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Fear, anxiety and cognitive status of the elderly patients qualified for coronary artery bypass grafting

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Summary

Introduction. Emotional states and cognition are close-related factors. Patients qualified for coronary artery bypass grafting develop postoperative cognitive impairment. Negative emotions, which occur before the procedure, may affect the cognitive status of the subjects postoperatively. ***Aim of the study.*** The main goal of the study was to assess the mutual relationship between fear, anxiety and cognition in patients undergoing coronary artery bypass grafting (CABG). ***Material and methods.*** Subjects with no cognitive impairment were enrolled in the study. Fear was evaluated by using the Fear of Pain Questionnaire III. Anxiety was assessed by using the Visual Analogue Scale in the three following domains: life threat, own illness and the unknown. Three cognitive tests were used. These were the Word Fluency Test, the Trail Making Test and the Stroop Word Interference Test. The assessment was performed preoperatively and on the 2nd postoperative day. ***Results.*** No differences between the groups in relation to preoperative fear and anxiety were found. Fear relating to severe pain and life threat anxiety were the most pronounced by subjects. Patients after cardiac operations presented worse results in the psychological assessment on the 2nd postoperative day. Fear and anxiety affected the cognition. The duration of the cardiopulmonary bypass negatively influenced the results of the cognitive tests. ***Conclusion.*** Negative emotions affect cognition in patients undergoing CABG procedures. *Anestezjologia i Ratownictwo 2011; 5: 16-22.*

Keywords: coronary artery bypass grafting, cognitive functions, fear, anxiety

Introduction

Preoperative fear and anxiety have been the subjects of many studies. On the basis of the previous surveys, it was stated that prior positive experience, such as the feeling of safety and care, being well-informed and having positive expectations are crucial factors contributing to the patient's comfort. Stress is proved to enhance a potentially adverse effect on the circulatory system and the metabolic changes. Kanto and Scheinin proved that strong preoperative fear is associated with a higher heart rate, as well as a higher concentration of noradrenaline and its metabolite - 3, 4-dihydroxyphenylacetic acid (DOPAC) in the cerebrospinal fluid in subjects not treated with diazepam before surgical procedures [1]. Preoperative anxiety is a factor causing elevated activity of the plasma cholinesterase with a decreased heart rate variability [2]. Preoperative stress potentiates the activity of the serum lipid peroxide in patients undergoing abdominal surgery, even in young and healthy controls. The maximal stress response was achieved on the second day of hospitalization [3].

Cardiac surgery has become a field of special interest in fear and anxiety surveys. It has been observed

that patients with a high level of preoperative anxiety-trait respond worse to analgesic medication than patients with a low level of anxiety measurements [4].

One of the easiest methods used in order to reduce negative emotions is to provide the patient with written information before anesthesia and surgery. In such cases, more than 40% of patients declared reduced levels of preoperative fear [5].

The measurement of anxiety level may have an implication for the anaesthesiological treatment. Maranets and Kain studied the possible role of the anxiety level during anesthesia. The conclusion was that a high baseline of anxiety predicts intra-operative anaesthetic requirement [6].

In this study the authors hypothesised that preoperative fear and anxiety in elderly patients qualified for coronary artery bypass grafting affect cognition.

The purposes of the study were as follows:

1. to evaluate preoperative fear and anxiety in the group of patients with no pre-existing cognitive decline who were to undergo coronary artery bypass grafting (CABG) in comparison with age-matched not operated controls.
2. to assess the early postoperative cognitive status of the elderly patients treated with CABG
3. to check relationships between fear and anxiety and cognitive functioning
4. to evaluate the influence of duration of cardiopulmonary bypass on the results of cognitive tests

Material and methods

1. The study obtained the permission of the local Bioethical Committee. The participants signed written consents for participation in the study. Patient anonymity was preserved. Psychological tests were used in two groups of subjects: anaesthetized and operated on (Group 1) and volunteers who were not hospitalized nor surgically treated at the moment of the study (Group 2).

2. Inclusion criteria: patients aged ≥65 years old with no preexisting cognitive dysfunction diagnosed by using the Mini-Mental State Examination (MMSE≥24 pts) and the Clock Drawing Test (CDT up to the 1st level of errors according to Shulman), without symptoms of depression (Geriatric Depression Scale - GDS<5 pts). The patients had to be self-managing, which was confirmed by the Katz Activity of Daily Living (ADL>4 pts) and the Lawton-Brody Instrumental Activity of Daily Living (IADL>12 pts). Subjects had no psychiatric history, alcoholism/drug abuse nor neurologic pathology.

3. The cognitive status of the subjects was tested by using the following: the Word Fluency Test (WFT), the Stroop Colour-Word Interference Test (Stroop Test) and the Trail Making Test (TMT). While performing WFT, the participant is giving the words beginning with three particular letters, next names of animals, fruits and vegetables for 1 minute for each letter or category; we count the number of given words, but also inaccuracies and perseverations. Stroop Test consists of 2 parts: A - we ask the patient to read loudly the names of colours, which are written with black ink; B - participant is describing the colour of ink, which is not equivalent with the true meaning of the written name of the colour. TMT consists of 2 parts: A - the participant is asked to connect the 25 numbered circles which are presented on a sheet of paper; B - some circles are numbered, some of them have letters, the task is to connect the numbers and letters in an alternating manner. In Stroop Test and TMT we test the speed of performance and number of errors. Fear and anxiety were assessed by using the Fear of Pain Questionnaire - III (FPQ-III) and the Visual Analogue Scale (VAS), respectively. The following aspects of the anxiety were tested: the unknown, own illness and life threat. All the tests were performed preoperatively. The cognitive assessment was repeated on the 2nd postoperative day, provided the respiratory and circulatory stability were achieved.

4. Anaesthesia. The patients were sedated with midazolam (Dormicum, Roche) 7.5 mg orally. The anaesthesia was initiated with fentanyl (Fentanyl WZF Polfa) 15 μg/kg and etomidate (Etomidate Lipuro, Braun) 0.3 mg/kg iv. The muscle relaxation was achieved by administration of rocuronium bromide (Esmeron, Organon) 0.6 mg/kg. The anaesthesia was maintained with propofol (Propofol, Fresenius Kabi) and sevoflurane (Sevorane, Abbott) (vaporizer Vapor 19.3, Dräger). Julian and Primus apparatus (Dräger Medical) were used. The extracorporeal circulation was performed by using Stöckert III (Perfusion COM INC) and Jostra (Maquet INC) apparatus. During the procedure a hemodynamic monitoring and temporary biochemical analyses of blood samples were performed.

Statistics

Patient demographics, operation characteristics, as well as the results of the cognitive tests were presented

as mean with standard deviation. In order to compare groups, the Mann-Whitney test, a chi-test and a t-test were applied. The Spearman rank test was used for analysis of the relationships between the FPQ-III, anxiety measurements and cognitive tests results. P<0.05 was considered statistically significant.

Results

1. Patient demographics
   There were 22 patients operated on (Group 1 - 16 men and 6 women aged 70 ± SD 4.83 years, BMI 28 ± SD 4.28) and 21 controls (Group 2 - 11 men and 10 women aged 71 ± SD 4.10 years, BMI 28 ± SD 3.10) qualified for the study. There were no statistical differences between the groups in the aspect of age, sex, BMI, level of education or preoperative cognitive screening (Mann-Whiney test, chi, t-test, p<0.05).
2. Operation characteristics
   The perioperative characteristics were homogenous within the group of the operated patients (Table 1).

Table 1. Operation characteristics

Variable	Mean	SD
Number of bypasses	3.04	0.78
Duration of anaesthesia (min)	188.41	33.54
Duration of CPB (min)	65.36	19.68
Duration of aortal cross-clamping (min)	34.54	8.91
Duration of reperfusion (min)	23.04	10.12
Ejection fraction (%)	45.52	9.89

3. Assessment of the preoperative fear in the group of patients operated on.
   The intensity of fear of pain was the most pronounced in severe pain situations (Group 1 mean FPQ 35.20±5.47 pts; Group 2 – 38.30±6.14 pts). The medical pain situations were interpreted as of medium importance (Group 1 – mean FPQ 25.40±7.18 pts; Group 2 - 27.65±8.33 pts) and minor pain situations (Group 1 – mean FPQ 21.72±7.11 pts; Group 2 – 22.70±9.53 pts) were considered as the weakest fear stimulators in both groups.
4. Statistical analysis of preoperative fear between the groups – not significant: Mann-Whitney Test p>0.05
5. Assessment of the preoperative anxiety in the group of operated patients
   The most influential factors causing anxiety were life-oriented. The mean VAS score in Group 1 was 49.34±29.49 mm and in Group 2 – 47.02±30.96 mm. Own illness related anxiety in Group 1 equaled 40.32±19.22 mm, whereas in Group 2 – 36.70±17.53 mm. The anxiety of the unknown was the least stressful agent: the mean VAS score achieved by the subjects in Group 1 was 37.44±20.44 mm and in Group 2 – 37.41±21.64 mm.
6. Statistical analysis of preoperative anxiety between the groups – not significant: Mann-Whitney Test p>0.05
7. There was no statistically significant difference as far as the results of the preoperative cognitive tests (WFT, Stroop Test, TMT) between the groups (U Mann-Whitney test; p<0.05) were concerned.
8. Postoperatively, the following changes were noted in the results between the groups:
   a) WFT – letter (U Mann-Whitney test; p=0.039), category (U Mann-Whitney test; p=0.039).
   b) Stroop Test – part A (U Mann-Whitney test; p=0.008).
   c) TMT – part B (U Mann-Whitney test; p=0.027), difference between durations of parts B and A (U Mann-Whitney test; p=0.029).

Table 2. Relationships between FPQ-III and cognitive tests' results – Spearman test

Variables: FPQ-III type: severe, weak, medical; Cognitive tests: WFT, TMT, Stroop 0 and 2 – days of assessment	R	t(N-2)	p
severe & WFT letter 0	0.37	2.62	0.01
severe & WFT category 2 perseveration	0.38	2.61	0.01
weak & Stroop B 0 errors	0.35	2.11	0.04
weak & WFT letter 0	0.35	2.44	0.02
weak & WFT category 0 inaccuracy	-0.32	-2.24	0.03
weak & WFT letter 2 perseveration	0.37	2.53	0.01
weak & WFT category 2 perseveration	0.32	2.18	0.03
weak & TMT B 0 errors	0.36	2.11	0.04
medical & WFT letter 0	0.30	2.03	0.05
medical & WFT category 0 inaccuracy	-0.31	-2.15	0.04

9. The results of the FPQ-III had statistically significant relationships with the verbal capabilities and psychomotor activity. The higher results in fear assessment, the bigger was the number of given words with better accuracy, yet the subjects forgot more quickly what they had said when the Word Fluency Test was performed. The level of fear correlated with the number of errors in the Stroop and TMT tests (Table 2).
10. The level of anxiety related to own illness and life threat reached statistical significance when analyzed in relation to cognitive evaluation. The higher the level of anxiety, the lower was the number of given words with a higher rate of inaccuracy. The higher the level of anxiety, the longer was the duration of performing the Stroop test with a higher number of errors. The higher the level of anxiety, the longer was the duration of performing the TMT test with a more pronounced difference between the B and A durations (Table 3).

Table 3. Relationships between mean anxiety VAS scores and the cognitive tests' results – Spearman test

Variables; type of anxiety: own illness, life threat Cognitive tests: WFT, TMT, Stroop 0 and 2 – days of assessment	R	t(N-2)	p
Own illness & Stroop B2	0.47	3.03	0.005
life & Stroop B0	0.39	2.46	0.02
life & Stroop B2	0.41	2.52	0.02
life & WFT letter 0	-0.31	-2.22	0.03
life & WFT category 0	-0.33	-2.38	0.02
life & WFT letter 2 inaccuracy	0.34	2.39	0.02
life & TMT B2	0.30	2.06	0.045
life & TMT difference 2	0.32	2.20	0.03

11. There were several correlations between the postoperative results in part B of the Stroop Test and durations of anaesthesia, cardiopulmonary bypass, aortal cross-clamping and reperfusion.
    The ejection fraction correlated with perseverations and inaccuracies in the WFT when tested postoperatively.
    The duration of aortal cross-clamping correlated with errors performed in the postoperative TMT- A Test (Table 4).

Table 4. Relationships between operation's characteristics and cognitive tests' results – Spearman test

Variables; Cognitive tests: WFT, TMT, Stroop 0 and 2 – days of assessment	R	t(N-2)	p
Duration of anesthesia & StroopB2	0.49	2.24	0.04
Duration of CPB & Stroop B2	0.51	2.37	0.03
Duration of aortal cross-clamping & Stroop B2	0.60	3.00	0.01
Duration of aortal cross-clamping & TMT A2 errors	-0.44	-2.15	0.04
Duration of reperfusion & Stroop B2	0.48	2.17	0.04
Ejection fraction & WFT letter 2 perseveration	0.47	2.23	0.04
Ejection fraction & WFT category 2 inaccuracy	0.56	2.86	0.01

Discussion

Anxiety and fear are common during hospitalization. The term "anxiety" refers to an unpleasant and overriding inner emotional tension that has no apparent identifiable cause and is often used in order to discuss a group of mental illnesses (anxiety disorders: phobias, panic disorder, obsessive-compulsive disorder and post-traumatic-stress disorder). Fear, in turn, causes emotional tension due to a specific external reason. The fear of dying, dyspnoea, pain or possibility of another heart attack prompt strong emotional distress, which has an impact on the psychological and somatic functioning. Patients suffering from cardiac events develop both states: fear and anxiety [7].

There are several scientific tools assessing anxiety. The three most widely used are the Taylor Manifest Anxiety Scale (MAS), the Spielberger Trait Anxiety Inventory (STAI) and the Eysenck Neuroticism "N" Scale [8].

Vingerhoets stated in his study that preoperative anxiety significantly predicts the level of emotional distress after surgery. He also pointed out the role of preoperative anxiety assessment [9].

Among the tools that are commonly used in order to assess preoperative anxiety, one of the easiest is the Visual Analogue Scale (VAS). According to the results of the study conducted by the Kindler et al the simple VAS proved to be a useful and valid measure of preoperative anxiety [10]. The VAS was also used by other researchers in different fields of anaesthesia [11-13].

We decided to use the Fear of Pain Questionnaire-III (FPQ-III) as a method of fear assessment, as it has been well evaluated in the Polish version [14]. It is a 30-item self-report measure that contains questions relating to fears about pain across three pain dimensions: severe, minor, and medical. Its reliability has already been proven [15].

The authors evaluated fear and anxiety in elderly patients - a population vulnerable to a cognitive decline and postoperative delirium. The advantage of the study is the fact that many studies assessing fear or anxiety were conducted among younger patients [12] or qualified subjects with a very broad range of age [16]. Besides, we were particularly interested in the early postoperative period, as many researches had performed cognitive evaluation on the later stage of hospitalization (e.g. on the 7th day after operation).

The fear assessment revealed that negative emotions related to medical procedures are interpreted as of medium importance just between severe and minor pain. The most pronounced anxious feeling was associated with the life threat in both groups. Medical anxiety was expressed on a medium level. The weakest emotional response was achieved when questions relating to the unknown were asked. On the basis of statistical analysis, older patients operated on seemed to perceive the potential threats the same way as the patients in out-hospital settings. It suggests that fear and anxiety seem to be stable emotional states and are not modified by external factors. It might be suspected that patients awaiting operations in hospital should present a higher level of fear and anxiety, but statistical evaluation did not prove it. It was not proved on the statistical ground, but the operated patients tended to have a more pronounced anxiety level and a lower level of fear in comparison with the controls.

The lack of statistical relationship might have stemmed from a low number of participants in the study.

Postoperatively, we observed worse cognition of the operated patients. The trend was statistically proven in all three tests.

In our study, anxiety and fear influenced cognition. The level of anxiety related to own illness and life threat reached statistical significance when analyzed in relation to the results of the cognitive tests. The results of the FPQ-III had statistical relationships with verbal capabilities (WFT) and the psychomotor activity, as well as concentration (Stroop and TMT tests). The higher the fear, the bigger was the number of given words with better accuracy although the subjects forgot more quickly what they had said when performing Word Fluency Test. The level of fear correlated with the numbers of errors in the Stroop and TMT tests. In general, it could be stated that fear enhances the patients' concentration, whereas anxiety disturbs cognitive abilities.

What seems to be interesting is that fear had more correlations with verbal tests, while anxiety pronounced impact evenly on all applied tests. It might be required to test it more thoroughly in the future. The mutual relationship between emotions and cognition can be explained. The hippocampus is a key organ in the brain responsible for cognition and emotionality. Its dorsal part is connected with learning, while the ventral part is associated with producing anxiety behaviour. Another part of the brain – the dentate gyrus takes part in releasing fear and anxiety. In 2009 Barkus et al. published experimental data achieved in genetically modified mice showing that NR1 NMDA receptor subunit deletion in the dentate gyrus cells impairs the short-term spatial memory and reduces anxiety. Thus we observe a close link between emotionality and cognitive functioning [17]. Studies of subjects with cognitively impaired people also showed this close interaction. Patients suffering from Mild Cognitive Impairment differentiate low and high-danger situations, as do age-matched healthy controls, but they tend to overestimate the low-level threat, which was presented in psychological studies published by Henry et al. [18].

During data analysis we found that there were several negative correlations between the postoperative results in the cognitive tests and the durations of anaesthesia, cardiopulmonary bypass, aortal cross-clamping and reperfusion.

The impact of cardiopulmonary bypass on the cognitive performance is well established and presented in many studies. The trends of the results are consistent with the previous studies. It is difficult to discuss the possible role of anaesthesia duration, because its potential influence is associated with the duration of the CPB. Especially, this protective, as well as the debilitating, influence of the anaesthetics on the nervous system has been recognized in the literature [19].

The role of metabolic stress on the fear circuit was presented by Rodrigues et al. in a review article [20]. Moreover, stress impairs neurogenesis in hippocampal cells and in other peripheral tissues. This effect is common in many species with no regard to the type

of the stressor. The possible role of glucocorticoids is discussed, although the results of several studies on this subject have not been consistent [21].

The results revealed correlations between the ejection fraction (EF) with perseverations and inaccuracies in the WFT if tested postoperatively.

Anxiety and fear have been the subject of research for many years. It might be suspected that the growing knowledge of health problems in societies should reduce the level of stress affecting patients. However, anxiety relating to life threat is still the driving force of the patients' emotionality. In our opinion it might be difficult to compare the results of the studies assessing the fear and anxiety between different groups of patients suffering from distinct illnesses. Each disease has its own specificity and affects the patient in a different way. Still, there is much to do in order to improve the present knowledge in this field.

Conclusions

1. Hospitalized patients awaiting coronary artery bypass grafting present a level of fear and anxiety similar to that of the community-dwelling controls.
2. In the postoperative period, the operated patients present a statistically significant cognitive decline in comparison with the counterparts not operated on.
3. Preoperative fear and anxiety negatively influence the cognitive functioning of the patients undergoing coronary artery bypass grafting.
4. The duration of cardiopulmonary bypass worsens cognition in the early postoperative period.

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