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The predictive power of depression screening procedures for veterans with coronary artery disease

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Stewart A Shankman[1]*
Jeffrey Nadelson[2]*
Sarah Kate McGowan[1]
Ali A Sovari[2]
Mladen I Vidovich[2]

[1]Department of Psychiatry and Psychology, University of Illinois, [2]Department of Cardiology, Jesse Brown VA Medical Center, Chicago, IL, USA

*These authors contributed equally to this work

Abstract: Depression leads to a worse outcome for patients with coronary artery disease (CAD). Thus, accurately identifying depression in CAD patients is imperative. In many veterans affairs (VA) hospitals, patients are screened for depression once a year using the patient health questionnaire (PHQ-9). Although the PHQ-9 is generally considered a specific and sensitive measure of depression, there is reason to believe that these screening procedures may miss a large number of cases of depression within CAD patients and cardiology patients more generally. The goal of this study was to provide data as to the predictive power of this depression screening procedure by (a) comparing the prevalence rate of depression identified by the PHQ-9 to known prevalence rates and (b) examining whether patients identified as "depressed" also had conditions that consistently co-occur with depression (eg, post-traumatic stress disorder [PTSD], other medical issues). Participants were 813 consecutive patients who received an angiogram in the cardiac catheterization laboratory at a large VA Medical Center. Prevalence of depression was 6.9% in the overall sample and less than 6% when the sample was restricted to CAD patients with significant stenosis. Depression was significantly associated with PTSD, smoking, and alcohol problems. However, depression was not associated with other medical problems such as diabetes, renal failure, peripheral vascular disease, or anemia. In conclusion, the low prevalence rate of depression and lack of associations with comorbid medical problems may suggest that the VA's depression screening procedures have low sensitivity for identifying depression in CAD patients. It is recommended that clinicians treating CAD regularly screen for depression and do not rely on archival depression screens.

Keywords: depression screening, coronary artery disease, PHQ-9, veterans

Introduction

Studies have consistently demonstrated that the prognosis, outcome, and treatment adherence for coronary artery disease (CAD) patients with comorbid major depressive disorder (MDD) is worse than in those without MDD.[1–4] Thus, accurate identification of MDD in CAD patients is critical.[5,6] Many hospitals (including most Veteran's Affairs [VA] hospitals) screen for depression annually using the Patient Health Questionnaire (PHQ-9), a questionnaire which assesses for depressive symptoms over the previous two weeks.[7–9] While the PHQ-9 has demonstrated adequate validity at correctly identifying patients with MDD, screening for depression annually may miss a large number of cases (ie, false negatives) as the episodes of MDD may not correspond with the timing of the screening.

The goal of this study is therefore to provide data regarding the predictive power of annual depression screening in CAD patients and patients who underwent

Correspondence: Mladen Vidovich
Section of Cardiology, Jesse Brown VA Medical Center, Assistant Professor of Medicine, University of Illinois at Chicago, 840 S Wood St, MC 715, Chicago, IL 60612, USA
Tel +1 312 996 6730
Fax +1 312 413 2948
Email miv@uic.edu

catheterization procedures more generally. First, we examined whether the prevalence rate is consistent with the known prevalence rate of depression. Second, given that numerous studies have shown that depression is highly comorbid with post-traumatic stress disorder (PTSD),[10,11] substance use disorders,[11,12] and several chronic medical diseases and CAD risk factors (diabetes,[13] renal failure,[14] peripheral vascular disease (PVD),[15] anemia,[16] and hypertension),[17] we examined whether individuals with MDD (as assessed by the PHQ-9) exhibited the expected high rate of co-occurrence of these conditions.

Methods

Participants

Participants included all consecutive patients (N = 1087) from June 1, 2008 through June 1, 2010 who underwent cardiac catheterization at the Jesse Brown VA Medical Center (Chicago, IL). Indications for cardiac catheterization followed standard practices in the United States. Specifically, patients were referred for coronary angiography after they were evaluated by a cardiologist and the procedure was indicated for them based on their clinical presentation and results of diagnostic tests such as electrocardiography, echocardiography, stress testing and Holter monitoring. Indications for coronary angiography included acute myocardial infarction, hemodynamic instability with or without cardiogenic shock, severe left ventricular dysfunction or overt heart failure, recurrent or persistent rest angina (despite intensive medical therapy), mechanical complications (such as acute mitral regurgitation or ventricular septal defect), sustained ventricular tachycardia, inconclusive or conflicting results after noninvasive stress testing, patient's ability to undergo noninvasive testing (disability, illness, or morbid obesity), or reevaluation of performed procedures (main stem percutaneous coronary intervention [PCI], high stenosis risk).

The inclusion/exclusion criteria were very broad. Given the low prevalence of women in this sample (N = 28; a number which is consistent with the population of veterans in this age range), the sample was restricted to male veterans. An additional 246 veterans were excluded because they did not complete a patient health questionnaire (PHQ-9) within a year of the visit to the catheterization laboratory. Thus, excluding these participants yielded a final N = 813. This investigation was approved by the institutional review boards (IRB) at the Jessie Brown VA Medical Center and the University of Illinois at Chicago and participants gave informed consent to have their medical records used for this research.

Measures

Medical variables

All coronary angiography reports were reviewed and the maximum percentage of stenosis was recorded for each patient. Revascularization procedures – coronary angioplasty (PCI), referral for coronary artery bypass surgery (CABG) – were recorded as well.

Depression assessment (PHQ-9)

The PHQ-9 is a nine item self-report questionnaire in which respondents rate the presence of the 9 core symptoms of a major depressive episode over the preceding two weeks. Each question is scored on a 4-point score where: 0 = not at all, 1 = several days, 2 = more than half the days, and 3 = nearly every day. Although the PHQ-9 has been used as continuous measure of depression, in most medical settings, the general convention is to determine cases of MDD with a cutoff of ≥10.[8,9,18] Additionally, the PHQ-9 has been shown to be highly correlated with other validated measures of depression (eg, r = 0.73 with the Beck depression inventory [BDI]).[19]

Other psychiatric and substance use variables

PTSD

The primary care-PTSD screen[20] (PC-PTSD) is a 4-item self-report measure used to identify individuals with PTSD or trauma-related problems. The PC-PTSD asks patients to recall a traumatic event and indicate whether or not, over the past month, they experienced any of four symptoms related to the four core factors of PTSD.[21] Presence of at least three symptoms identifies veterans with PTSD with strong sensitivity (0.85) and specificity (0.82).[20,22]

Alcohol use disorders

The alcohol use disorders identification test[23] (AUDIT-C) is a 3-item self-report measure used to identify individuals with alcohol abuse or dependence. Scores range from 0–12 and a cutoff ≥ 4 identifies male veterans who drink heavily and/or have active alcohol abuse or dependence with a sensitivity of (0.86) and a sensitivity of (0.72).[23,24]

Of note is that the above cutoffs for the PC-PTSD and AUDIT are the ones adopted by the VA[25,26] for determining referral or follow-up treatment for PTSD and alcohol problems, respectively. From patient's medical records, we also recorded whether they reported smoking on a regular basis.

The PHQ-9, PTSD, and AUDIT-C screens are given annually to patients at most VA hospitals and the most recent

assessment prior to the patients' cardiac catheterization was selected for analysis.

Data analysis

All analyses were performed using SPSS (v 16.0; SPSS Inc, Chicago, IL). *T*-tests and chi-squared tests were used for group comparisons on demographics. Logistic regressions (adjusted for covariates) were used to examine the association between depression status and the psychiatric, substance and medical issues.

Results

Descriptive statistics and angiography

The sample had a mean age of 64.6 ± 10.8 years, body mass index (BMI) of 29.6 ± 6.4, and was ethnically diverse, although the majority of the sample was African-American: 63.1% African-American, 32.8% White, 3.2% Hispanic and 0.9% other ethnicity.

Normal coronaries were present in 24.1% of patients, 19.5% had between 1 and 50% stenosis, 7.6% had between 51% and 70% stenosis, 24.5% had between 71% and 99% stenosis, and 24.3% had 100% stenosis in one of the major coronary arteries. PCI was performed in 24.7% of the sample and an additional 10.7% were referred for CABG. The other 64.6% of the sample received standard medical management for CAD.

Prevalence of depression

Of the 813 veterans who underwent catheterization procedures, only 56 scored ≥10 suggesting a prevalence of 6.9%.

If the sample was restricted to veterans with more than 50% stenosis (N = 454), the prevalence was 5.9%. If the sample was restricted to more than 70% stenosis (N = 393), the prevalence was 5.6%. Thus, the estimated prevalence rate of depression was largely consistent whether all patients were examined or just patients with significant stenosis.

Additionally, in the overall sample, 640 (78.7%) scored a 0 on the PHQ-9 (slightly larger percentages were observed in veterans with significant stenosis). Given the highly skewed nature of depressive symptoms in the present sample, for all subsequent analyses, we compared those who scored 0 to those who scored above 10 (thus, excluding those who endorsed a few symptoms of depression, but fell below the clinically significant range). Compared to those who endorsed zero symptoms, veterans in the clinical range on the PHQ-9 were significantly younger (55.8 versus 65.8, $P < 0.001$; adjusted for significant Levene's Test) and had higher BMI (31.9 versus 29.2; $P < 0.01$), with no ethnic differences. Age and BMI were therefore included as covariates in the analyses below.

In order to examine whether the results varied by whether patients had significant stenosis (ie, true CAD patients), analyses were also conducted in those with (a) greater than 50% stenosis, and (b) greater than 70% stenosis. It is noteworthy that depression was not related to degree of stenosis (r = –0.05, ns).

Association between depression and substance and psychiatric problems

The top of Table 1 presents results examining the co-occurrence of depression and several substance and psychiatric problems. After adjusting for age and BMI, smoking, alcohol, and PTSD were all significantly related to depression status on the PHQ-9 in the overall sample and in patients with significant stenosis.

Association with medical comorbidities/CAD risk factors

The bottom of Table 1 presents the results examining the co-occurrence of depression and several medical issues and risk factors for CAD. Individuals with depression did not have a significantly greater likelihood of having diabetes, renal failure, peripheral vascular disease, and anemia. Individuals with depression had a marginally higher likelihood of hypertension in the overall sample.

Discussion

This study examined the predictive power of the PHQ-9 in male veterans receiving cardiac catheterization. Given the importance of depression to the course and outcome of CAD,[1,2] it is important that valid procedures for screening depression are in place. This is particularly true for veterans, a population for whom CAD is quite prevalent.[10] Our study had several noteworthy findings.

In the overall sample, only 56 veterans scored in the clinical range on the PHQ-9 suggesting a prevalence of 6.9%. Similar (and even somewhat lower) rates were observed if the analyses were restricted to true CAD patients with significant stenosis (>50% or >70% blockage). Although the true prevalence of MDD in veterans with CAD is unknown, this number is considerably lower than what the literature would suggest. Studies in CAD patients suggest that the prevalence of MDD in patients with CAD in the general population is approximately 20%–23%.[27,28] Additionally, one would predict that this number would likely be higher in veterans given the increased rates of depression in veterans

Table 1 Association between PHQ-9 assessed depression and conditions known to be associated with depression

	% of total sample	Association with PHQ-9 depression Odds ratio (OR), 95% CI		
		Total sample	Sample with >50% stenosis	Sample with >70% stenosis
Psychiatric and substance use disorders				
PTSD	9.5%	4.01 (1.98–8.13)***	2.91 (1.08–7.90)*	4.43 (1.53–12.82)**
Smoking	25.7%	2.22 (1.22–4.04)**	4.82 (2.00–11.615)***	5.17 (1.91–13.97)**
Alcohol	10.7%	2.62 (1.29–5.30)**	2.86 (1.00–8.21)*	3.08 (0.96–9.93)+
Medical issue/CAD risk factor				
Diabetes	41.3%	ns	ns	ns
Renal failure	26.8%	ns	ns	ns
Peripheral vascular disease	17.7%	ns	ns	ns
Anemia	12.6%	ns	ns	ns
Hypertension	87.7%	4.01 (0.94–17.07)+	ns[a]	ns[a]

Notes: All OR are adjusted for age and BMI. *$P \leq 0.05$; **$P \leq 0.01$; ***$P \leq 0.001$; +$P < 0.10$; [a]For patients with substantial stenosis, although non-significant, the confidence intervals for odds ratios could not be calculated for hypertension because every patient with depression (N = 27 in Veterans with >50% stenosis and N = 22 in veterans with >70% stenosis) had hypertension (and, conversely, no patient without hypertension had depression).
Abbreviations: BMI, body mass index; CI, confidence interval; CAD, coronary artery disease; ns, not-significant; OR, odds ratio; PTSD, post-traumatic stress disorder.

compared to the general population.[29] There are several possible explanations for this low prevalence rate.

First, it is possible that the PHQ-9 is uniformly invalid at assessing depression in veteran males with CAD. This conclusion, however, would be inconsistent with the overall strong predictive power exhibited by the PHQ-9 in other populations (including veterans).[8,9] Additionally, this conclusion would be inconsistent with the fact that depression was significantly associated with comorbid mental health conditions. Numerous studies have shown that depression frequently co-occurs with PTSD, alcohol use disorders, and smoking problems.[10–12] Thus, the fact that depression was associated with the mental health conditions in the present study suggests that PHQ-9 appeared to largely identify valid cases of depression.

An alternative and more likely reason for the low prevalence rate is that the PHQ-9 likely identified individuals with MDD (ie, low number of "false positives") but the PHQ-9 likely missed a large number of cases as well (ie, large number of "false negatives."). In other words, the PHQ-9 may have exhibited low sensitivity. Interestingly, our results were consistent with the Heart and Soul study, which found that the PHQ-9 may have strong specificity in CAD patients, but inadequate sensitivity in this population.[27] This conclusion is also supported by the present finding that depression was not significantly associated with any of the medical issues/CAD risk factors or degree of stenosis, despite a large literature suggesting that depression should be correlated with these variables. Lastly, a high number of "false negatives" is also consistent with the fact that a surprisingly high 78.7% of CAD veterans denied any symptoms of depression.

Thus, the VA's procedures for screening depression may not be adequately identifying all CAD patients who have depression. This is likely to be particularly problematic for African-American veterans (who compromised the largest percentage of our sample), a group who are not only at higher risk for CAD,[30] but who are also less likely to seek mental health services on their own.[31,32]

A concern with the VA's screening of depression may not be the screening instrument (PHQ-9), but rather the procedures under which it is administered. In most VA hospitals, the computerized personal record system flags patients who have not been administered the PHQ-9 within the last year and then reminds clinicians (typically primary care physicians) to administer it. Thus, depressive episodes that occurred closer in time to cardiac catheterization may be missed.

Additionally, the PHQ-9 is often administered by simply handing the patient the questionnaire and asking them to complete it. The validity of a self-report questionnaire assumes that individuals can read and comprehend each question. A recent study showed that the PHQ-9 requires at least a ninth grade reading level.[33] Hence, a subset of patients may have had difficulty reading and understanding the questions. We are currently investigating this issue by measuring the reading ability of patients who completed the PHQ-9 and examining whether this has an effect on depression prevalence.

It is important to assess for current depression when patients visit the cardiac catheterization laboratory because a depressive episode may have contributed to why patients are seeking cardiovascular care. Not only has depression been associated with both cardiac and non-cardiac chest pain,[34,35] but there is a growing literature on the overlapping

pathophysiology between depression and cardiac disease.[36] For example, inflammatory cytokines, endothelial dysfunction and autonomic nervous system dysfunction have all been proposed to play a role in both depression and cardiac disease.[36–41]

Additionally, it is important to assess the urgency of a patient's referral for cardiac catheterization, as severity of CAD would likely impact depression ratings. Unfortunately, in our archival database, we were unable to examine this question. However, it should be noted that the administration of the PHQ-9 was rarely the same day as the catheterization. Currently in the VA system, the PHQ-9 is only given annually and its administration does not necessarily coincide with a cardiology visit (let alone an urgent cardiology visit). Thus, it is unlikely that ratings of depression were affected by the urgency of patients' cardiac symptoms. Studies have also shown that among patients who have an urgent referral, identification of those with a psychological need is particularly predictive of outcome.[42] This highlights the importance of assessing depression at the time of cardiac catheterization, as well as regular screening of depression during the treatment of CAD over time.

The conclusions of the study are tempered by several limitations. First, although our sample was representative of CAD patients (and veterans in general) who receive treatment at the Jesse Brown VA, the sample was all male and predominantly African-American. Thus, our conclusions may not generalize to different populations. Second, the large percentage of patients with hypertension (87%) may have precluded us from finding a significant association between depression and this risk factor (although, it is noteworthy that this was the only medical issue/risk factor that even approached statistical significance). Third, MDD was not formally diagnosed (ie, with a diagnostic interview) in the patients. However, a formal assessment of MDD would have likely confirmed the low sensitivity of the PHQ-9 depression assessment procedures. Finally, given that we had to exclude women from the sample due to their low prevalence in the VA population, the results may not generalize to CAD patients in general, but perhaps only to male CAD patients.

In summary, our study found that the depression screening procedures employed in many VA medical centers may not be ideal as numerous cases of MDD are likely to be missed. Given the importance of depression as a predictor of prognosis and outcome in CAD, it is essential that clinicians do not solely rely on a patient's archival depression screen and regularly screen for depression in cardiology clinics. Additionally, the problems with annual self-report depression screening highlight the importance of future research to identify valid biomarkers for depression.

Disclosure

The authors report no conflicts of interest in this work.

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