Type-D personality and depressive symptoms predict anxiety 12 months post-percutaneous coronary intervention

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Research report

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Abstract

Background: We examined whether type-D personality exerts a stable effect on anxiety over time and the clinical relevance of type-D personality as a predictor of anxiety 12 months post-percutaneous coronary intervention (PCI).
Methods: Consecutive patients ($n=416$) with stable or unstable angina pectoris treated with PCI completed the Type-D Scale (DS14) at baseline and the Hospital Anxiety and Depression Scale (HADS) at baseline and 12 months.
Results: At baseline, 26% of the patients were anxious, with 67% of these patients still being anxious 12 months post-PCI ($p<0.001$). There was no significant change in anxiety between baseline and 12 months ($p=0.96$) nor was the interaction effect type-D personality by time significant ($p=0.41$). However, type-D patients experienced significantly higher levels of anxiety than non-type-D patients ($p<0.001$). Type-D personality (OR: 2.89; CI: 1.57–5.34), depressive symptoms (OR: 3.27; CI: 1.73–6.18) and anxiety at baseline (OR: 8.38; CI: 4.65–15.12) were independent predictors of anxiety 12 months post-PCI, adjusting for baseline demographic and clinical characteristics.
Limitations: A limitation of the study is the attrition rate of 105 patients who did not complete the HADS at 12 months. No information was available on the use of psychotropic medication and participation in cardiac rehabilitation, which could serve as confounders.
Conclusion: Type-D exerted a stable effect on anxiety over time and was an independent predictor of anxiety 12 months post-PCI together with depressive symptoms and anxiety at baseline. The DS14 could be used as a screening tool in clinical practice to identify high-risk patients post-PCI.
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1. Introduction

There is a substantial body of evidence showing that psychological factors play a role in the pathogenesis of coronary artery disease (CAD), with depression having

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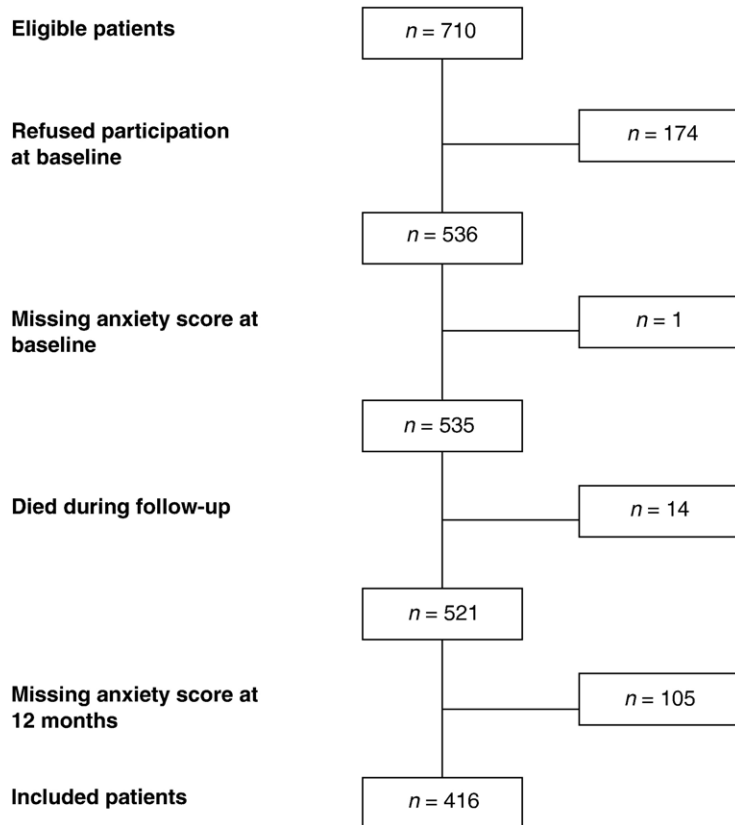(R.T. van Domburg).

Fig. 1. Flowchart of patient selection.

been studied most extensively (Januzzi et al., 2000; Lett et al., 2004; Astin et al., 2005; Nicholson et al., 2005). In patients with established CAD, depression has been associated with an increased risk of morbidity and mortality (Denollet, 2000; Januzzi et al., 2000; Carney and Freedland, 2003; Lett et al., 2004) and future cardiac events (Musselman et al., 1998). These findings were confirmed in a recent meta-analysis, showing that post-myocardial infarction (MI) depression is associated with a 2-fold increased risk of adverse clinical outcome (van Melle et al., 2004).

Anxiety is a frequent co-morbid disorder of depression (Clark et al., 1998; Januzzi et al., 2000; Grace et al., 2004). However, anxiety has received far less attention than depression, although anxiety has been associated with increased risk of mortality (Januzzi et al., 2000; Eaker et al., 2005), recurrent ischemic and arrhythmic events (Grace et al., 2004), impaired health-related quality of life (HRQL) (Astin et al., 2005; Pedersen et al., 2006a) and increased health care consumption (Strik et al., 2003; Grace et al., 2004). Despite these findings, anxiety is frequently underrecognized and undertreated in cardiac

patients (Grace et al., 2004; Haworth et al., 2005). In addition, little is known about predictors of anxiety. Studying anxiety is not only important due to its associations with prognosis, HRQL and health care consumption, but also because it is an important patient-centered outcome (Krumholz et al., 2005). A recent report of the National Heart, Lung, and Blood Institute Working Group on Outcomes Research on Cardiovascular Disease advocates the studying of patient-centered outcomes and their determinants, in order to enhance the applicability of research results in clinical practice (Krumholz et al., 2005). Knowledge of predictors of anxiety would help identify these high-risk patients and may also aid in the designing of more successful intervention trials.

Personality is an important determinant of the emotional and physical health of patients with CAD (Denollet, 2000). The *distressed* (type-D) personality, defined by high negative affectivity and social inhibition (Denollet, 2000), is associated with a wide range of emotional distress including anxiety, depressive symptoms, and post-traumatic stress disorder (Denollet et al., 2000; Pedersen and Denollet, 2003; Pedersen et al.,

Table 1
Baseline characteristics stratified by type-D personality

	Type-D (n=103)	Non-type-D (n=313)	p
Demographics			
Males (%)	75	75	0.95
Age, mean (SD)	62 (10)	63 (11)	0.37
Married/partner (%)	84	84	0.86
Indication for PCI			
Unstable angina (%)	53	44	0.08
Clinical variables			
Multi-vessel disease (%)	53	61	0.15
Previous MI [a] (%)	41	40	0.90
Previous PCI [b] (%)	23	26	0.65
Previous CABG [c] (%)	12	14	0.49
Recent cardiac event [d]	8	10	0.46
Hypertension (%)	49	48	0.96
Dyslipidemia (%)	79	75	0.46
Diabetes mellitus (%)	21	18	0.48
Current smoking (%)	11	13	0.63
Cardiac medication			
Aspirin (%)	96	96	0.90
Statins (%)	72	76	0.39
ACE-inhibitors (%)	13	8	0.13
Beta-blockers (%)	20	23	0.63
Diuretics (%)	4	1	0.02 *

[a] Previous MI = myocardial infarction prior to the index event.
[b] Previous PCI = percutaneous coronary intervention prior to the index event.
[c] Previous CABG = coronary artery bypass surgery prior to the index event.
[d] MI, PCI, and CABG between baseline and 12 months.
* $p < 0.05$.

2004b). Type-D also predicts recurrent cardiac events and poor prognosis, independent of biomedical risk factors (Denollet et al., 1996, 2000; Pedersen et al., 2004a; Denollet, 2005; Denollet et al., 2006; Pedersen et al., 2006b). In addition, type-D personality has been identified as an independent predictor of the onset of depressive symptoms post-percutaneous coronary intervention (PCI) in patients free of depressive symptoms (Pedersen et al., 2006b). Hence, type-D personality may also be a predictor of anxiety in patients post-PCI. To date, only one study has investigated the association between type-D personality and anxiety in a pure sample of PCI patients, but this study looked at predictors of chronic anxiety (Spindler et al., 2006).

The objectives of the present study were: (1) to investigate whether type-D personality exerts a stable effect on anxiety between baseline and 12 months post-PCI; and (2) to examine if type-D personality is an independent predictor of anxiety at 12 months, adjusting for baseline demographic and clinical characteristics, and anxiety and depressive symptoms at the time of the index PCI.

2. Methods

2.1. Study design and participants

Between July 1, 2003 and July 1, 2004 a series of consecutive patients with stable or unstable angina treated with PCI at the Erasmus Medical Center Rotterdam, using the paclitaxel-eluting stent (PES) as the default stent, were included in the current study. Of the 845 patients, 116 were excluded due to language and 19 patients died within the first 4 weeks. Of the remaining 710 patients, 536 (75% response rate) completed a set of standardized and validated psychological questionnaires 4 weeks post-PCI, which will be referred to as baseline in the remainder of the paper. Differences on baseline characteristics between responders and excluded/non-responders were found on smoking status and dyslipidemia. Excluded and non-responders were more likely to smoke (22% versus 14%; $p = 0.003$) but less likely to suffer from dyslipidemia (63% versus 74%; $p = 0.001$). No other differences were found on baseline characteristics, including cardiac medication.

Only patients who had a score on the anxiety measure (i.e. the Hospital Anxiety and Depression Scale) both at the time of the index PCI and at 12 months qualified for inclusion in the current study. See flowchart of the patient selection (Fig. 1).

The study was approved by the local medical ethics committee and conducted in accordance with the Helsinki Declaration. All patients provided written informed consent.

2.2. Measures

2.2.1. Demographic and clinical variables

Demographic variables included gender, age, and marital status. Clinical variables included indication for PCI (stable or unstable angina), multi-vessel disease, previous myocardial infarction (MI), previous PCI, previous coronary artery bypass graft surgery (CABG), hypertension, dyslipidemia, diabetes mellitus, and current smoking behavior. A recent cardiac event was defined as MI, PCI or CABG between the index PCI and 12 months. Cardiac medication included aspirin, statins, ACE-inhibitors, beta-blockers, and diuretics. All clinical variables were obtained from the medical records at 4 weeks, referred to as baseline in the remainder of the article.

2.2.2. Type-D personality

Type-D personality was assessed at baseline using the 14-item Type-D Scale (DS14) (Denollet, 2005). The

Table 2
Univariable and multivariable predictors of anxiety at 12 months

	Univariable			Multivariable		
	OR	[95% CI]	p	OR	[95% CI]	p
Type-D personality	**5.65**	**[3.49–9.15]**	**0.00‡**	**2.89**	**[1.57–5.34]**	**0.001***
Depressive symptoms	**6.51**	**[3.98–10.65]**	**0.00‡**	**3.27**	**[1.73–6.18]**	**0.000‡**
Anxiety (at baseline)	**11.92**	**[7.17–19.83]**	**0.00‡**	**8.38**	**[4.65–15.12]**	**0.000‡**
Male gender	0.82	[0.51–1.33]	0.42	0.80	[0.41–1.58]	0.53
Age	**0.98**	**[0.96–0.99]**	**0.01***	0.99	[0.96–1.02]	0.42
Living alone	0.76	[0.41–1.39]	0.37	0.46	[0.20–1.04]	0.06
Multi-vessel disease	**0.60**	**[0.39–0.92]**	**0.02***	0.66	[0.37–1.20]	0.18
Unstable angina	1.23	[0.80–1.88]	0.34	0.98	[0.55–1.72]	0.93
Previous cardiac history [a]	0.94	[0.61–1.44]	0.77	0.85	[0.48–1.51]	0.58
Hypertension	0.74	[0.48–1.13]	0.16	0.88	[0.49–1.59]	0.67
Dyslipidemia	0.92	[0.56–1.50]	0.72	0.62	[0.32–1.19]	0.15
Diabetes mellitus	1.29	[0.76–2.18]	0.35	1.65	[0.81–3.36]	0.17
Current smoking	1.48	[0.79–2.75]	0.22	1.02	[0.41–2.52]	0.97
Recent cardiac event [b]	1.77	[0.90–3.46]	0.10	0.98	[0.55–1.72]	0.93

*$p<0.05$; ‡$p<0.001$.
[a] Previous MI, PCI or CABG.
[b] MI, PCI, CABG between baseline and 12 months.

scale consists of two subscales, *negative affectivity* (NA) and *social inhibition* (SI). Each subscale comprises seven items, which are answered on a 5-point Likert scale from 0 to 4 with a score range of 0–28 per subscale. The NA subscale covers dysphoria, anxiety, and irritability (e.g. "I often feel unhappy" and "I often find myself worrying about something"); the SI subscale covers discomfort in social interactions, reticence, and lack of social poise (e.g. "I make contact easily when I meet people" and "When socializing, I don't find the right things to talk about") (Denollet, 2005). A standardized cut-off ≥10 was used for both subscales to classify patients as type-D (Denollet, 2005). The DS14 has a high level of internal consistency with Cronbach's alpha=.88/.86 and 3-month test–retest reliability $r=.72/.82$ for the NA and SI subscales, respectively (Denollet, 2005). It is important to emphasize that type-D personality is more than negative affect, due to the inclusion of the social inhibition component within the construct (Pedersen et al., 2006a). In addition, it is the co-occurrence of SI and NA and not the single traits that incurs an increased risk of adverse health outcomes, with SI having been shown to moderate the effect of NA on prognosis, also adjusting for mood states (Denollet et al., 2006).

2.2.3. Anxiety and depression

The Hospital Anxiety and Depression Scale (HADS) was used to assess anxiety and depressive symptoms at baseline and 12 months post-PCI (Zigmond and Snaith, 1983). The scale consists of two subscales, a 7-item anxiety and 7-item depression scale. Both 7-item scales

are answered on a 4-point Likert scale from 0 to 3 with a score range of 0–21. A cut-off ≥8 was used to categorize patients with anxiety and depressive symptoms. This cut-off has an optimal sensitivity and specificity (Bjelland et al., 2002). The HADS is a reliable questionnaire that performs well in screening for the separate dimensions of anxiety and depression (Bjelland et al., 2002).

2.3. Statistical analyses

For the statistical analyses, SPSS for Windows version 11.5 was used. Discrete variables were compared using the chi-square test (Fisher's exact test when appropriate) and are presented as percentages. Continuous variables were compared with the Student's *t*-test
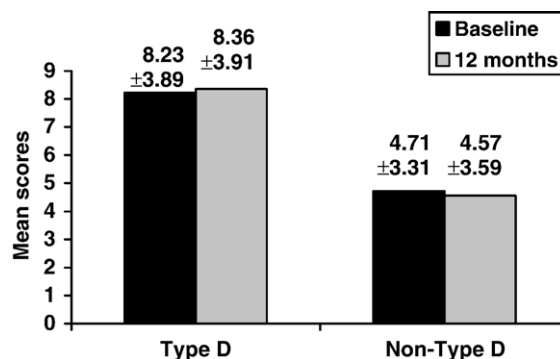

Fig. 2. Anxiety score at baseline and 12 months post-PCI stratified by type-D personality*.

and are presented as means±SD. Analysis of variance (ANOVA) for repeated measures was used to examine the effect of type-D on anxiety over time. Univariable and multivariable logistic regression analyses were performed to evaluate predictors of anxiety at 12 months. Prior to analyses, the continuous variables anxiety and depressive symptoms were dichotomized, using a standardized cut-off ≥8 to classify patients with the respective symptomatologies (Bjelland et al., 2002). In multivariable analyses, we entered type-D personality, anxiety and depressive symptoms at baseline, gender, age, marital status, multi-vessel disease, indication for PCI, previous cardiac history, hypertension, dyslipidemia, diabetes, and current smoking simultaneously. In order to examine whether the addition of type-D personality to a multivariable model comprising demographic and clinical baseline characteristics, and anxiety and depressive symptoms at baseline, added to the prediction of anxiety at 12 months, we performed a hierarchical logistic regression analysis. Given that cardiac events occurring between the index PCI and 12 months may influence levels of anxiety, this variable was also entered into the multivariable model. Results are presented as odds ratio (OR) with 95% confidence intervals (CI). All statistical tests were two-tailed, and a *p*-value<0.05 was considered to be statistically significant.

3. Results

3.1. Participants

The mean age of the 416 included patients was 63 years (SD=11 years) and 75% were male. At baseline, the prevalence of type-D personality was 25%. Baseline characteristics stratified by type-D personality are shown in Table 1. No significant differences on baseline characteristics were found between type-D and non-type-D patients, apart from type-Ds more likely being prescribed diuretics (Table 1). At baseline, 26% of the patients were anxious with 67% of these patients still being anxious 12 months post-PCI (*p*<0.001).

3.2. Change in anxiety over time by type-D personality

ANOVA for repeated measures showed that type-D patients had a significantly higher score on anxiety than non-type-D patients (*p*<0.001) (Fig. 2). There was no significant change in anxiety over time (*p*=0.96) nor was the interaction effect type-D personality by time significant (*p*=0.41), indicating that type-D exerted a stable effect on anxiety over time.

3.3. Predictors of anxiety 12 months post-PCI

In unadjusted analysis, type-D personality (OR: 5.65; CI: 3.49–9.15), depressive symptoms (OR: 6.51; CI: 3.98–10.65) and anxiety at baseline (OR: 11.92; CI: 7.17–19.83) were associated with anxiety at 12 months (Table 2). A cardiac event between the index PCI and 12 months was not associated with anxiety at 12 months (*p*=0.10). Hence, anxiety at 12 months could not be accounted for by a cardiac event occurring during the follow-up period.

Type-D personality (OR: 2.89; CI: 1.57–5.34), depressive symptoms (OR: 3.27; CI: 1.73–6.18) and anxiety at baseline (OR: 8.38; CI: 4.65–15.12) were independent predictors of anxiety at 12 months, adjusting for all other baseline characteristics.

These findings were confirmed with linear regression analysis, using continuous scores of anxiety, with type-D remaining an independent predictor of anxiety at 12 months adjusting for baseline characteristics, anxiety and depressive symptoms at baseline (results not shown).

The prediction of the model, comprising demographic and clinical baseline characteristics and anxiety and depressive symptoms at the time of the index PCI, improved significantly with the addition of type-D personality (χ^2=11.243 (*df*=1), *p*=0.001).

4. Discussion

To our knowledge, only one study has examined the impact of type-D personality on anxiety in a pure sample of PCI patients (Spindler et al., 2006). We found no change in anxiety between the index PCI and 12 months nor was the interaction effect type-D personality by anxiety significant, showing that type-D personality exerted a stable effect on anxiety over time. Type-D patients experienced significantly higher levels of anxiety at both time points compared with non-type-D patients. Type-D personality, anxiety and depressive symptoms at baseline were independent predictors of increased anxiety 12 months post-PCI, adjusting for demographic and clinical risk factors.

The results of the current study showed that once present, symptoms of anxiety tend not to remit over the course of 12 months. Of note, the patients who were anxious at baseline, 67% were still anxious 12 months post-PCI. This is in accordance with the findings of Spindler et al. (2006). Similarly, studies of MI patients found that 26% of patients were anxious during hospital admission, with 53% of these patients continuing to be anxious 12 months post-MI (Lane et al., 2002). In

patients with unstable angina or MI, Grace and colleagues (2004) found a prevalence rate of 36%, with 54% exhibiting persistent symptoms of anxiety at 12 months (Grace et al., 2004).

Type-D personality and depressive symptoms were both independent predictors of anxiety at 12 months, with a 3-fold associated risk. It is noteworthy that both factors remained significant when adjusting for baseline symptoms of anxiety. This emphasizes the importance of studying anxiety and depression together, which has also been advocated by others (Clark et al., 1998). It also points to the independence of the constructs of type-D personality and depressive symptoms, and that these risk factors should be studied in their own right. Type-D personality has in previous studies been shown to predict prognosis in cardiac patients above and beyond mood states, such as anxiety and depression (Denollet et al., 2000, 2006). In addition, type-D has previously been associated with symptoms of anxiety (Pedersen and Denollet, 2006), but these studies were conducted in a mixed group of CAD patients and prior to the introduction of drug-eluting stents and not in a pure sample of PCI patients.

The results of the present study have implications for research and clinical practice. In clinical practice, it is essential to identify PCI patients at high risk for anxiety (i.e. those with a type-D personality or depressive symptoms), given evidence that anxiety is a risk factor for morbidity and mortality (Januzzi et al., 2000; Eaker et al., 2005), impaired HRQL (Pedersen and Denollet, 2003; Astin et al., 2005), and increased health care consumption (Strik et al., 2003; Grace et al., 2004). The relative stability and persistence of anxiety symptoms once manifest suggest that it may be important to screen patients already 4 weeks post-PCI. Although either the DS14 or the depression subscale of the HADS could be used as screening tools in clinical practice, we would suggest using the DS14 given that type-D is a stable personality taxonomy with stable effects on behavior and health outcomes, as also shown in the current study. By contrast, anxiety and depression are considered state measures and hence may fluctuate across time and situations. In addition, type-D personality has been associated with multiple health outcomes, including distress, such as anxiety, depression, and post-traumatic stress disorder, impaired quality of life, and increased morbidity and mortality (Pedersen and Denollet, 2006). Finally, the importance of participating in cardiac rehabilitation should be emphasized to patients at high risk for anxiety, as rehabilitation has been shown to decrease both symptoms of anxiety and depression (Januzzi et al., 2000). Additional treatment with e.g.

cognitive–behavioral therapy and pharmacotherapy may be warranted for subgroups of patients with particularly elevated levels of anxiety (Januzzi et al., 2000).

A limitation of our study is the attrition rate of 105 patients who did not complete the HADS at 12 months. We also had no information on the use of psychotropic medication and participation in cardiac rehabilitation, which could serve as confounders. However, an advantage of the current study was that anxiety was assessed at two time points, and that we also adjusted for depressive symptoms in addition to type-D personality and baseline characteristics, given that anxiety and depression are frequent co-morbid disorders.

In conclusion, symptoms of anxiety were stable over a 12-month period showing that once manifest symptoms are not likely to remit. Type-D personality exerted a stable effect on anxiety over time, and both type-D and depressive symptoms were independent predictors of anxiety 12 months post-PCI, with a 3-fold increased risk, adjusting for baseline anxiety and demographic and clinical risk factors. Screening for type-D personality and depressive symptoms in clinical practice is important in order to identify patients at risk of anxiety 12 months post-PCI. This subgroup of patients may require some form of psychosocial intervention in order to prevent the onset and persistence of symptoms of anxiety, as anxiety is a risk factor for clinical events, increased health care consumption, and impaired HRQL.

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