesia were having no children (OR = 0.443, 95% CI: 0.239–0.821, p = 0.010), previous personal bad experiences with anesthesia (OR = 2.294, 95% CI: 1.043–5.045, p = 0.039) and time since the initial diagnosis for $\geq$ 4 months (OR = 1.634, 95% CI: 1.023–5.983, p = 0.040) (Table 4).

For high-level preoperative anxiety related to surgery, the multivariate logistic regression model included female

Table 1 Postoperative outcomes of interest

Postoperative complication
Nausea
Vomiting
Mental disorders
Restlessness
Agitation[a]
Delirium[b]
Cardiac and hemodynamic disturbances
Cardiac arrest
Hypotension[c]
Hypertension[d]
Myocardial infarction
Cardiac rhythm disturbances
Miscellaneous
Acute kidney injury[e]
Pulmonary complications
Pneumonia
Pleural effusion
Reintubation
Hypoxemia/hypercarbia
Bronchospasm
Neurological complications
Stroke
Transient ischemic attack
Miscellaneous neurological deficits
Gastrointestinal complications
Diarrhea
Haematemesis
Melena
Re-intervention
Local wound infection[f]

[a]Defined according to the American Association for Emergency Psychiatry BETA project guidelines [11], [b]defined according to the American Psychiatric Association criteria [12] and any documentation of the treatment with neuroleptic agents, [c]systolic blood pressure below 90 mmHg, that required therapeutic intervention, [d]systolic blood pressure over 180 mmHg, that required therapeutic intervention, [e]diagnosed according to Kidney Disease: Improving Global Outcomes (KDIGO) practice guidelines [13], [f]defined as redness, pain and/or drainage on the surgical site, along with an increase in infectious parameters, with or without fever $>$ 38 °C

Table 2 Demographics and basic clinical characteristics of patients

Patients' characteristics	Number (Percentage)
Sex	
Male	305 (79.2%)
Education	
Not literate/Incomplete primary school	15 (3.9%)
Primary	72 (18.7%)
High school	214 (55.6%)
University degree/Master's/PhD	84 (21.8%)
Marital status	
Single (never married)	33 (8.6%)
Married/cohabiting	271 (70.4%)
Widowed	52 (13.5%)
Separated/divorced	29 (7.5%)
Employment status	
Employed	71 (18.4%)
Unemployed	41 (10.7%)
Retired	273 (70.9%)
Socio-economic conditions	
Good	156 (40.5%)
Fair	180 (46.8%)
Bad	49 (12.7%)
Children	
Yes	331 (86.0%)
Number of household members	
Multi-member household	318 (82.6%)
Surgery type	
Aortic	143 (37.1%)
Carotid	157 (40.8%)
Peripheral arteries	85 (22.1%)
Anesthesia type	
Regional	225 (58.4%)
General	160 (41.6%)
Smoking status	
Smoker	193 (50.1%)
Regular anxiolytics consumption*	
Yes	170 (44.2%)
Previous surgery	
Yes	240 (62.3%)
Patients' previous bad experiences	
Related to surgery	11 (2.9%)
Related to anesthesia	33 (8.6%)
Patients' relatives' previous bad experiences	
Related to surgery	7 (1.8%)
Related to anesthesia	21 (5.5%)
Surgery postponement	
Yes	47 (12.2%)
Comorbidities	
Hypertension	342 (88.8%)
Myocardial infarction	63 (16.4%)
Angina pectoris	77 (20.0%)
Cardiac rhythm disturbances	77 (20.0%)
Chronic obstructive pulmonary disease	86 (22.3%)
Diabetes mellitus	125 (32.5%)
Chronic kidney disease	33 (8.6%)
Stroke/transitory ischemic attack	94 (24.4%)
Malignancy	19 (4.9%)
Psychiatric diseases	11 (2.9%)

*In the treatment of conditions other than anxiety disorders

sex, chronic obstructive pulmonary disease, and chronic kidney disease. Female sex turned out to be an independent predictor of high surgery-related preoperative anxiety (OR = 2.387, 95% CI: 1.432–3.979, $p = 0.001$) (Table 5).

The frequencies of postoperative complications are presented in Table 6. Postoperative mental disorders, cardiac and hemodynamic disturbances, pulmonary complications, and nausea, were the most common, while the in-hospital mortality rate was zero.

The point-biserial correlation was applied to examine the association between preoperative anxiety and postoperative complications. A higher level of anesthesia-related anxiety significantly correlated with the occurrence of postoperative mental disorders ($r_{pb} = 0.193$, $p = 0.001$) and postoperative pulmonary complications ($r_{pb} = 0.104$, $p = 0.042$), while high-level preoperative anxiety related to surgery was associated with postoperative nausea ($r_{pb} = 0.111$, $p = 0.03$) and postoperative mental disorders ($r_{pb} = 0.160$, $p = 0.002$). (Table 7).

Discussion

In a large cross-sectional observational study from 2016 by Walker et al., anxiety was designated as the worst aspect of perioperative experience [16]. Preoperative anxiety may lead to serious complications [8, 17–20], and significantly increases healthcare costs [21]. These facts emphasize its importance. Prompted by the previous, the present study was designed and conducted to examine the impact of preoperative anxiety on vascular patients. Our results revealed several noteworthy findings.

The incidence of anesthesia-related anxiety was 31.2%, while a slightly higher percentage of patients (43.4%) felt anxiety due to forthcoming surgery. Previously published data suggest that the incidence of preoperative anxiety varies in the range from 70 to 94% [22, 23]. However, only a limited number of studies have investigated anesthesia- and surgery-related anxieties separately. For instance, a

Table 3 Comparative characteristics of patients with high/low anesthesia- and surgery-related anxiety

Variable	APAIS-a			APAIS-p		
	≤ 9 $n = 265$	> 9 $n = 120$	p-value	≤ 8 $n = 218$	> 8 $n = 167$	p-value
Sex						
Male	80.8%	75.8%	0.27	85.8%	70.7%	**0.001**
Female	19.2%	24.2%		14.2%	29.3%	
Age						
< 65 years	33.2%	32.5%	0.891	33.5%	32.3%	0.812
≥ 65 years	66.8%	67.5%		66.5%	67.7%	
Education						
Not literate/Incomplete primary school	4.2%	3.3%	0.163	3.2%	4.8%	0.682
Primary	16.6%	23.3%		17.4%	20.4%	
High school	54.7%	57.5%		57.8%	52.7%	
University degree/Master's/PhD	24.5%	15.8%		21.6%	22.2%	
Employment status						
Retired	73.6%	65%	0.180	69.3%	73.1%	0.704
Employed	17.4%	20.8%		19.7%	16.8%	
Unemployed	9.1%	14.2%		11%	10.2%	
Marital status						
Married	70.2%	70.8%	0.116	71.6%	68.9%	0.361
Single (never married)	7.5%	10.8%		10.1%	6.6%	
Divorced	6.4%	10%		6.4%	9%	
Widowed	15.8%	8.3%		11.9%	15.6%	
Number of household members						
Lives alone	16.6%	21.7%	0.233	17%	19.8%	0.482
Multi-member household	83.4%	78.3%		83%	80.2%	
Children						
No	10.2%	22.5%	**0.001**	13.8%	14.4%	0.864
≥ 1	89.8%	77.5%		86.2%	85.6%	
Socio-economic conditions						
Good	39.5%	42.5%	0.641	39%	42.5%	0.417
Fair	48.3%	43.3%		49.5%	43.1%	
Bad	12.1%	14.2%		11.5%	14.4%	
Previous surgery						
No	34.7%	44.2%	0.076	39%	35.9%	0.539
Yes	65.3%	55.8%		61%	64.7%	
Patients' previous bad experiences with anesthesia						
No	93.6%	86.7%	**0.025**	90.8%	92.2%	0.629
Yes	6.4%	13.3%		9.2%	7.8%	
Patients' previous bad experiences with surgery						
No	97.4%	96.7%	0.745	97.7%	96.4%	0.324
Yes	2.6%	3.3%		2.3%	3.6%	
Patients' relatives' previous bad experiences with anesthesia						
No	96.2%	90.8%	**0.031**	94%	95.2%	0.615
Yes	3.8%	9.2%		6%	4.8%	
Patients' relatives' previous bad experiences with surgery						
No	97.7%	99.2%	0.443	98.2%	98.2%	0.643
Yes	2.3%	0.8%		1.8%	1.8%	

Table 3 continued

Variable	APAIS-a			APAIS-p		
	≤ 9 *n* = 265	> 9 *n* = 120	*p*-value	≤ 8 *n* = 218	> 8 *n* = 167	*p*-value
Time since the initial diagnosis						
0–120 days	57.4%	46.7%	0.051	56%	51.5%	0.384
≥ 121 days	42.6%	53.3%		44%	48.5%	
Surgery postponement						
No	85.7%	92.5%	0.058	86.2%	89.8%	0.287
Yes	14.3%	7.5%		13.8%	10.2%	
Smoking status						
Smoker	44.5%	62.5%	**0.004**	46.3%	55.1%	0.206
Ex-smoker	40.4%	29.2%		39%	34.1%	
Non smoker	15.1%	8.3%		14.7%	10.8%	
Regular anxiolytics consumption*						
No	57.7%	51.7%	0.267	56%	55.7%	0.957
Yes	42.3%	48.3%		44%	44.3%	
Type of surgery						
Carotid	40.4%	41.7%	0.922	41.7%	39.5%	0.904
Aortic	37%	37.5%		36.7%	37.7%	
Peripheral arteries	22.6%	20.8%		21.6%	22.8%	
Type of anesthesia						
Regional	59.2%	56.7%	0.634	59.2%	57.5%	0.739
General	40.8%	43.3%		40.8%	42.5%	

Statistically significant values are given in bold ($p < 0.05$)

*in the treatment of conditions other than anxiety disorders; data are presented as number (percentage)

Table 4 The multivariate logistic regression for APAIS-a

Variables	*p*-value	OR	95% CI	
			Lower bound	Upper bound
Number of children (0 vs. ≥ 1)	**0.010**	0.443	0.239	0.821
Previous surgery (no vs. yes)	0.082	0.65	0.4	1.056
Patients' previous bad experiences with anesthesia (no vs. yes)	**0.039**	2.294	1.043	5.045
Patients' relatives' previous bad experiences with anesthesia (no vs. yes)	0.068	2.37	0.939	5.983
Time since the initial diagnosis (0–120 vs. ≥ 121 days)	**0.040**	1.634	1.023	2.61
Surgery postponement, (no vs. yes)	0.052	0.449	0.2	1.006
Smoking status				
Smoker	Referent category			
Ex-smoker	0.075	0.633	0.382	1.048
Non smoker	0.060	0.475	0.219	1.032

Statistically significant values are given in bold ($p < 0.05$)

OR odds ratio, *CI* confidence interval

study by Mavridou et al. from 2013 [24], found that 81% of patients experience preoperative anxiety related to anesthesia, while according to Masjedi et al. that percentage amounts to 77.5 [25]. In the present study, approximately twice fewer patients felt anxious towards anesthesia. This difference can be explained by the fact that the incidence reported in our study refers to high-level anxiety, unlike the overall incidence in the above-mentioned studies. Unfortunately and to the best of our knowledge, no studies have investigated surgery-related anxiety separately, so no comparison can be made.

Table 5 The multivariate logistic regression for APAIS-p

Variables	*p*-value	OR	95% CI	
			Lower bound	Upper bound
Sex (male vs. female)	**0.001**	2.387	1.432	3.979
Chronic obstructive pulmonary disease (yes vs. no)	0.159	1.441	0.867	2.394
Chronic kidney disease (yes vs. no)	0.059	0.488	0.231	1.028

Statistically significant value is given in bold ($p < 0.05$)

OR odds ratio, *CI* confidence interval

Table 6 Frequencies of postoperative complications

Postoperative complication	Number	Percentage
Nausea	47	12.2%
Vomiting	38	9.9%
Mental disorders	168	43.6%
Restlessness	91	23.6%
Agitation	56	14.5%
Delirium	21	5.5%
Cardiac and hemodynamic disturbances	147	38.2%
Cardiac arrest	4	1%
Hypotension	44	11.4%
Hypertension	96	24.9%
Myocardial infarction	3	0.8%
Cardiac rhythm disturbances	22	5.8%
Miscellaneous	18	14.7%
Acute kidney injury	15	3.9%
Pulmonary complications	58	15.1%
Pneumonia	13	3.4%
Pleural effusion	2	0.5%
Reintubation	10	2.6%
Hypoxemia/hypercarbia	27	7.1%
Bronchospasm	17	4.5
Neurological complications	15	3.9%
Stroke	5	1.3%
Transient ischemic attack	7	1.8%
Miscellaneous neurological deficits	3	0.9%
Gastrointestinal complications	4	1.1%
Diarrhea	2	0.5%
Haematemesis	1	0.3%
Melena	1	0.3%
Re-intervention	26	6.8%
Local wound infection	44	11.4%

Further on, literature data regarding risk factors for the development of preoperative anxiety are inconsistent: different authors have reported various predisposing factors, depending on the patient sample, methodology, and geographic region where the study was conducted. Thus, the occurrence of preoperative anxiety may be associated with patients' socio-demographic characteristics [26], comorbidities [10], type and extensiveness of surgery, as well as anesthesia techniques [27]. Based on our results, patients who have never had any children, those who have already had some bad experiences with anesthesia, as well as those who knew someone with such experiences, smokers, females, and patients with chronic kidney disease are more prone to develop anxiety during the preoperative period.

The majority of previously published papers have shown that the female sex is predictive of preoperative anxiety [17, 19, 24]. Among the limited number of studies that have addressed this issue in vascular patients, a study conducted by Liu and colleagues demonstrated that females are 2.8 fold more likely to experience preoperative anxiety than men [10]. The present study re-confirms those findings: females are 2.4 fold more likely to experience high-level surgery-related preoperative anxiety. Hormonal fluctuations [28], enhanced emotional reactions in women [29], social standards [24], and the assumption that women develop closer relationships with their families, so they are more affected by the separation during the preoperative period [30] might clarify those sex-related differences.

Having no children represents an independent predictor for the occurrence of anesthesia-related anxiety in the present study. To our knowledge, no studies have examined the influence of having children on preoperative anxiety. Still, there are studies that have shown that such persons experience a higher level of anxiety when faced with a certain health issue [31]. We can assume that those patients are preoperatively more concerned for their own future due to the possibility of postoperative adverse events.

Previous surgery and anesthesia exposure lower anxiety levels for future surgical treatments [32], since those who have already undergone surgery/anesthesia are not exposed to completely unfamiliar situations. Still, the question might be asked whether previous bad experience with surgery/anesthesia affects the level of preoperative anxiety? Contrary to our expectations, previous bad experiences with anesthesia, but not with surgery, predict high-level preoperative anxiety. We can assume that the amount

Table 7 Correlation between APAIS scores and postoperative complications

Postoperative complication	APAIS-a		APAIS-p	
	r_{pb}	p-value	r_{pb}	p-value
Nausea (no vs. yes)	0.066	0.196	0.111	**0.03**
Mental disorders (no vs. yes)	0.193	**0.001**	0.160	**0.002**
Pulmonary complications (no vs. yes)	0.104	**0.042**	0.025	0.622

Statistically significant values are given in bold ($p < 0.05$)

r_{pb} correlation factor for *Point-biserial* correlation

of information provided by an attending surgeon is higher, in comparison to anesthesia, probably due to more frequent contacts with surgeons during the preoperative period, which may result in less anxiety. Still, our results are in line with the findings of Eberhart et al. who demonstrated that prior negative anesthesia experience has a strong influence on preoperative anxiety [33].

Significantly more patients who knew about their disease for $\geq$ 4 months, experienced preoperative anxiety more frequently: time since the initial diagnosis for $\geq$ 4 months represents an independent predictor of the preoperative anxiety in the present study. This kind of association is not surprising, since it has been demonstrated that surgical patients feel anxious from the moment they were told that they have to have surgery [34] and that its intensity is increasing as the time remaining until the scheduled operation decreases [35].

Finally, we were able to demonstrate the correlation between preoperative anxiety and certain postoperative complications. Postoperative mental disorders were the most important postoperative event since they were associated with both anesthesia- and surgery-related preoperative anxiety in the present study. Although an association between anxiety and postoperative mental disorders has been described [9, 18], the definitive reason behind this association remains unknown. Similar inflammatory processes might contribute to the development of preoperative anxiety and postoperative delirium [36].

Anxiety may aggravate symptoms of reactive airway diseases [37]. A prospective observational study by Kocaturk and Oguz showed that preoperative anxiety increases the risk for the development of bronchospasm following anesthesia induction [38]. Our results indicate that anesthesia-related preoperative anxiety positively correlates with postoperative pulmonary complications. To date, no study has published similar findings. The unique design of the current study, which included a relatively large and homogenous sample and assessed the impact of numerous variables, probably allowed the detection of such an association. This also suggests that further studies are needed to better evaluate demonstrated association.

While some authors did not find a significant correlation between preoperative anxiety and postoperative nausea [23, 39], others reported the opposite and even that patients with preoperative anxiety have a greater degree of postoperative nausea [40, 41]. The present study confirms the latter: high-level preoperative anxiety is associated with postoperative nausea.

The present study has several limitations that need to be mentioned. The design of the present study (observational, single-center) limits the generalization of our findings. To obtain more reliable data multicenter studies are needed. Also, the study sample included only vascular patients, and due to the nature of vascular diseases, a smaller percentage of patients were younger. On the other hand, the fact that this is probably one of the most comprehensive studies that investigated vascular patients' preoperative anxiety and its implications, should be considered as its true strength.

Conclusion

Vascular patients differ from other surgical patients in terms of the incidence, risk factors, predictors, and impact of preoperative anxiety on the postoperative course. The present study demonstrated its association with postoperative mental disorders, pulmonary complications, and postoperative nausea in vascular patients. This finding advocates routine preoperative screening of anxious patients. To reduce the rate of complications related to preoperative anxiety, special attention should be paid to females, patients who have never had any children, those who have had previous bad experiences with anesthesia, and those who know about their disease for $\geq$ 4 months.

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Declarations

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

Ethical approval The authors declare that the present study is in compliance with Ethical Requirements of the journal, and in accordance with Sex-Inclusive SJEG Guidelines.

Informed consent statement Informed consent was obtained from all individual participants included in the study.

Statement of human and animal rights The study was approved by the Ethics Committee of the Faculty of Medicine, University of Belgrade, Serbia (No 1550/V-18).

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