J Med Dent Sci 2016; 63: 37–43

Review

Predictors of Depression in Patients Diagnosed with Myocardial Infarction after Undergoing Percutaneous Coronary Intervention: A literature review

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Aim: This study identified the factors associated with depression in patients diagnosed with myocardial infarction (MI) who underwent percutaneous coronary intervention (PCI).
Methods: We searched the literature using PubMed and CINAHL from their inception in 1946 to December 2014. The search terms were "myocardial infarction," "depression," and "percutaneous coronary intervention." Studies which investigated factors associated with depression in patients diagnosed with MI who underwent typical medical procedures were searched.
Results: Eleven studies met our inclusion criteria. None of these limited their samples to patients with MI who underwent PCI. Twenty-one factors were identified as possible risk factors for depression in patients who were diagnosed with MI and underwent PCI: gender; negative illness beliefs; neuroticism; autonomy; baseline depression scores; previous diagnosis of depression, anxiety, or stress; smoking; marital status; Type D personality; procedure; length of hospital stay; fat intake; functional disability; time engaged in physical activity; social support; and a history of angina, MI, coronary artery bypass graft surgery, PCI, diabetes mellitus, and stroke.
Conclusions: This review suggests that these 21 factors should be considered in future studies as possible independent variables or covariates of depression among MI patients who have undergone PCI.

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Received March 8 ; Accepted June 10, 2016

Key Words: depression, myocardial infarction, percutaneous coronary intervention.

Introduction

Cardiovascular disease, including myocardial infarction (MI), is one of the most common causes of death in the world[1]. It is also well known that the prevalence of depression in patients diagnosed with MI, which ranges from 16% to 25%[2-4], is considered to be quite high. Depressed patients diagnosed with MI have increased rates of mortality and cardiac events[2, 4]. Given these consequences, depression in MI patients needs to be addressed promptly.

It is necessary to clarify the factors that predict the progression of mental disorders so that medical professionals can help patients avoid depression. We have assumed that the factors associated with depression in patients with MI varied by the procedures they underwent. There are two main procedures for treating MI: percutaneous coronary intervention (PCI) and coronary artery bypass graft surgery (CABG). The first procedure, PCI, is a non-surgical one, requiring patients to be admitted to the hospital briefly. The average length of stay (LOS) for PCI is shorter than for other procedures unless physical problems result from the procedure. Therefore, some PCI patients may be discharged before adapting to their postoperative situation. The second procedure, CABG, is open-heart surgery; patients require a longer LOS than patients undergoing PCI. Because of these variations, patients' experiences are different. Patients who have CABG tend to recover fully and have positive reactions[5], whereas patients who have PCI have negative perceptions of their future and concerns about a recurrence of a cardiac event[6]. Therefore, the factors associated with

depression may not be the same for the two procedures.

We focused on the factors related to depression among PCI patients for prevention, because of their brief opportunity for adaptation. They might appear vital at home after hospitalization because their procedure was minimally invasive, but research suggests they are sometimes depressed after discharge[6]. Since patients with MI who undergo PCI have a high risk for depression and the factors predicting depression may differ from patients with other medical procedures, such as CABG, this review focused on patients who underwent PCI.

The purpose of this review was to integrate knowledge from the findings of previous studies of the factors associated with depression in patients with MI who had PCI. Our preliminary literature review, however, found few studies in which all participants were MI patients who had PCI. Therefore, we synthesized the study's results of the risk factors for depression in MI patients, regardless of which procedure they had. The identification of these risk factors in all MI patients should enable researchers to examine these factors as predictors of depression in MI patients undergoing PCI in the future. This may help to improve the robustness of future studies on this topic.

Methods

Search Strategy

We searched the literature dating from 1946 to December 16, 2014, in the PubMed and CINAHL databases. The search terms were "myocardial infarction," "depression," and "percutaneous coronary intervention." Percutaneous coronary intervention is a Medical Subject Heading (MeSH) used in the PubMed database to index journal articles. This MeSH term is an upper level (broad) category i.e., a family of percutaneous techniques that are used to manage coronary occlusion, including standard balloon angioplasty, the placement of intracoronary STENTS, and atheroablative technologies (e.g., percutaneous transluminal laser angioplasty).

Inclusion and Exclusion Criteria

Studies that investigated factors associated with depression in patients with MI who underwent PCI were included in this study. We also selected studies that did not limit recruitment to MI patients with PCI, but included MI patients with other medical procedures, because a preliminary literature search found few studies of only MI patients who underwent PCI. Moreover, only studies that identified one or more significant predictors through statistical analyses were included because this review aimed to identify predictors of depression from the articles searched. We only included literature written in English and for which abstracts were available.

The exclusion criteria were as follows: (1) case report; (2) review article; (3) not a peer-reviewed scientific journal article; (4) unrelated to the onset of depression; (5) unrelated to the three search terms; or (6) no participants with PCI.

Selection of Studies and Data Extraction

The studies were selected initially based on their titles and abstracts. Then, the full text was examined by one of the authors if she needed more information to assess the six exclusion criteria. All of the identified studies met the inclusion criteria.

Results

Description of Studies

Of the 218 studies extracted by the search, 196 were from PubMed and 22 were from CINAHL (Table 1); 18 studies were excluded due to duplication, leaving 200 studies for assessment. Based on the inclusion criteria, 11 studies were chosen. The reasons for the exclusion of studies are shown in Figure 1.

Astin *et al*. examined scores on a depression scale three times (pre procedure, six to eight weeks post procedure, and six to eight months after the procedure) at a percutaneous transluminal coronary angioplasty (PTCA) clinic in Australia (n = 117), and gender differences were analyzed at all three points[7]. In four Netherland hospitals, Gravely-Witte *et al*. used a depression scale to examine the mood of 121 patients

Table 1. Studies Identified by Database, Search Terms, and Limitations

Databases and Keywords		Review by keyword	Abstract available and in English
PubMed			
Myocardial infarction	200,903		
Depression	319,127	232	196
Percutaneous coronary intervention	44,503		
CINAHL			
Myocardial infarction	34,347		
Depression	87,496	22	22
Percutaneous coronary intervention	3,833		

with MI, PCI, or CABG 45 days and 6 months after hospital admission[8]. The researchers used multiple linear regression to examine the predictors of depression[8]. In a study at ten hospitals in Canada, Lauzon *et al*. surveyed 550 patients who had an acute myocardial infarction (AMI) using a questionnaire to assess depression[9]. Participants answered the questionnaire a few days after admission, and 30 days, six months, and one year after the AMI; the scores after the AMI were analyzed by baseline characteristics[9]. At 29 Danish medical facilities, Mortensen *et al*. examined differences in the depression scores of 1,298 patients diagnosed with ST-segment elevation MI who underwent PCI and fibrinolysis[10]. The participants answered the questionnaire one month and 12 months after the infarction[10]. Murphy *et al*. investigated the depression scores of 270 patients six weeks after their discharge from two Australian hospitals following an AMI, or undergoing a PCI or CABG[11]. They analyzed the patients' depression scores by their sociodemographic characteristics and health behaviors[11]. Naqvi *et al*. surveyed 944 acute coronary syndrome patients in a United States hospital at discharge by administering a questionnaire, which included a depression scale[12]. They used multiple linear regression to identify predictors of depression[12]. At a Swedish hospital, Norrman *et al*. compared depression scores by gender of 220 patients who underwent PCI or CABG or suffered an AMI[13]. In four Australian hospitals, Schrader *et al*. surveyed 1,444 patients (MI, unstable angina pectoris, arrhythmia, congestive heart failure, angioplasty, or CABG) using a questionnaire, including a depression scale at the time of hospital admission, and three months and 12 months after discharge[14]. They used multinomial logistic regression to identify predictors of depression[14]. Stafford *et al*. investigated depression scores in 193 patients who were hospitalized for an MI, or underwent PCI or CABG in an Australian hospital, at three and nine months after discharge[15, 16]. They examined the associations between the patients' characteristics, illness beliefs, and depression scores[15], and patients' characteristics, cognitive-personality styles, and depression scores[16] using regression analysis. Yu *et al*. surveyed patients who were hospitalized for an AMI or underwent CABG or PCI in two Australian hospitals (n = 326) using an interview based on a depression scale when they were admitted to the hospital[17]. The scores were analyzed

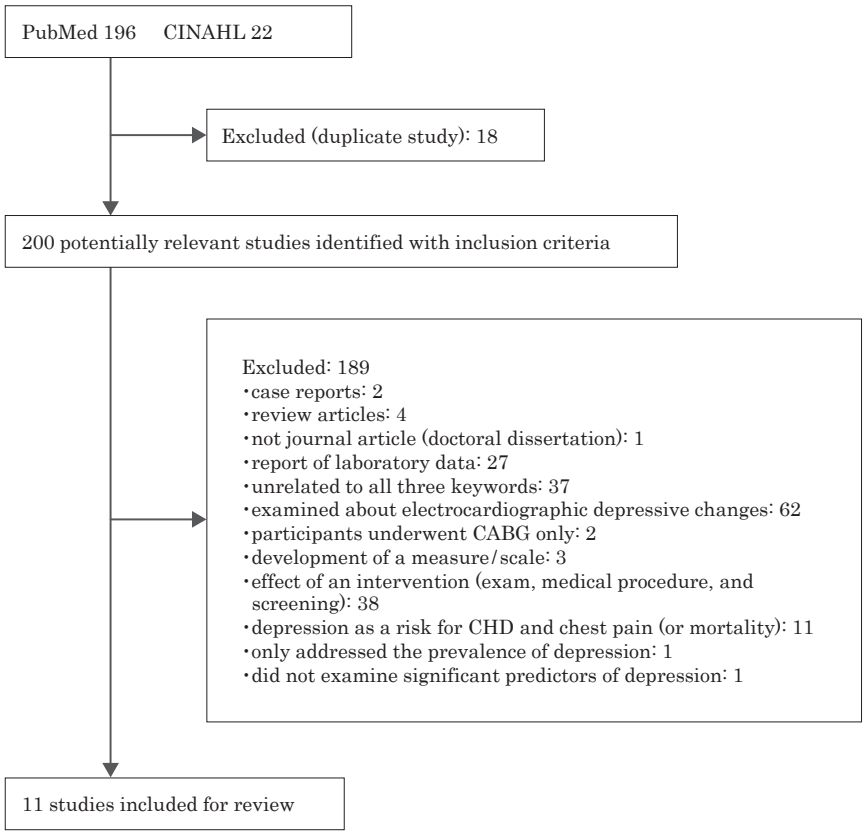

Figure 1. Flow chart of the inclusion and exclusion of studies in this review

by gender and personality type[17]. Six studies analyzed depression scores by selected factors[7, 9–11, 13, 17], and five studies conducted regression analysis[8, 12, 14–16].

Table 2 provides an overview of the included studies[7–17]. The studies, which were published between 2003 and 2013, included five multicenter[8–11, 14] and six single-center studies[7, 12, 13, 15–17]. The Beck Depression Inventory was used in two studies and the Hospital Anxiety and Depression Scale was used in five studies. Other scales (the Hamilton Depression Scale, Cardiac Depression Scale, the Center for Epidemiological Studies Depression Scale, the 90-Item Symptom Checklist-Revised, and the Zung scale) were used in one study each. None of the studies included only MI patients who underwent PCI. None of them included sub-group analyses of participants with different medical procedures or stratifications of participants by their medical procedures to compare outcomes and related factors between procedures.

Predictors of Depression in MI Patients who Underwent PCI and Other Medical Procedures

Twenty-one factors were detected as possible predictors of depression in patients with an MI who underwent PCI. We classified the 21 factors into six categories.

Personal characteristics, personality, and perception of illness. Being female and unmarried increased the depression risk significantly[8, 9, 12, 13]. Gender was analyzed in two longitudinal studies[8, 13] and one cross-sectional study[12]. Astin's study was excluded because it only reported a pre-procedure association between gender and depression[7]. Marital status was analyzed longitudinally in one study[9]. Negative illness beliefs, high neuroticism, high autonomy, and Type D personality were significantly associated with depression[15–17]. Individuals with Type D personality tend to experience negative emotions in day-to-day circumstances and to inhibit their own emotional and

Table 2. Overview of the 11 Identified Studies in the Review

Author (year)	Study design¶	Patient Age = mean (*SD*)	Depression scale	Assessment point	Possible factors which assessed in the study	Depression factor (s)*
Lauzon *et al.* (2003)[9]	L	AMI in 10 Canadian hospitals *N* = 550: age = 60.0†‡	BDI	2–3 days after admission, 30 days, 6 months and 1 year after AMI	sex, age, education, married status, racial, admitting hospital settings, length of stay, clinical history, cardiac risk factors (e.g. DM), and characteristics of AMI	Unmarried History of angina
Norrman *et al.* (2004)[13]	L	PCI or CABG or suffered AMI in a Swedish hospital *N* = 220: male = 62.0 (8.0) ; female = 59.0 (9.0)	summarized scale by BDI and Hamilton Depression Scale	2 and 6 weeks, 5 months and 1 year after discharge	sex	Female
Astin *et al.* (2005)[7]	L	Elective PTCA at an Australian hospital *N* = 117 : 62.0 (10.7)‡	Cardiac Depression Scale	Pre-PTCA, 6–8 weeks and 6–8 months post-PTCA	sex	Female (only pre-PTCA)
Schrader *et al.* (2006)[14]	L	MI, UAP, arrhythmia, congestive heart failure, angioplasty or CABG in 4 Australian hospitals *N* = 1,444: ages = 18–84†‡	CES-D	Hospital admission, 3 and 12 months after discharge	level of depression at baseline, previous diagnosis of depression, anxiety or stress, smoking status, length of hospital stay, sex, and age	having depressive symptoms at baseline, previous diagnosis of depression, anxiety or stress, length of hospital stay (<5 days), and currently smoke
Gravely-Witte *et al.* (2007)[8]	L	MI, PCI, or CABG patients in 4 Netherland hospitals *N* = 121 : 54.9 (8.0)‡	90-Item Symptom Checklist-Revised	45 days and 6 months after admission	cardiac history, having angina, sex, age, and diagnosis (PCI, CABG, or MI)	female, cardiac history
Mortensen *et al.* (2007)[10]	L	MI with ST-segment elevation in 29 Denmark hospitals *N* = 1,298: males = 62.4; females = 66.0†	HADS	1 and 12 months after infarction	procedures (PCI or fibrinolysis)	At one month: higher scores in fibrinolysis group than PCI (male) At 12 months: higher scores in PCI group than fibrinolysis (female)

Author (year)	Study design¶	Patient Age = mean (*SD*)	Depression scale	Assessment point	Possible factors which assessed in the study	Depression factor (s)*
Naqvi *et al.* (2007)[12]	C	UAP or AMI in an American hospital *N* = 944 : 68.0 (13.0)‡	Zung scale	After resuming normal daily life	sex, prior MI,CABG or PCI, DM, hypercholesterolemia, smoking, cerebrovascular accident, and age	female, prior MI, CABG or PCI, stroke and DM, smoking
Stafford *et al.* (2009)[15]	L	PCI, MI, or CABG in an Australian hospital *N* = 193 : 64.1 (10.4)‡	HADS	3 and 9 months after discharge	sex, age, income, smoking status, DM, left ventricular ejection fraction, neuroticism, social support, baseline depression score, and illness perception	Negative illness beliefs, high neuroticism
Stafford *et al.* (2009)[16]	L	PCI, MI, or CABG in an Australian hospital *N* = 193 : 64.1 (10.4)‡	HADS	3 and 9 months after discharge	age, sex, marital status, left ventricular ejection fraction, smoking status, DM, alcohol, functional disability, history of depression, baseline depression score, sociotropy, autonomy, others think (e.g., I am very sensitive to criticism by others), pleasing, dependency, perfection, need for control, and defensive	Autonomy, functional disability, and baseline depression score
Yu *et al.* (2010)[17]	C	Angina, MI, ischemic heart failure, or PCI in a Chinese hospital *N* = 326 : 67.3 (11.9)‡	HADS	in hospital	sex and type D personality	Type D personality
Murphy *et al.* (2013)[11]	C	AMI, CABG, or PCI in 2 Australian hospitals *N* = 270 : 59.0 (9.1)‡	HADS	6 weeks after discharge	sex, age, event type (AMI, CABG, or PCI), partnered, education, workforce, private health cover, social support, smoking status, alcohol, physical activity, and dietary fat intake	Less total activity time, high dietary fat intake, low social support

SD: Standard Deviation; PTCA: percutaneous transluminal coronary angioplasty; STAI: State-Trait Anxiety Inventory; BDI: The Beck Depression Inventory; AMI: acute myocardial infarction; HADS: The Hospital Anxiety and Depression Scale; UAP: unstable angina pectoris; Zung scale: Zung Self-Assessment Depression Scale; DM: diabetes mellitus; CES-D: the Center for Epidemiological Studies Depression Scale
¶L: Longuitudinal; C: Cross-sectional, *significantly indicated, †SD unavailable, ‡There is no details (male/female)

behavioral expression in interactions with others, so as to prevent disapproval by them[17]. Negative illness beliefs, high neuroticism, and autonomy were assessed longitudinally[15, 16]. Type D personality was examined in one cross-sectional study[17].

Disease history. Baseline depression scores and previous diagnoses of depression, anxiety, or stress were identified as predictors of depression[8, 10, 12, 15, 16]. These mental states were measured at baseline in the longitudinal studies. A history of angina, MI, CABG, PCI, diabetes mellitus (DM), and stroke significantly predicted depressed mood[8, 9, 12]. Cardiac (MI, PCI, or CABG) and angina history were studied using longitudinal designs[8, 9]. Participants' prior histories of DM and stroke were examined in one cross-sectional study[12].

Type of procedure and LOS. Procedure, PCI, and fibrinolysis significantly predicted depression in some settings[10]. One month after infarction, male patients who underwent fibrinolysis had higher depression scores than patients who underwent PCI. Twelve months after infarction, female patients who underwent PCI had higher depression scores than those who underwent fibrinolysis. A LOS < 5 days was identified as a significant depression predictor[14]. Procedure and LOS were examined longitudinally.

Smoking and dietary fat intake. The association between smoking and depression was significant in longitudinal and cross-sectional studies[12, 14]. High dietary fat intake was significantly associated with depression in one cross-sectional study[11].

Physical functioning. A longitudinal study reported that functional disability significantly predicted depressed mood[17]. A cross-sectional study reported that less time engaging in physical activity was significantly

associated with depression[11].

Social support. Low social support was significantly related to depression in one cross-sectional study[11].

Discussion

This review identified 21 factors in six categories as possible risk factors for depression among MI patients who had PCI. Thus, the 21 factors should be considered in future studies of this patient population as independent variables or covariates of depression.

Future studies should evaluate the 21 factors in patients who have had an MI and PCI only. Given patients' backgrounds, traits, LOS, and their anxiety about restenosis[6], suitable interventions for these patients are needed. However, there are no studies to date that have limited their samples to patients in this diagnostic and treatment category. Therefore, predictors of depression have not been identified in this patient population.

It is noteworthy that patients with a LOS fewer than five days had a higher rate of depression than those with a longer LOS did[14]. This relationship suggests that a short LOS might contribute to depression among MI patients. This association should be highlighted because minimally invasive procedures, such as PCI, are increasing[18]. The association might be interpreted as follows. Patients whose LOS is fewer than five days might not receive sufficient education regarding diet and pharmacological management after discharge[19] because of insufficient time. Therefore, they might not be ready for life as a "cardiac patient" after they are discharged or be able to manage even minor problems. A short LOS also might prevent patients from overcoming difficulties in their lives, thereby increasing their susceptibility to depression. However, there are no studies on the relationship between shorter LOS and depression; therefore, such a study is needed.

Considering the possible adverse effects of a shorter LOS in PCI patients, interventions to prevent depression in these patients should be developed. Effective methods to prevent depression are to avoid an extremely short LOS or to develop interventions that are efficient in providing patient education and support during a short LOS.

This review revealed that functional disability in patients with MI might be another factor leading to depression. A study of patients with acute coronary syndrome who underwent PCI found that 14–18% of them reported a decline in their ability to perform their usual activities[20]. Given the advantages of PCI (minimally invasive, preferable outcomes, and early discharge), patients tend to be less likely to acquire induced physical dysfunction. Nishiyama (2012) reported that patients misperceive their reduced physical functioning[21]. Thus, it is important to note that physical dysfunction emerged as a candidate for predicting depression in patients with MI who underwent PCI.

Reduced physical functioning due to MI might occur in spite of PCI's minimal invasiveness. In the case of acute myocardial infarction (experienced by most MI patients), patients' mental conditions might be negatively affected by the realization that their level of physical functioning has decreased dramatically compared to their functioning before the acute onset of cardiac disease. It would be worthwhile to investigate the effect of physical dysfunction on depression after PCI in future studies of only PCI patients.

Personal characteristics, negative illness perceptions, and disease histories also were identified as possible factors in depression. Healthcare professionals should assess these factors in PCI patients to help prevent depression.

Of the 21 factors, Type D personality, history of DM and stroke, dietary fat intake, time engaged in physical activity, and social support were examined only in cross-sectional studies. Future studies should investigate the causal effects of these factors on depression through more robust research designs, including longitudinal studies.

This review's strength is that we conducted a search of over sixty years of published studies. However, there are some limitations. First, publication biases might exist because studies reporting non-significant results are published rarely. Second, we only included articles written in English. Third, this study is a descriptive review of the literature, and did not perform summarized analysis Thus, future studies should examine articles published in other languages and use robust studies are needed to summarize conduct systematic reviews of data on predictors of depression. Additionally, the Hospital Anxiety and Depression Scale should be used for the assessment of depression in future studies because this scale was used most frequently.

Conclusion

There were no studies in which the samples were limited to MI patients who underwent PCI. This study identified 21 possible predictors of depression. These factors should be incorporated into longitudinal studies examining predictors of depression in this patient population to clarify their risk factors for depression.

Acknowledgments

This study was funded by JSPS KAKENHI Grant Number 26861896. We are grateful for the cooperation of our colleagues and staff.

Author Information

M. K. and H. F. were responsible for the conception and design of the study; M. K. performed the selection of the study and the extraction of data and drafted the manuscript; and H. F. critically reviewed the manuscript and supervised the entire study process. Both authors read and approved the final manuscript.

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