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Anxiety and Depression in Cardiovascular Surgery

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Abstract

Although anxiety and depression are psychological risk factors for coronary artery disease (CAD), psychological aspect in patients with cardiovascular surgery has been less considered. Cognitive and psychological deficit has been still concerning in spite of notable improvement of cardiovascular surgery using cardiopulmonary bypass perfusion. The purpose of this chapter review is to discuss recent data concerning the prevalence and trend of anxiety and depression of patients with cardiovascular surgery and to introduce the nonpharmacological intervention studies. The prevalence of anxiety and depression of patients after cardiovascular surgeries has varied from 10 to 60% and has been likely higher than that of general people. From the limited studies about patients over 6 months after surgery, we guessed the followings about the trends of anxiety and depression of patients with CABG without any other additional intervention programs before/after surgery: (1) patients improved scores of anxiety and depression 3–6 months after surgery, (2) anxiety decreased considerably for about 6 months after CABG and then leveled out for some time, (3) depression remained a bit higher 6 months and more after CABG. Patients' longitudinal psychological conditions would have been influenced by not only invasive cardiovascular surgery but also life events. The nonpharmacology intervention would have improved patients' psychological conditions. Further research is needed to clarify the long-term psychological outcome and to develop the effective intervention programs toward patients with cardiovascular surgery.

Keywords: cardiovascular, surgery, depression, anxiety

1. Introduction

Although Rozanski et al. extensively reviewed and found that anxiety and depression were psychological risk factors for coronary artery disease (CAD), and that depression was particularly a predictor of cardiac events, many research studies have been focused on psychological outcomes of patients with heart failure, myocardial infarction, and acute coronary syndromes

among CAD [1]. Results of cardiovascular surgery have improved remarkably in recent years but psychological aspect in patients who underwent cardiovascular surgery has been less considered.

The advances in both surgical and cardiopulmonary bypass perfusion techniques regarding cardiovascular surgery have been reducing mortality and relieving from patients' symptoms. However, cognitive and psychological deficit has been concerning [2–4]. Selnes and Gottesman suggested that late cognitive changes do occur and these changes are not specific to coronary artery bypass grafting surgery (CABG) or more specifically to the use of cardiopulmonary bypass [2].

Therefore, out of various kinds of cardiovascular surgery using cardiopulmonary bypass, we found out coronary artery bypass grafting surgery (CABG), valve surgery (VS), ventricular device surgery (VDS), and thoracic aortic surgery (TAS) in terms of the adults' main cardiovascular surgery and then reviewed the psychological outcomes of patients with these four surgical procedures. The articles in English language journals were collected by using PubMed (accessed on August 26, 2016) with keywords as follows: CABG, VS, TAS, VDS, cardiovascular surgery, depression, and anxiety. We also described nonpharmacological intervention research.

2. Anxiety and depression in coronary artery bypass grafting surgery (CABG)

Coronary artery bypass grafting (CABG) surgery is performed more frequently than other cardiovascular surgeries. Tully and Baker reviewed about depression, anxiety, and cardiac morbidity outcomes after coronary artery bypass surgery [5]. They suggested the followings: (1) the approximate percentage of coronary artery bypass graft (CABG) surgery patients affected by depression (i.e., major, minor, dysthymia) was between 30 and 40% immediately leading up to and after surgery, (2) both depression and anxiety raised the risk for mortality and morbidity after CABG surgery independent of medical factors, although the behavioral and biological mechanisms are poorly understood, and (3) although neither depression nor anxiety seem to obviously affect neuropsychological dysfunction, depression contributes to a risk for incident delirium.

Compared to psychological condition immediately leading up to and after CABG surgery, the midterm or long-term psychological condition in CABG patients was limited. The long-term psychological research in CABG patients using a hospital anxiety and depression scale (HADS) has only been performed by Ben-Noun [6], who reported HADS results in 132 CABG patients in Israel 7–22 years after surgery. He found the following: (1) anxiety: 31 (23.5%) patients were severe, and two (1.5%) were mild, and (2) depression: 25 (18.9%) patients were severe and three (2.3%) were mild. We examined the psychological outcome of patients at intervals of 1–5 years after CABG using HADS and found that six (8.7%) of them were mild anxiety and five (7.2%) were severe anxiety [7]. Regarding to depression, seven (10.1%) were mild and seven (10.1%) were severe. Compared with his findings, our figures for patients

in the significant range ($HAD-A > 10$) of both anxiety and depression were lower, while our figures for patients in the borderline range ($7 < HAD-A < 11$) were higher. Ben-Noun's study was conducted in Israel and there are long-running conflicts between the Palestinian and the Israeli people. Mataria et al. have found that the chronic and entrenched conflict over generations has resulted in a lower QOL for the population living in the occupied Palestinian territory [8]. Although it might be simplistic to suggest that these factors could influence levels of anxiety and depression, we thought that they might have been a contributing influence to the psychological aspects of the subjects of Ben-Noun's study.

Table 1 presents the trends of HADS anxiety and depression in studies preCABG to post-CABG [4, 9–12]. Some studies have found that CABG patients without any intervention programs after surgery had improved scores of both anxiety and depression 3–6 months after CABG [4, 10, 11]. The means for anxiety 3–6 months after surgery in these studies ranged from 4.2 to 4.9, similar to our results, and for depression from 2.6 to 4.25. Our interpretation of these findings was that anxiety would decrease considerably for about 6 months after CABG and then level out for some time. In contrast, values for depression in our study ranged on the high side. That might have been influenced somewhat by life events because most patients were elderly and had survived several years after their operation [13].

In our study, the prevalence of anxiety and depression in patients more than 1 year after CABG was similar to other reported studies. The exceptions were Ben-Noun's study [6] in Israel with the added effect of war-like conditions. Although most of the previous research on psychological aspects in CABG patients examined them within 1 year of the operation, in which case proximity to the surgical event might have had a great influence, our findings help to understand midterm psychological transitions, and suggest the possible need for further research such as a longitudinal study carried out over several years to better quantify the process of psychological transition.

3. Anxiety and depression in valve surgery (VS)

Not only CABG but valve surgery (VS) procedures also are more common surgical treatment for cardiovascular disease, and some patients need both procedures. There were less psychological studies of patients with VS than those of patients with CABG.

The postoperative psychological research studies revealed that some of patients with VS and/or CABG had anxiety and depression, which had associated with their self-management performance, readmission. Williams et al found that about 30% of patients before CABG and/or VS had moderate to high levels of anxiety [14]. Fredericks et al. reviewed systematically about psychological condition of patients with CABG and/or VS and revealed that moderate to severe levels of anxiety and depression existed during the first month of home recovery and appeared to have an effect on their performance of selfmanagement behaviors [15]. Sibilitz et al. conveyed a nationwide cohort study on patients 1 year after valve surgery in Denmark and found that anxiety and depression were present in 13.6 and 13.8%, respectively (hospital anxiety and depression scale score ≥ 8) and that higher HADS-D scores was one of

References/nation	No. of subject	Anxiety and depression score: means (standard deviations)					Results
		Before surgery/ treatment	1–2 months after surgery/treatment	3–6 months after surgery/treatment	7–11 months after surgery/treatment	1 year or more after surgery/ treatment	
Cross-sectional study							
Okamoto et al. [7]/Japan	49 pts: TAS 79 pts: CABG Anxiety & depression: HADS					1–5 years TA CABG A: 4.0(3.1) 4.7(4.2) D: 5.5(3.7) 5.0(4.5)	
Oterhals et al. [17]/Denmark	593 pts: AVR 369 pts: AVR+CABG Anxiety & depression: HADS					1–13 years AVR AVR+CABG A: 3.78(3.58) 3.57(3.69) D: 3.67(3.39) 4.33(3.53)	
Longitudinal study							
Thornton et al. [4]/UK	71 male pts; CABG Anxiety & depression: HADS	1 week before surgery A: 6.4 D: 4.7	2 months A: 5.3 D: 3.4	6 months A: 4.9 D: 2.6			Anxiety and depression decreased
Hallas et al. [9]/UK	22 pts: CABG Anxiety & depression: HADS	1 week before surgery A: 8.4(4.6) D: 5.7(2.9)	2 months A: 3.4(2.3) D: 2.0(2.2)				Anxiety and depression decreased
Höfer et al. [10]/Austria	432 pts: CAD (CMT: 96 pts, PCI: 60 pts, CABG: 121pts) Anxiety & depression: HADS	Before angiography/ treatment CABG CMT PCI A: 6.40(3.42) 6.52(3.62) 6.55(3.67) D: 4.61(3.14) 4.88(3.38) 5.06(3.86)	1 month CABG CMT PCI A: 5.04(3.97) 6.04(4.12) 5.61(3.25) D: 4.26(3.34) 5.27(4.25) 4.27(3.52)	3 months CABG CMT PCI A: 4.25(3.67) 6.55(4.42) 5.90(3.85) D: 4.25(3.80) 5.30(4.37) 4.59(3.98)			Anxiety and depression in CABG decreased

References/nation	No. of subject	Anxiety and depression score: means (standard deviations)					Results
		Before surgery/ treatment	1–2 months after surgery/treatment	3–6 months after surgery/treatment	7–11 months after surgery/treatment	1 year or more after surgery/ treatment	
Amonn et al. [25]/Switzerland	51 pts: transcatheter aortic valve implantation (TAVI) 93 pts: surgical aortic valve replacement (AVR) Anxiety & depression: HADS					A mean follow-up of 15 + 10 months <u>TAVI AVR</u> A: 4.0(4) 4.0(3) D: 4.7(4) 4.0(4)	
Brouwers et al. [32]/Netherlands	54 pts: LVAD Anxiety: Generalized Anxiety Disorder, GAD-7 (range: 0–21, cutoff: 10/9) Depression: Patient Health Questionnaires, PHQ-9 (range: 0–27, cutoff;10/9)		3–4 weeks A: 4.4(4.8) D: 6.9(4.5)	3 and 6 months: data was not shown		12 months: data was not shown	Higher scores on anxiety and depression over time were associated with poor health status
Reynard et al. [29]/ USA	66 pts: LVAD Anxiety: Generalized Anxiety Disorder, GAD-7 (range: 0–21, cutoff: 10/9) Depression: Patient Health questionnaire, PHQ-9 (range: 0–27, cutoff;10/9)	Before implantation A: 10.4(6.2) D: 12.1(7.5)	Follow-up (median:54 days, mean:126 days) A: 3.4(4.3) D: 5.7(5.4)				Anxiety and depression scores improved after LVAD implantation and remained stable up to 1 year

References/nation	No. of subject	Anxiety and depression score: means (standard deviations)					Results
		Before surgery/ treatment	1–2 months after surgery/treatment	3–6 months after surgery/treatment	7–11 months after surgery/treatment	1 year or more after surgery/ treatment	
Randomized controlled trial							
Furze et al.[42]/UK	I. 100 pts: first elective CABG C: 104 pts: first elective CABG Intervention: cognitive-behavioral intervention, nurse counseling Anxiety: the State Trait Anxiety Inventory, STAI (range: 20–80, cutoff: 55/54) Depression: cardiac depression scale, CDS (range: 26–182, cutoff: 95 or 100)	Baseline: placed on the elective waiting list <u>IC</u> A: 40.01(12.30) 41.52(12.69) D: 93.09(22.12) 96.78(23.49) 8 weeks after baseline <u>IC</u> A: no data D: 81.96 93.37					Anxiety and depression in the intervention group decreased
Rollman et al. [43]/USA	I_1: 150 depressed postCABG, telephone-delivered collaborative care I_2: 151 depressed post-CABG, usual care C: 151 nondepressed post-CABG, usual care Depression: the 17-items Hamilton Rating scale for depression (range: 0–68, cutoff: 8/7)		Discharge <u>I_1 I_2 C</u> D: 16.5(7.1) 15.9(6.9) 3.1(2.6)		8 months <u>I_1 I_2 C</u> D: 9.0(0.7) 11.4(0.7) no data		Anxiety and depression in the I_1 group decreased compared to the I_2 group
Lie et al. [11]/Norway	185 pts: elective CABG Intervention: a structured informational and psychological support by a skilled nurse at each patient's home Anxiety & depression: HADS	<u>IC</u> A: 5.7(3.8) 6.5(4.1) D: 3.8(3.6) 4.5(3.7)	6 weeks <u>IC</u> A:3.2(3.2) 3.9(3.6) D:3.2(2.8) 3.6(3.6)	6 months <u>IC</u> A:3.1(3.6) 4.2(4.2) D:2.7(3.1) 3.5(4.0)			Anxiety and depression in both group decreased. Not significant differences in two groups

References/nation	No. of subject	Anxiety and depression score: means (standard deviations)					Results
		Before surgery/ treatment	1–2 months after surgery/treatment	3–6 months after surgery/treatment	7–11 months after surgery/treatment	1 year or more after surgery/ treatment	
Trzcieniecka-Green et al. [12]/UK	50 pts: MI 50 pts: CABG Intervention: therapist- guided relaxation and stress management Anxiety & depression: HADS		2–3 months (Baseline) <u>IC</u> A: 7.50(3.3) 7.38(4.0) D: 4.32(2.5) 4.70(3.6)	5–6 months (3 months) <u>IC</u> A: 5.94(3.3) 7.60(4.2) D: 3.36(3.0) 4.68(3.7)	8–9 months (6 months) <u>IC</u> A: 5.73(3.1) no data D: 2.98(2.4) no data		Anxiety and depression in the intervention group decreased
<i>Nonrandomized controlled trial</i>							
Kugler et al. [36]/ Germany	I: 34 LVAD C: 36 LVAD Intervention: nutrition management, physical recondition program, psychosocial support and counseling Anxiety & depression: HADS		6 weeks <u>IC</u> A:2.0(0.6) 5.0(0.6) D:4.5(0.6) 4.0(0.5)	6 months: shown in only graph		12 and 18 months: shown in only graph	Anxiety level in the control group increased over time relative to the intervention group. No significant changes and differences in depression level were detected for both groups.
A: HADS anxiety; D: HADS depression; I: intervention group, C:control; TAS: thoracic aortic surgery, CABG: coronary artery bypass grafting, CMT: continuous medical treatment, PCI: percutaneous coronary intervention group.							

Table 1. The level of anxiety and depression before/after surgery.

the associated factors to readmission [16]. Oterhals et al. examined mid-term/long-term self-reported health status of patients 1 year or more after aortic valve replacement and/or CABG. The mean assessment interval since surgery was 6 years (range: 1–13 years) [17]. Compared to patients 1–5 years after CABG or TAS, the averages of both anxiety and depression were low (**Table 1**). That might be because the interval period after surgery in Oterhals's study was much longer and psychological conditions of dead patients after surgery were unknown, who was afraid of moderate/severe level of anxiety/depression.

There were a few prospective studies to patients with VS and/or CABG. Preoperative anxiety and/or depression would predict postoperative patient's QOL [18–20], persistent depression [21], worse physical condition [18], mortality, and morbidity [14]. These studies did not show the mean of anxiety and depression of patients with VS and/or CABG.

Since transcatheter valve implantation (TVI) was carried out for the first time in 2002 [22], its technology has been developing speedily. TVI is less-invasive treatment than valve surgery and more patients with a high-risk for valve surgery have been undergoing TVI. Psychological research about patients who underwent TVI also has begun recently. Elmalem et al. found that 37% of patients had improved anxiety and depression both 1 month and 6 months after TVI [23]. Two studies reported that anxiety/depression had become better after TVI but there were no differences about anxiety/depression between TVI and valve surgery patients after adjustment for baseline characteristics [24, 25]. Amonn et al. assessed anxiety and depression using HADS after a mean follow-up of 15 + 10 months and found that anxiety disorder was present in 5.7% of AVR and 12.9% of TAVI patients and that depression disorder was apparent in 17.1% of AVR and 12.9% of TAVI patients [25].

4. Anxiety and depression in ventricular device surgery (VDS)

Left ventricular assist devices (LVADs) have been developing dramatically, and patient with end-stage heart failure can be treated it as a destination therapy or as a bridge to transplant. Continuous-flow LVADs have reduced incidence of morbidity and mortality [26]. The number of psychological research has been increasing gradually.

Brouwers et al. reviewed systematically 16 quantitative studies with a sample size ≥ 10 that examined the impact of LVAD therapy, including both pulsatile devices and continuous-flow devices, on patients' health status and anxiety/depression [27]. They suggested that patients had improved their health status, anxiety, and depression in the first few months after LVAD implantation and that those scores of patients receiving LVAD therapy were still below for physical, social, and emotional functioning compared with transplant recipients. After Brouwer's study, some studies [28, 29] found decreasing of anxiety/depression after introducing LVADs, but two studies [30, 31], whose sample size were about 10, did not found the significant improvement in anxiety and depression. Higher scores on anxiety/depression over time were associated with poor health status [32] and rehospitalization [33]. Family of patients with LVAD was also increasing anxiety or depression level after implantation [34, 35].

Nonrandomized intervention research was carried out by Kugler et al. [36]. It used behavior-modifying strategies and consisted of nutrition management by a dietician, physical reconditioning program, psychosocial support, and counseling. Thirty-four patients were intervention group and 36 patients were the control group. Baseline was 6 weeks after implantation and patients were reassessed at 6, 12, and 18 months during their LVAD support time. The anxiety level in the control group increased over time relative to the intervention group. No significant changes and differences in depression level were detected. Physical health status scores in the intervention group increased significantly but mental health status scores in both groups did not change.

Patients' psychological status would improve after LVAD implantation. That might be because they relieve from bad physical conditions. Heart failure patients are not always in good physical conditions and have psychological problems. After implantation, patients need anticoagulation treatment and monitoring function of devices, etc., in addition to maintain healthier lifestyle for secondary prevention. Moreover, they have several risk-like malfunction device, infection, neurological dysfunction, etc. So patients need both physical and psychological care, and further research needs to develop better programs for their support.

5. Anxiety and depression in thoracic aortic surgery (TAS)

Instead of recent improvement of the surgical treatment of cardiovascular diseases, the hospital mortality rate for thoracic aortic surgery (TAS) is still high (approximately 10.5% in Japan) compared to coronary artery bypass grafting (CABG) surgery (approximately 2.2% in Japan) [37]. Some adverse complications of TAS can be extremely serious (e.g., brain injury, spinal cord injury, and bleeding, etc.). TAS is included in the same surgical repertoire as CABG in terms of open heart surgery, but it has a worse postoperative outcome. A few studies on psychological outcome have been conducted in TAS patients [38].

We surveyed 190 patients who underwent TAS or CABG at intervals of 1–5 years after the procedure, and then analyzed 128 patients with TAS ($n = 49$) or CABG ($n = 79$) as the primary surgery. Psychological outcomes were assessed using the hospital anxiety and depression scale (HADS). The incidence of mild (8–10) anxiety in TAS and CABG patients was five (11.6) vs. six (8.7%), respectively, and depression was present in nine (19.1%) and seven (10.1%), respectively. The incidence of severe (11 and more over) anxiety in TAS and CABG patients was four (8.5) vs. seven (10.1%), respectively, and depression was present in four (8.5%) and seven (10.1%), respectively. Psychological outcomes scores for the two groups did not differ significantly [7].

Fukuhara and Suzuki has reported that 5.6% of general Japanese ($n = 2279$) were suffering from severe depression using HADS on nationwide survey [39]. Kawakami reviewed that the prevalence of major depression among community-dwelling Japanese was 1–2% and estimated that of those who were seen in a general practice in Japan were approximately 5% [40]. He also reviewed that the prevalence of major depression among community-dwellers in the world was 1–8%. Compared to these community-based previous studies, not only CABG

patients, as we mentioned in Section 2, but also TAS patients at intervals of 1–5 years after the procedure might have higher percentage of depressive patients. Psychological outcomes in TAS patients might improve in the same manner as CABG.

Emergency surgery was revealed only one significant factor associated with depression in TAS, and there was no significant associated factor about anxiety in TAS. Symptoms such as chest pain and fatigue were associated with both anxiety and depression in CABG. We found that the frequency in TAS survivors was nearly equal to that in CABG survivors and that variables related to anxiety or depression were not so apparent in TAS patients compared to CABG patients [7]. Interestingly, emergency operation was related to depression in TAS patients but not in CABG patients, suggesting that awareness of their disease before surgery was related to depression. Generally speaking, many patients with TAS are asymptomatic until diagnosis [41], and some of them had to undergo an emergency operation just after diagnosis. This might have had an influence on depression in TAS patients who had undergone an emergency operation even if they had survived for some time afterward. On the other hand, even if CABG patients had undergone an emergency operation, they were already aware of their own disease because of the presence of symptoms such as chest pain, and shortness-of-breath. This would have lessened the impact on their psychological wellbeing after surgery compared with the TAS patients.

Interestingly, there were no variables on symptoms significantly related to anxiety and depression in TAS patients but there were some significantly related to both anxiety and depression in CABG patients. As Herrmann has suggested in cardiac patients HADS anxiety or depression is correlated with some symptoms, but there have been differences across studies [13]. Although the reason why TAS patients with some symptoms were not positive for anxiety or depression remains unknown, we suggest that TAS patients might be less fearful of death postoperatively because the surgical removal or repair of their aortic lesion had, in their minds, reduced the risk of a cardiac event, even if they were still experiencing some symptoms.

6. Nonpharmacological intervention

Several behavioral and psychological RCT intervention research have been carried out toward patients with CABG. In this section, one research prior to CABG surgery and three ones after CABG surgery were introduced.

Regarding intervention before CABG surgery, Furze et al. evaluated the addition of a brief, cognitive-behavioral RCT intervention (the HeartOp Program) to routine nurse counseling for people waiting for CABG surgery [42]. When patients in the intervention group were introduced, for the first time, in the outpatient clinic by nurses using a booklet that covered cardiac myths and misconceptions, reducing risk factors for secondary prevention and recovery process after surgery. The HeartOp program also included relaxation program on audiotape or CD and a diary for recording activity and risk factor reduction goals. Nurses followed by telephone at 1, 3, and 6 weeks and then monthly until they were hospitalized. At

8 weeks after baseline, there were no differences in anxiety. There were significant differences in depression (cardiac depression scale: difference = 7.79, $p = 0.008$, 95% CI = 2.04–13.54). There was no data after CABG surgery.

Rollman et al. had tested the effectiveness of an 8 month, biweekly, nurse-led telephone-delivered collaborative care for post-CABG depression vs. usual physician care in a randomized controlled trial [43]. A nurse telephoned to intervention patients and provided basic psycho-education about depression and its impact on cardiac disease using a workbook. The nurse also adjusted antidepressant drugs prescribed under their physicians' direction, monitoring, and referral to a mental health specialist if needed. Not only physical functioning (duke activity status index: delta=4.6 points, 95% CI=1.9-7.3) but also depression (Hamilton rating scale for depression: delta=3.1 points; 95% CI=1.3-4.9) had improved at 8 months after baseline. But the average HRQL and physical functioning of intervention patients did not recover that of the nondepressed comparison group.

Lie et al. evaluated the effects of a home-based intervention program (HBIP) on anxiety and depression 6 months after CABG [11]. An HBIP for the intervention group was performed 2 and 4 weeks after surgery. A skilled nurse provided education about angina symptoms, medication, how to emergency attention, and so on with emotional support at 2 and 4 weeks after surgery. Although the improvements of anxiety and depression symptoms did not differ significantly between the groups, on 6-week and 6-month follow-ups, significant improvements in anxiety and depression symptoms were found in both groups.

Trzcieniecka-Green and Steptoe assessed the impact of group-based stress management training on emotional wellbeing, functional status, social activity, and chest pain in patients following acute myocardial infarction or coronary bypass surgery, within a randomized controlled trial [12]. Experimental patients underwent a 10 group-based weekly sessions about relaxation-based stress management program by therapists. Significantly greater improvements in both anxiety and depression were found in the experimental groups than control groups, and improvements were maintained at 6-month follow-up.

In the nonpharmacology intervention, patients received behavioral and psychological education, etc., by a nurse or a therapist, and their depression would be improved after the intervention. Further research needed to clarify the effect of intervention group compared to control group.

7. Conclusion and implication for future research

The prevalence of anxiety and depression of patients after cardiovascular surgeries has varied from 10 to 60% and has been likely higher than that of general people. Although there were several studies about patients within 6 months after surgery, studies about patients over 6 months after surgery were limited. From the limited studies about patients over 6 months after surgery, we guessed the followings about the trends of anxiety and depression of patients with CABG without any other additional intervention programs before/after surgery: (1) patients improved scores of anxiety and depression 3–6 months after surgery,

(2) anxiety decreased considerably for about 6 months after CABG and then leveled out for some time, and (3) depression remained a bit higher 6 months and more after CABG. Patients' longitudinal psychological conditions would have been influenced by not only invasive cardiovascular surgery using cardiopulmonary bypass perfusion techniques but also life events. The nonpharmacology intervention consisting of behavioral and psychological education, etc., by a nurse or a therapist would have improved patients' psychological conditions. Further research needed to clarify the long-term psychological outcome and to develop the more effective intervention programs toward patients with cardiovascular surgery.

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