REVIEW

Depressive Symptoms After CABG Surgery: A Meta-analysis

Simha Ravven, MD,* Caroline Bader, BA,* Armin Azar, PhD, and James L. Rudolph, MD, SM

Learning Objectives: After participating in this educational activity, the reader should be better able to measure the risk of depression before and after coronary artery bypass graft (CABG) surgery; examine the course of depression after CABG; and apply the results of the study to the treatment of patients.

Objective: Depression is highly comorbid with coronary artery disease. Clinicians face the question of whether patients' depressive symptoms will improve after coronary artery bypass graft surgery (CABG). The objective of this meta-analysis is to determine the course of depressive symptoms after CABG.

Methods: EMBASE, PubMed, and PsycINFO were searched for studies assessing depression before and after CABG. Meta-analyses were performed for depression at early (1–2 weeks), recovery (>2 weeks to 2 months), mid (>2 months to 6 months), and late (>6 months) postoperative time points. Heterogeneity and publication bias were analyzed.

Results: Thirty-nine studies were included in the meta-analysis. Twelve reported dichotomous outcomes; 18 reported continuous outcomes; and 9 reported both. Risk of depression was increased early (relative risk [RR] = 1.27; 95% confidence interval [CI], 1.01–1.61). There was a significantly decreased risk of depression at recovery (RR = 0.78; 95% CI, 0.67–0.90), mid (RR = 0.64; 95% CI, 0.58–0.70), and late (RR = 0.68; 95% CI, 0.58–0.79) time points without heterogeneity. All studies reporting continuous depression scales had significant heterogeneity.

Conclusions: The risk of depression decreased post-CABG when depression was measured dichotomously. While depression improves overall and remits for some patients after CABG, the majority of patients will not experience remission of depression. Preoperative and postoperative depression monitoring is important.

Keywords: cardiac surgery, coronary artery bypass graft surgery, depression

INTRODUCTION

Coronary artery bypass graft surgery (CABG) is the most common cardiac surgery in the United States, with over 200,000 procedures currently performed a year.[1] Depression and coronary artery disease are highly comorbid conditions with estimates of comorbidity from 14% to 47%.[2] Many patients undergoing cardiac surgery, especially CABG, suffer from depression, both pre- and postoperatively.[2–5] Both preoperative and also postoperative depression predict poor recovery from this procedure. Providers are often faced with the question of whether a patient with major depressive disorder or subclinical depressive symptoms will experience an improvement or worsening in depressive symptoms after CABG. The high comorbidity between coronary artery disease (CAD) and depressive symptoms necessitates an understanding of the effect of CABG on depressive symptoms. Several theories will be discussed.

Preoperative depression is predictive of decreased cardiac symptom relief, quicker return of symptoms, more frequent rehospitalizations, and increased mortality in the immediate postoperative period.[3,6] In a prospective study of patients undergoing CABG, Blumenthal and colleagues[2] showed that those patients who were moderately to severely depressed before CABG had a greater than twofold risk of death after surgery as compared to their nondepressed counterparts. Additionally, the presence of depression preoperatively is predictive of postoperative depression.[7,8] Recent research has shown that depression in CAD patients is often not detected and treated adequately.[9,10]

Postoperative depression is also associated with complicated recovery and poor postoperative outcomes after

From Harvard Medical School (Dr. Ravven); Department of Psychiatry, Cambridge Health Alliance (Dr. Ravven); Albert Einstein College of Medicine (Ms. Bader); Geriatrics and Extended Care, Providence VA Medical Center, Providence, RI (Dr. Azar); Geriatric Research, Education, and Clinical Center, VA Boston Healthcare System, Boston MA (Dr. Rudolph); Division of Aging, Brigham and Women's Hospital, Boston, MA (Dr. Rudolph).

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Correspondence: James L. Rudolph, MD, SM, 150 S. Huntington Ave., Boston, MA 02130. Email: jrudolph@partners.org

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* Dr. Ravven and Ms. Bader contributed equally and have agreed to share first authorship.

CABG. Depression after CABG increases both the risk of poor physical and emotional recovery from surgery[3,11] and the morbidity and mortality from cardiovascular disease.[12] Postoperative depression has been associated with decreased physical function,[13] increased risk of cardiovascular events (angina, myocardial infarct, cardiovascular mortality),[10,14] and increased mortality.[2,15] Postoperative depression is further associated with poor wound healing, increased likelihood of wound infection, and increased risk of cardiac events postoperatively.[16]

The aim of the present study is to conduct a systematic literature review and meta-analysis to examine the course of depressive symptoms after CABG. We hypothesized that depressive symptomatology would improve after surgery due to alleviation of pain, improvement in physical function, and relief of the anticipatory stress of cardiac surgery.

MATERIALS AND METHODS

Search Methodology

EMBASE, PubMed, and PsycINFO were searched. We reviewed studies between October 1, 1995, and June 15, 2011, that were limited to the English language, adults (≥18 years), and human subjects. The cardiac surgery search term was created by the combination of the following medical subject headings: "cardiac surgery, coronary artery bypass graft, CABG, heart surgery, valve replacement OR thoracic thoracic surgery." The depression term included the MeSH terms "major depressive disorder, depression or depression screen or depression scale."

Abstract Review and Study Selection Criteria

Abstracts using both the cardiac surgery and depression terms were independently reviewed by two authors, and relevant studies were identified for full-text review. Inclusion criteria included prospective studies that measured depression preoperatively and postoperatively (using the same instrument) and that looked specifically at CABG patients. (The search initially included a broad range of cardiac surgeries. We subsequently focused our search on CABG because of the variability in cardiac surgery types and combinations.) We excluded studies examining CABG with valve surgery, where data for CABG alone were not reported. Exclusion criteria included studies that did not specify how depression was assessed, that used single-question depression scales, that did not report postoperative and preoperative depression measurements, that did not report mean and error values for continuous depression measures, that measured postoperative depression less than one week postoperatively, and that measured preoperative depression postoperatively. We did not exclude studies based on their enrollment criteria regarding preexisting mental illness. Additionally, the reference lists of all included studies were manually reviewed for relevant references. Figure 1 is a flow diagram of the article selection process.

Measurement Variables

Study characteristics, demographic characteristics, and depression measures were abstracted from studies that met

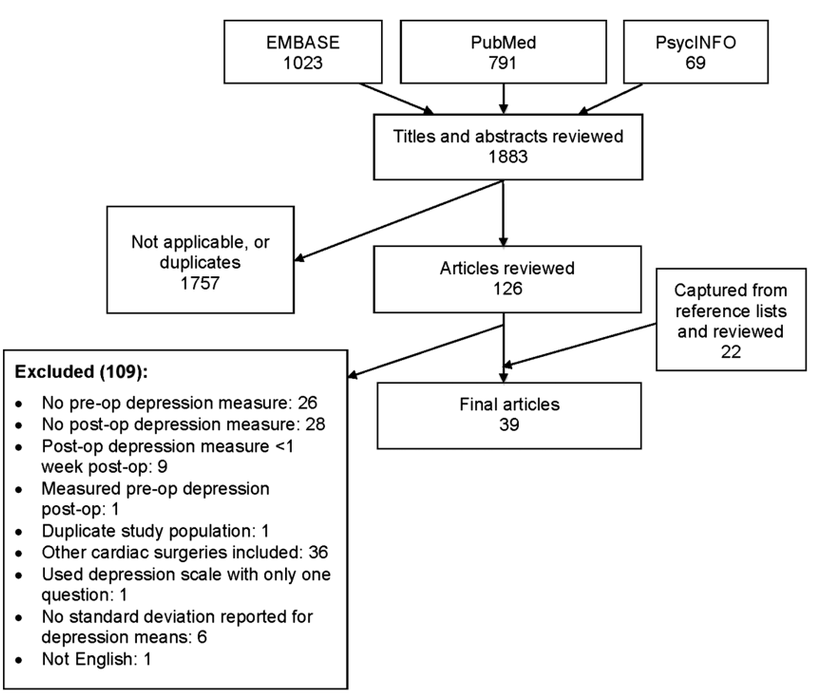

Figure 1. Flow diagram of the article selection process.

inclusion criteria. The mean age of subjects and the percentages of male and female subjects were recorded. We recorded depression at the time points used by the studies preoperatively and postoperatively. Postoperative time points were chosen to reflect a normal course of recovery; recovery to full function after CABG usually takes 1–2 months. Time points were categorized as follows: early (1–2 weeks), recovery (>2 weeks to 2 months), mid (>2 months to 6 months), and late (>6 months). In the analysis of depression expressed as a continuous variable, baseline data were stratified into the proximal baseline assessment (depression assessed ≤1 week preoperatively) and remote baseline assessment groups (depression assessed >1 week preoperatively).

For the studies with dichotomous data, the number of patients identified as depressed and not depressed for each time point measured was abstracted. Additionally, the cutoff on the depression measure used was noted. For those with continuous variables, the data points used were the means and standard deviations of scores on the given depression measure for each time point measured by that study. If a study presented both dichotomous and continuous data, both were used in analysis.

Statistical Analysis

DICHOTOMOUS OUTCOMES Studies with dichotomous depression outcomes were assembled with the timing of the outcome as the dependent variable and the preoperative assessment as the control variable. A meta-analysis was performed for each of the four postoperative time points. The relative risk of depression at each postoperative time period was calculated and is displayed on the forest plot (Figure 2). Heterogeneity magnitude (I^2) and significance was calculated for each meta-analysis.[17]

CONTINUOUS OUTCOMES For each of the postoperative time points, we calculated a standardized mean difference (effect size) relative to the mean and standard deviation of the baseline. Heterogeneity magnitude (I^2) and significance were calculated. Further analyses were stratified by the timing of the preoperative depression assessment. The proximal baseline assessment included those studies in which depression was evaluated one week or less preoperatively. Remote baseline assessment included those studies in which depression was evaluated greater than one week preoperatively. For these analyses, the overall effect size,

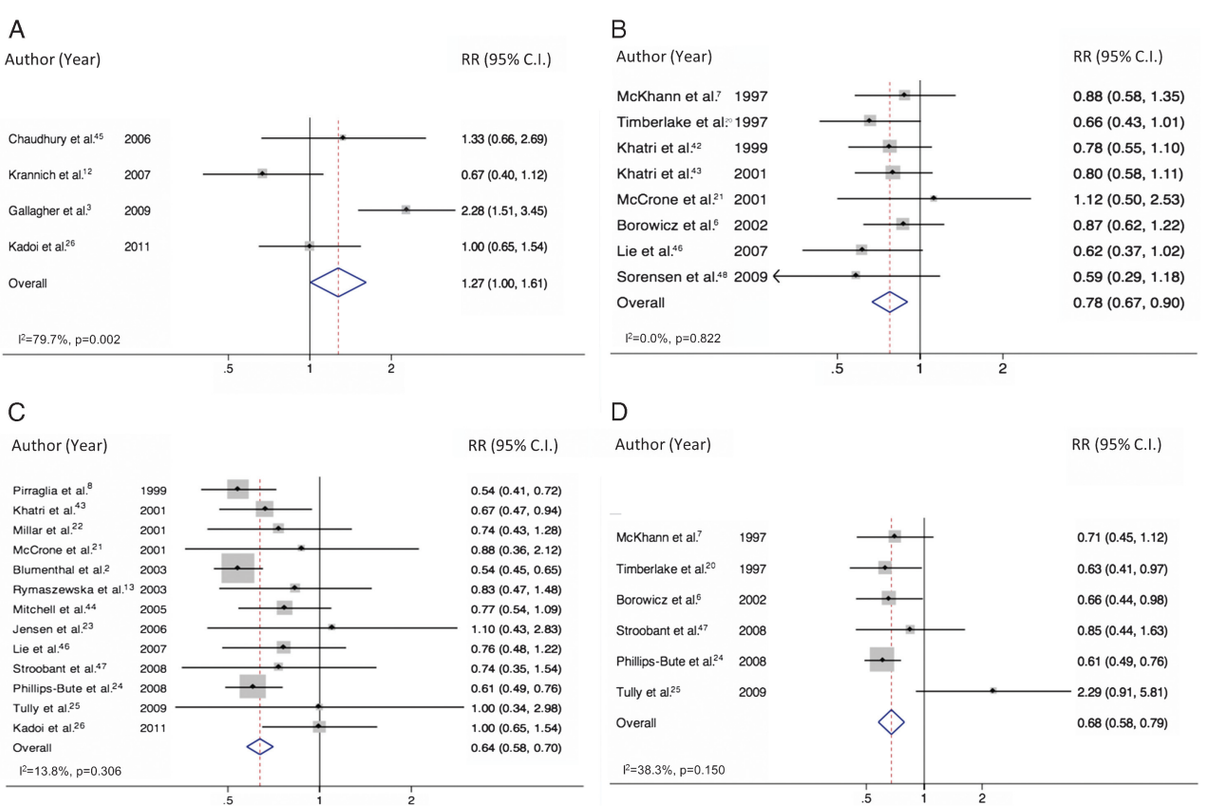

Figure 2. Forest plots of dichotomous data. Displays relative risks of depression from the preoperative time point (baseline) to four different time points postoperatively. Panel A: Relative risk of depression from baseline to 1–2 weeks post-surgery. Panel B: Relative risk of depression from baseline to >2 weeks to 2 months post-surgery. Panel C: Relative risk of depression from baseline to 2–6 months post-surgery; Panel D: Relative risk of depression from baseline to >6 months post-surgery. RR, relative risk.

Table 1

Characteristics of 39 Eligible Studies[a]

	Type of study (& RCT intervention)	n (pre-op/final post-op)	Post-op measurement times	Depression measure & cutoff	Mean age in years (SD)	% women (n)	CPB used?[b]
Dichotomous							
McKhann et al. (1997)[7]	Cohort	124/124	1 month, 1 year	CES-D > 16	63.0 (NR)	21.3 (27)	NR
Timberlake et al. (1997)[20]	Cohort	103/103	2 months, 1 year	BDI ≥ 9	56.0 (7.9)	9.9 (12)	Yes
Pirraglia et al. (1999)[8]	Cohort	218/218	6 months	CES-D ≥ 16	65.3 (9.3)	18.8 (41)	Yes
McCrone et al. (2001)[21]	Cohort	31/31	8 weeks, 3 months	CES-D ≥ 16	70.0 (8.6)	38.7 (12)	NR
Millar et al. (2001)[22]	Cohort	81/81	6 months	BDI ≥ 9	60.9 (9.4)	21 (17)	Yes
Borowicz et al. (2002)[6]	Cohort	172/132	1 month, 1 year	CES-D ≥ 16	63.4 (NR)	22.1 (38)	NR
Blumenthal et al. (2003)[2]	Cohort	817/490	6 months	CES-D ≥ 16	61.0 (10.2)	27.1 (221)	NR
Rymaszewska et al. (2003)[13]	Cohort	56/53	3 months	BDI (cutoff NR)	58.6 (NR)	30.2 (16)	Yes
Jensen et al. (2006)[23]	RCT (on-pump/ off-pump)	120/109	3 months	MDI > 2.5	75.5 (4.5)	40 (48)	Both[b]
Phillips-Bute et al. (2008)[24]	Cohort	427/411	6 months, 1 year	CES-D ≥ 16	61.0 (10.9)	30 (128)	Yes
Tully et al. (2009)[25]	Cohort	86/75	6 months, 5 years	DASS ≥ 10	65.1 (9.9)	26.7 (23)	Yes
Kadoi et al. (2011)[26]	Cohort	90/90	1 week, 6 months	BDI ≥ 10	65.0 (9.0)	24.4 (22)	Yes
Continuous							
Duits et al. (1999)[4]	Cohort	270/217	1week, 6 months	HADS-D	60.8 (8.8)	18.9 (41)	NR
Edell-Gustafsson & Hetta (1999)[27]	Cohort	38/38	1 & 6 months	Zung SDS	61.3 (5.0)	0 (0)	NR
Keresztes et al. (2003)[28]	Cohort	80/80	1 & 3 months	POMS-D	63.3 (11.5)	50 (40)	NR
Lindquist et al. (2003)[29]	Cohort	674/600	6 weeks, 6 months, 1 year	CES-D	63.6 (9.4)	39.9 (269)	NR
Knipp et al. (2004)[30]	Cohort	35/29	3 months	HADS-D	67.6 (8.7)	17.2 (5)	Yes
Phillips-Bute et al. (2006)[31]	Cohort	732/551	6 weeks, 1 year	CES-D	62.3 (11.0)	39.2 (216)	Yes
Ruiz et al. (2006)[32]	Cohort	111/97	18 months	CES–D-10	61.1 (10.3)	0 (0)	NR
Sorlie et al. (2006)[33]	RCT (educational intervention/control)	109/87	6 weeks, 6 months, 1 year	Zung SDS	58.3 (6.3)	11.9 (13)	NR
Szalma et al. (2006)[34]	RCT (piracetem/ placebo)	109/88	6 weeks	BDI	55.9 (5.6)	17.4 (19)	NR
Bay et al. (2007)[35]	RCT (religious intervention/control)	170/170	1 & 6 months	HADS-D	64.0 (NR)	24.7 (42)	NR

Table 1
Continued

	Type of study (& RCT intervention)	n (pre-op/final post-op)	Post-op measurement times	Depression measure & cutoff	Mean age in years (SD)	% women (n)	CPB used?[b]
Lopez et al. (2007)[36]	Cohort	68/68	1 week, 6 months	CES-D	63.9 (10.1)	33.8 (23)	Both
Murphy et al. (2008)[5]	Cohort	180/119	2 & 6 months	HADS-D	65.6 (9.8)	21.7 (39)	NR
Sandau et al. (2008)[37]	Cohort	54/54	3 months	CES-D	65.2 (9.3)	21.9 (14)	Both
Azzopardi & Lee (2009)[38]	Cohort	48/48	2 years	BDI	66.6 (9.9)	14.6 (7)	NR
Elliott et al. (2010)[39]	Cohort	174/117	2 & 6 months	POMS-D	65.5 (9.8)	21.3 (37)	NR
Kozora et al. (2010)[40]	RCT (on-pump/ off-pump)	1801/1156	1 year	BDI	62.0 (8.2)	0.6 (7)	Both
van Mastrigt et al. (2010)[41]	RCT (short-stay intensive care treatment/control)	406/361	1 month, 1 year	BDI	61.9 (12.2)	19.2 (78)	Both
Nemati & Astaneh (2011)[11]	Cohort	71/71	1 month	HADS-D	59.9 (8.7)	26.8 (19)	NR
Dichotomous & continuous							
Khatri et al. (1999)[42]	Cohort	170/170	6 weeks	CES-D	61.0 (10.0)	25.3 (43)	NR
Khatri et al. (2001)[43]	RCT (hypothermic/ normothermic)	226/208	6 weeks, 6 months	CES-D >16	61.6 (12.7)	24.8 (56)	Yes
Mitchell et al. (2005)[44]	Cohort	123/120	2 months	BDI ≥10	63.3 (10.2)	44.2 (53)	NR
Chaudhury et al. (2006)[45]	Cohort	30/30	1 week	HADS-D (cutoff NR)	60.0 (5.5)	10 (3)	NR
Krannich et al. (2007)[12]	Cohort	97/97	10 days	HADS-D ≥ 8	65.0 (8.5)	18.6 (18)	NR
Lie et al. (2007)[46]	RCT (psychological support/control)	203/185	6 weeks, 6 months	HADS-D ≥ 8	62.0 (NR)	10.3 (9)	NR
Stroobant & Vingerhoets (2008)[47]	Cohort	53/43	6 months, 3–5 years	BDI-CA ≥ 4	59.4 (7.2)	7.5 (4)	Both
Gallagher & McKinley (2009)[3]	Cohort	155/126	2 weeks	HADS-D ≥ 8	66.3 (10.7)	26.5 (41)	NR
Sorensen & Wang (2009)[48]	Cohort	70/63	6 weeks	GDS ≥ 5	72.0 (5.7)	34.3 (24)	NR

BDI, Beck Depression Inventory; BDI-CA, Beck Depression Inventory (cognitive-affective subscale); CES-D, Center for Epidemiologic Studies Depression Scale; CES-D-10, Center for Epidemiologic Studies Depression Scale (10-item version); CPB, cardiopulmonary bypass; DASS, Depression Anxiety Stress Scale (depression subscale); GDS, Geriatric Depression Scale; HADS-D, Hospital Anxiety and Depression Scale (depression subscale); MDI, Major Depression Inventory; NR, not reported; POMS-D, Profile of Mood States Depression Scale; RCT, randomized, controlled trial; SD, standard deviation; Zung SDS, Zung Self-Rating Depression Scale.

[a] Dichotomous only: n = 12; continuous only: n = 18; dichotomous and continuous: n = 9.

[b] *Yes* refers to the use of CPB (on-pump). *Both* includes surgeries with (on-pump) and without (off-pump) CPB.

Table 2

The Ten Depression Measures Used

Depression measure	Scale	Significance of score	Continuous studies (total n = 27)		Dichotomous studies (total n = 21)		
			Studies (n)	Studies	Studies (n)	Studies	Cutoffs used: studies (n) using the cutoff
Beck Depression Inventory[34]	0–63	0–9: normal 10–15: mild depression 16–19: mild to moderate depression 20–29: moderate to severe depression 30–63: severe depression	5	Mitchell (2005)[44] Szalma et al. (2006)[34] Azzopardi (2009)[38] Kozora (2010)[40] van Mastrigt (2010)[41]	5	Timberlake (1997)[20] Millar (2001)[22] Rymaszewska (2003)[13] Mitchell (2005)[44] Kadoi (2011)[26]	≥9: 2 ≥10: 3 NR: 1
Beck Depression Inventory (cognitive-affective subscale)[47]	0–39	0–3: normal 4–6: mild depression >7: moderate depression	1	Stroobant (2008)[47]	1	Stroobant (2008)[47]	≥4: 1
Center for Epidemiologic Studies Depression Scale[49]	0–60	Higher scores represent worse depressive symptoms	6	Khatri (1999)[42] Khatri (2001)[43] Lindquist (2003)[29] Phillips-Bute (2006)[31] Lopez (2007)[36] Sandau (2008)[37]	8	McKhann (1997)[7] Khatri (1999)[42] Pirraglia (1999)[8] Khatri (2001)[43] McCrone (2001)[21] Borowicz (2002)[6] Blumenthal (2003)[2] Phillips-Bute (2008)[24]	>16: 3 ≥16: 5
Center for Epidemiologic Studies Depression Scale (10-item version)[32,49]	0–30	Higher scores represent worse depressive symptoms	1	Ruiz (2006)[32]	0		
Depression Anxiety Stress Scale (depression subscale)[25]	0–42	Higher scores represent worse depressive symptoms	0		1	Tully (2009)[25]	≥10: 1
Geriatric Depression Scale (15-item)[50]	0–15	≤10: normal 11–20: mild depression ≥21: moderate to severe depression	1	Mui (1996)[50]	1	Mui (1996)[50]	≥5: 1
Hospital Anxiety and Depression Scale (depression subscale)[3]	0–21	0–7: low levels of depression 8–10: borderline cases ≥10: clinical cases	9	Duits (1999)[4] Knipp (2004)[30] Chaudhury (2006)[45] Krannich (2007)[12] Lie (2007)[46] Bay (2008)[35] Murphy (2008)[5] Gallagher (2009)[3] Nemati (2011)[11]	4	Chaudhury (2006)[45] Krannich (2007)[12] Lie (2007)[46] Gallagher (2009)[3]	≥8: 3 NR: 1

Table 2
Continued

Depression measure	Scale	Significance of score	Continuous studies (total n = 27)		Dichotomous studies (total n = 21)		
			Studies (n)	Studies	Studies (n)	Studies	Cutoffs used: studies (n) using the cutoff
Major Depression Inventory[23]	0–50	20–24: mild depression 25–29: moderate depression ≥ 30: severe depression	0		1	Jensen (2006)[23]	>2.5: 1
Profile of Mood States Depression Scale[28]	0–60	Higher scores represent worse depressive symptoms	2	Keresztes (2003)[28] Elliott (2010)[39]	0		
Zung Self-Rating Depression Scale[51]	25–100	25–49: normal 50–59: mild depression 60–69: moderate depression ≥ 70: severe depression	2	Edell-Gustafsson (1999)[27] Sørlie (2007)[33]	0		

NR, not reported.

95% confidence interval, and presence of significant heterogeneity were reported at each time point.

ASSESSMENT FOR PUBLICATION BIAS Data were analyzed for publication bias using the methods of Egger[18] and Peters[19] to assess for small study bias for dichotomous outcomes.

RESULTS

Figure 1 summarizes the search strategy and results. The search identified 1883 abstracts, 126 of which were identified for full text review. The references were also manually searched, yielding an additional 22 articles. 109 studies were excluded. Ultimately 39 studies on depression after CABG fitting the inclusion criteria were identified, including a total of 8,633 patients.

Studies are presented by type of variables used. Table 1 describes all studies (dichotomous only: n = 12; continuous only: n = 18; both dichotomous and continuous: n = 9), including the number of subjects, age, depression measure, and times of follow-up. Table 2 describes the depression measures (n = 10) used by the 39 studies. The Center for Epidemiological Studies Depression Scale and the Hospital Anxiety and Depression Scale depression rating were the most commonly used tests (n = 13 for each).

Table 3 displays the results of the meta-analyses for both the dichotomous and continuous data, as well as the results of the heterogeneity and publication bias analyses for each time point. Thirty percent of subjects were depressed preoperatively, and 21.6% were depressed at the latest (>6 months) postoperative time point.

Figure 2 shows the Forest plots from the meta-analysis of the dichotomous data at each of the four postoperative time points. The early time point (panel A) showed an increased risk of depression relative to baseline (relative risk [RR] = 1.27; 95% confidence interval [CI], 1.01–1.61) but showed significant heterogeneity between studies (I^2 = 79.70%; p for heterogeneity < .001). By contrast, the recovery time point (panel B) showed a significant decreased risk of depression (RR = 0.78; 95% CI, 0.67–0.90) and no between-study heterogeneity (I^2 = 0.00%; p for heterogeneity = 0.82). The mid time point (panel C) showed a more pronounced decrease in depression risk post-surgery (RR = 0.64; 95% CI, 0.58–0.70), also without heterogeneity (I^2 = 13.80%; p for heterogeneity = 0.31). Analysis of the late postoperative time point (panel D) also showed a reduction in depression (RR = 0.68; 95% CI, 0.58–0.79) without heterogeneity (I^2 = 38.30%; p for heterogeneity = 0.15), indicating that this decreased risk of depression was sustained throughout the long-term postoperative period.

Analysis of the continuous data yielded significant heterogeneity across all time points. In the stratified data, the proximal baseline assessment group also showed significant heterogeneity across all time points; thus, these data cannot be considered statistically valid. Upon stratification,

Table 3

Summary of Depressive Symptoms Postoperatively by Type of Study

		Postoperative time points			
		Early (1 to 2 weeks)	Recovery (from 2 weeks to 2 months)	Mid (from 2 to 6 months)	Late (over 6 months)
Dichotomous studies (n = 21)					
Overall baseline assessment (n = 21)					
	% depressed (median)[a]	35.5%	24%	22%	21.6%
	% depressed (range)	18%–45%	11%–29%	7%–31%	16%–26%
	Relative risk	1.27	0.78	0.64	0.68
	95% CI	1.01, 1.61	0.67, 0.90	0.58, 0.70	0.58, 0.79
	Number of studies[b]	4	8	13	6
	Heterogeneity	Yes	No	No	No
	Publication bias	No	No	Yes	No
Continuous studies (n = 27)					
Overall baseline assessment (n = 27)					
	Standard mean difference	0.21	−0.19	−0.41	−0.21
	95% CI	0.09, 0.33	−0.24, −0.14	−0.47, −0.35	−0.26, −0.16
	Number of studies[b]	5	15	15	8
	Heterogeneity	Yes	Yes	Yes	Yes
	Publication bias	No	No	No	No
Proximal baseline assessment (n = 10)					
	Standard mean difference	0.24	−0.17	−0.48	−0.20
	95% CI	0.04, 0.45	−0.24, −0.09	−0.57, −0.39	−0.26, −0.15
	Number of studies[b]	3	4	5	3
	Heterogeneity	Yes	Yes	Yes	Yes
	Publication bias	Yes	No	No	No
Remote baseline assessment (n = 6)					
	Standard mean difference	−0.08	−0.34	−0.35	−0.25
	95% CI	−0.26, 1.00	−0.48, −0.19	−0.46, −0.24	−0.52, 0.03
	Number of studies[b]	1	4	4	1
	Heterogeneity	NA	No	No	NA
	Publication bias	NA	No	No	NA

CI, confidence interval; NA, not enough data available for analysis.

[a] Median percentage depressed preoperatively was 30%, with a range of 7% to 43%.

[b] Since some studies take measurements at more than one time point, the number of studies adds up to more than the number in each broader category.

there was a decrease in standardized mean difference (SMD) for the remote baseline assessment group without heterogeneity at all time points: early (SMD = −0.08; 95% CI, −0.26 to 1.00); recovery (SMD = −0.34; 95% CI, −0.48 to 0.19); mid (SMD = −0.35; 95% CI, −0.46 to −0.24), and late (SMD = −0.25; 95% CI, −0.52 to 0.03).

Only one time point in the dichotomous data (mid) and one in the stratified continuous data (early, in the proximal baseline assessment group) demonstrated publication bias.

DISCUSSION

This study found that depression is prevalent in patients undergoing CABG, both before and after the procedure. The overall risk of being depressed after CABG is decreased, though greater than 20% of those who undergo CABG are depressed in the months afterward, after the immediate postoperative period has passed. This conclusion was drawn from a systematic synthesis and meta-analysis of data on depression and depressive symptoms after CABG from 39 studies.

These findings have clinical application in multiple areas, including psychiatry, cardiac surgery, cardiology, primary care, and research. Depression is highly comorbid with coronary artery disease. Clinicians frequently face the question of whether a patient's depressive symptoms are likely to change after CABG. The findings of this study suggest that significant improvement in depressive symptoms is experienced by nearly one-third of those preoperatively depressed but that a significant portion (approximately one-fifth) of those who have undergone CABG remain depressed or develop new depression.

The relationship between cardiovascular disease, especially CAD, and depression has been widely examined. There is likely a reciprocal relationship between the two. The association between depression and poor outcomes in cardiovascular disease is well established.[3,11,45] Cardiovascular disease contributes to depression according to the vascular-depression hypothesis that thromboembolism and hypotension from vascular disease reduce perfusion to brain areas associated with depression—in particular, the frontal-subcortical circuits and hippocampus.

While this study found overall improvement in depressive symptoms after CABG, for the majority of patients, depression persists after the surgery.[2,8,20,22] Thus, both preoperative and postoperative assessments of depression are critical in the CABG patient. Preoperative assessment is important because preoperative depression is predictive of the ability to weather the stress of major surgery and may therefore compromise effective postoperative recovery.[3] More specifically, preoperative assessment of depression enables the identification of patients at risk for delirium, poor recovery, and subsequent depression; postoperative interventions and depression monitoring can therefore focus on these patients. Note, too, that because preoperative depression is associated with postoperative mortality,[2] study dropout due to mortality may result in a more positive picture of postoperative depression than is actually the case. Regular postoperative assessment is needed to identify and treat depressed patients.

The current study highlights the importance of the timing of depression measures before and after CABG in assessing clinically meaningful mood disturbance. As the stratified continuous data showed, measuring preoperative depression close to the time of surgery ($\leq$1 week prior) may yield results that do not reflect clinically meaningful mood disorders. A depression measure taken too close to the point of surgery may be reflecting anticipation of impending surgery and a worsening of physical symptoms.[4] Similarly, as shown in the dichotomous data, a measurement taken in the two weeks after surgery may reflect the known consequences of surgery and perioperative care (e.g., pain, poor sleep, complications) rather than a mood disorder. If preoperative depression is assessed in sufficient time before ($>$1 week) and after ($>$2 weeks) surgery, this evaluation will yield more clinically useful information and generate more appropriate interventions.

Research on this topic has been intense in recent years. A major strength of the present meta-analysis is the large number of studies available for inclusion. Another strength is the ability to break down the data into discrete postoperative time points, which allowed the course of depressive symptoms during recovery to be measured precisely. Depression was analyzed as both a continuous and a dichotomous variable, allowing the examination of fluctuation in depressive symptoms before and after CABG. Heterogeneity and publication bias were also systematically measured. This analysis yielded dichotomous data that displayed heterogeneity only at the earliest time point, and publication bias only at one of the four time points.

This study has several limitations. Studies included in our analysis measured depressive symptoms using clinical assessment tools—most frequently, the Center for Epidemiological Studies Depression Scale and the Hospital Anxiety and Depression Scale depression rating—rather than diagnosing depression through clinical interviews. Additionally, to be included in this meta-analysis, studies needed to assess depression both before and after surgery. This condition excluded many studies that examined depressive symptoms only before CABG, and it also likely limited the population included in the meta-analysis to those undergoing planned CABG (to allow sufficient time preoperatively to assess depression). Relatively few women were included, though this limitation likely reflects the population receiving non-emergent CABG. Our study was also limited by not knowing the patients' indications for CABG, patients' comorbid medical and psychiatric conditions, and the characteristics of the hospitalizations (e.g., length of stay). We were also unable to analyze depression risk by age, sex, or surgical and other treatment characteristics because these variables were not consistently reported.

The population included in this study was heterogeneous in terms of preexisting mental illness. Some studies excluded patients who had a history of psychiatric illness, whereas others did not assess or report preoperative diagnosis of mental illness. Likewise, none of the studies reported postoperative treatment for depression. It is not known whether treatment specifically for depression (e.g., psychotherapy or pharmacotherapy) contributed to the improvement in depressive symptoms that was observed. A recent randomized, cross-sectional survey of U.S. cardiovascular physicians revealed that nearly three-fourths of them ask less than half their patients about depression and that over three-fourths of them (79%) of them do not use a standard screening tool.[9] Just under half stated that they treat depression.[9] According to a nationally representative study on the prevalence and correlates of major depressive disorder in a general adult population, its 12-month prevalence was 16.2%, and 21.7% of those with major depressive disorder were adequately treated for their depression.[10] This percentage of adequate treatment, though low, could explain some of the improvement in depressive symptoms observed after CABG. This same low percentage of adequate treatment also highlights, however, the need for depression screening and treatment in the especially vulnerable population of those with CAD.

Other significant limitations of this meta-analysis are that it included both interventional and observational studies and that the quality of included studies was not systematically assessed.

Finally, analysis of the continuous data was limited by the heterogeneity found across all time points in the overall baseline assessment data. Though sub-analysis yielded a remote baseline assessment group without heterogeneity, assessing depression greater than one week prior to surgery is more meaningful than doing so shortly before surgery.

This meta-analysis found significant depression both before and also after CABG. Systematic screening for depression in the period both before and after this procedure is crucial. Identifying depression in CABG patients is important in view of the high comorbidity of depression in those with coronary artery disease, the negative effect of depression on postoperative recovery, morbidity, and mortality, and the treatability of depression.

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