

Interest of Supra-Aortic Trunks Doppler Ultrasound in Preoperative Assessment of a Valve Replacement

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Abstract

Objective: The interest of ultrasound of the supra-aortic trunks (USAT) is proven in the preoperative assessment of coronary bypass grafting (CABG) but remains to be demonstrated for valve replacement (VR).

Materials and methods: We counted 666 patients who benefited from USAT as part of the preoperative assessment of a CABG or VR due to rheumatic heart disease from 2010 to 2017.

Results: Cardiovascular risk factors (CVRFs) were significantly more frequent ($p < 0.001$) in patient undergoing CABG. There was a positive correlation ($r = 0.145$) between coronary status and carotid status.

Discussion: Valvular disease patients should benefit from USAT based on CVRFs, history of stroke and coronary status.

Keywords: Coronary disease; Valvular heart disease; Doppler; Carotid stenosis

Introduction

Ischemic strokes are a real public health and socioeconomic problem because of the morbidity and mortality they cause. The presence of tight carotid stenosis is a risk factor for the occurrence of ischemic stroke and after cardiac surgery [1,2], which justifies ultrasound of the supra-aortic trunks (USAT) as part of the preoperative assessment of cardiac surgery under extracorporeal circulation. USAT indications for tight carotid stenosis are well established for patients undergoing coronary artery bypass surgery (CABG). However, there are no specific recommendations regarding its indications in the preoperative assessment of valve replacement (VR). USAT is indicated by extrapolation of indications for coronary angiography. The purpose of our study is to evaluate the interest of USAT in the preoperative assessment of a VR compared to that of the CABG in order to try to identify the relevant indications of this examination before extracorporeal circulation for RV.

Materials and Methods

We carried out a retrospective study gathering all the patients who benefited from an USAT at the echocardiography laboratory of the cardiology department of Habib Thameur Hospital between 2010 and 2017. USAT is indicated by extrapolation of indications for coronary angiography. The purpose of our study was to evaluate the interest of USAT in the preoperative assessment of VR compared to that of the CABG in order to try to identify the relevant indications of this examination before valvular surgery.

In all selected patients, epidemiologic data, coronary angiography findings, and USAT results were obtained from operative reports and medical records. Coronary stenosis was judged to be significant if it reduced the arterial lumen by at least 70%, or 50% of lumen of the left coronary artery or first segment of the left anterior descending artery. Carotid stenosis was considered to be tight if it reduced carotid light by at least 70% and if it sat on the primitive or the internal carotid because of its surgical implications. We divided the study population into two groups: Group 1: Patients who have benefited from an USAT as part of the preoperative assessment of a CABG. Group 2: Patients who have received an USAT as part of the preoperative assessment of a VR due to rheumatic heart disease. Then we compared data of these two groups.

Statistical Analysis

The data analysis and the choice of the statistical tests were realized thanks to the software SPSS version 23. The Pearson correlation coefficient allowed us to study the links between two quantitative variables. The comparison of two matched series averages was performed using the Student's Paired Series t-test. A difference is statistically significant if the p value is less than 0.05.

Results

We had 666 patients: 490 patients in group 1 and 176 patients in group 2. The mean age of the general population was 62.5 years \pm 9.7 (35-88) with a sex ratio of 2M/1F. Group 2 was significantly younger than group 1 with a mean age of 59.6 years \pm 11.21 vs. 63.5 years \pm 8.91 ($p < 0.001$). In group 1, we had a male predominance with a sex ratio of 3M/1F whereas in group 2 we had a sex ratio of 1M/1F. The prevalence of CVRFs was greater in group 1 than in group 2 with a statistically

significant difference ($p < 0.001$), except for obesity and familial coronary artery disease (Table 1). Thus, 98.8% of patients in group 1 had at least 2 CVRFs and 64.3% had at least 4 CVRFs vs. only 19.3% for patients in group 2 ($p < 0.001$).

	Group Effective (%) 1	Group Effective (%) 2	p Value
Age>55 years	490 (96.8)	176 (84.6)	<0.001
Sex (males)	367 (75.1)	81 (47.1)	<0.001
FCAD	11 (2.2)	2 (1.1)	NS
Diabetes	324 (66.1)	47 (26.7)	<0.001
AHT	276 (56.3)	66 (37.5)	<0.001
Dyslipidemia	174 (35.5)	28 (15.9)	<0.001
Obesity	17 (3.5)	8 (4.5)	NS
Tabacco	292 (59.6)	64 (36.4)	<0.001

Note: FCAD: Family Coronary Artery Disease; AHT: Arterial Hypertension; NS: Non-Significant.

Table 1: Prevalence of CVRFs in Group 1 and Group 2.

All patients in group 1 had significant coronary stenosis and 73.5% of them had three-vessel disease. In contrast, only 7 (4%) patients in group 2 had significant coronary stenosis. 56 patients (11.5%) in group 1 had tight carotid stenosis compared with only 3 (1.7%) patients in group 2 (Figure 1). Prevalence of tight carotid stenosis was significantly greater in patients with coronary heart disease ($p < 0.001$).

Study of the epidemiological characteristics of patients with tight carotid stenosis

Patients with tight carotid stenosis were older than those without significant stenosis (age 66 ± 9 (48-88) vs. age 62 ± 9.7 (35-86)). They were mostly male (72.9% men or a sex ratio of 3M/1F). They had at least 2 CVRFs and these patients had more CVRFs than patients without carotid stenosis ($p < 0.001$). Only arterial hypertension was significantly more common ($p < 0.05$) in this subgroup compared to the other CVRFs (Table 2). Besides, the frequency of history of ischemic stroke was significantly greater ($p < 0.05$) in patients with tight carotid stenosis.

Hypertension had a strong negative predictive value (NPV) (94%) in foreseeing tight carotid stenosis for patients scheduled for extracorporeal circulation. However, its sensitivity (67%), specificity (50%) and positive predictive value (PPV) (11.7%) were poor. Similarly, the history of stroke had a good specificity (93.7%) and NPV (92%). Whereas, its sensitivity (17%) and PPV (20%) were low.

Study of the correlation between coronary status and carotid status

The severity of carotid involvement was proportional to the severity of coronary involvement. 72% of patients with significant carotid stenosis had three-vessel disease ($r = 0.145$) (Figure 2).

Pathological coronary angiography predicted the presence of significant carotid stenosis with a high sensitivity of 94% and a specificity of only 28%. The PPV of coronary angiography was low at

11% but its NPV was very important at 98%. This means that normal coronary angiography eliminates carotid stenosis in 98% of cases.

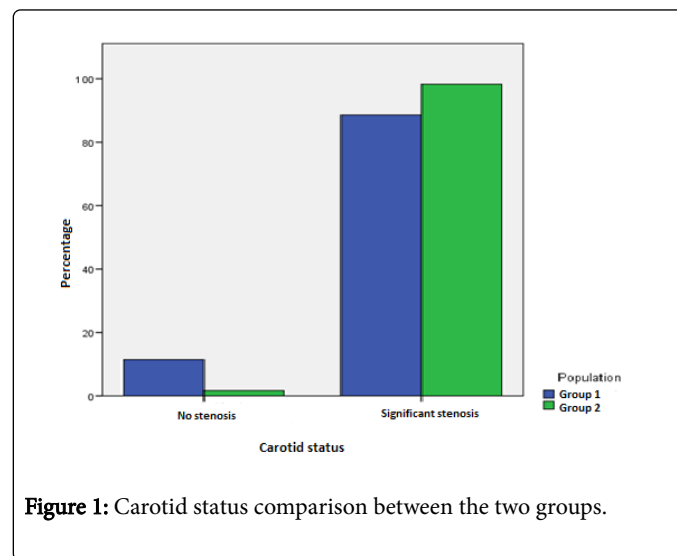


Figure 1: Carotid status comparison between the two groups.

	No stenosis Effective (%)	Significant stenosis Effective (%)	p Value
Age>55 years	566 (93)	58 (98)	NS
Sex (males)	405 (66)	43 (76)	NS
FCAD	13 (2.1)	0 (0)	NS
Diabetes	334 (55)	37 (62)	NS
AHT	302 (49)	40 (67)	<0.05
Dyslipidémie	179 (29)	23 (38)	NS
Obesity	23 (3.7)	2 (3.3)	NS
Tabacco	323 (48)	33 (55)	NS
RF	11 (1.8)	2 (3.3)	NS
Ischemic Stroke	38 (6.2)	10 (16)	<0.05
Hemorrhagic Stroke	1 (0.16)	0 (0)	NS

Note: FCAD: Family Coronary Artery Disease; AHT: Arterial Hypertension; RF: Renal Failure; NS: Non-Significant.

Table 2: Comparison of epidemiological data between patients with and without significant carotid stenosis.

Characteristics of Group 2 patients with tight carotid stenosis

Only three patients in group 2 had tight carotid stenosis. They were two women and one man. All patients were over 59 years old and had hypertension. The mean age was 70.7 ± 15.08 (59-88). The prevalence of diabetes, smoking and dyslipidemia was 33%. All three patients had more CVRFs than the rest of group 2 patients. They all had at least two CVRFs and two of them had 4 CVRFs. The sensitivity of hypertension for the prediction of tight carotid stenosis in patients planned for VR was 100%, its specificity was 78% and its NPV was 100%.

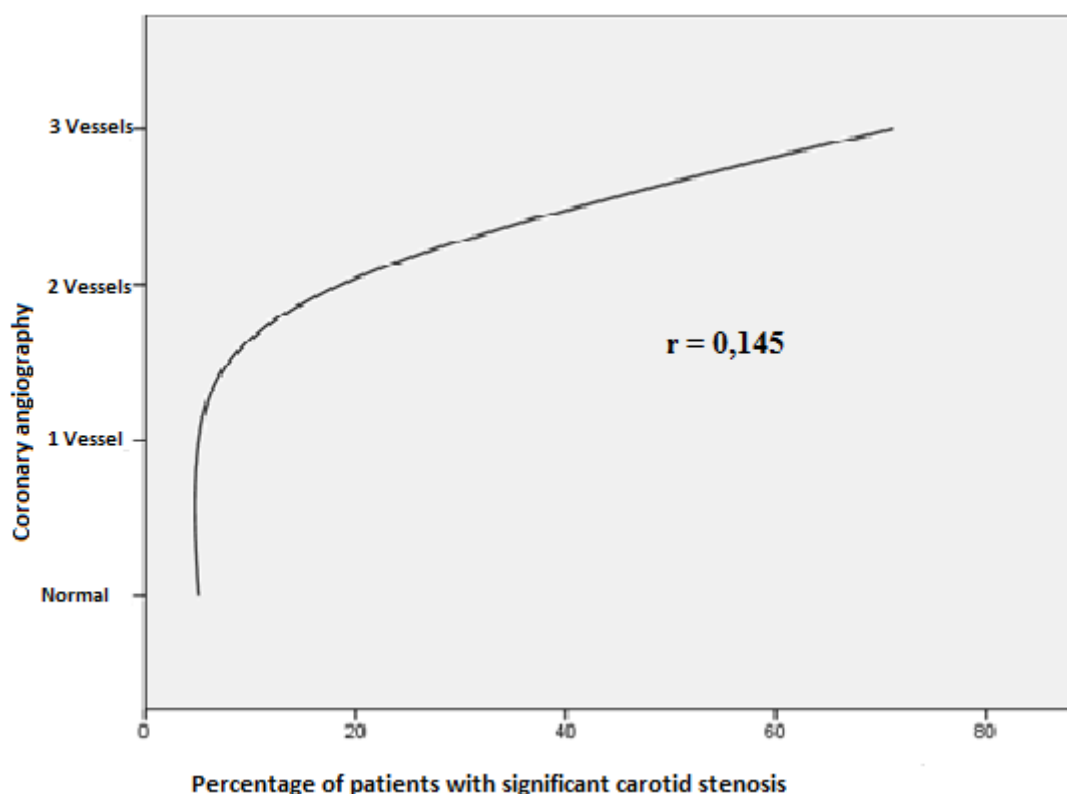


Figure 2: Correlation between coronary status and carotid status.

The history of stroke had a good specificity (78%) and NPV (98%). Whereas, its sensitivity (33%) and PPV (8%) were low.

Discussion

The purpose of our study was to evaluate the value of USAT in the preoperative assessment of patients receiving VR in an attempt to identify its indications. Few studies in the literature have evaluated this topic. The prevalence of significant carotid involvement is low in patients scheduled for cardiac surgery under extracorporeal circulation. In our study, it was only 8.9%. In Yuebing Li's study [3], it was 6.1%. The prevalence of significant carotid involvement was found to be low in both groups but was significantly higher in group 1 than in group 2 (11.5% vs. 1.7%, $p < 0.001$). Durand et al. [4] reported that the prevalence of tight carotid stenosis in patients receiving CABG was 13%. The study of Zayed et al. [5] about carotid involvement screening before valvular surgery showed that only 4% of patients had significant carotid stenosis. No study has compared the results of the USAT among coronary and valvular disease patients. We found that arterial hypertension and a history of stroke were significantly more common in patients with significant carotid stenosis.

The study of Drohomirecka et al. [6] in coronary patients showed that advanced age was a predictor of tight stenosis and that the history of stroke was a predictor of bilateral tight stenosis ($p < 0.05$). D'agostino et al. [7] demonstrated that age, diabetes, smoking, and history of stroke were predictive ($p < 0.05$) of significant carotid stenosis in patients scheduled for coronary surgery. Similarly, Sheiman et al. [8]

reported that smoking, diabetes, hypertension, and history of stroke were associated with a higher risk of significant carotid stenosis in patients scheduled for coronary surgery. The presence of each of these factors increases the probability of carotid stenosis by 2.98. The study of Woo et al. [9] showed that age (OR=1.07), hypertension (OR=3.16) and smoking (OR=6.97) were predictive factors for carotid stenosis in the general population. The paper of Mathiesen et al. [10] about the prevalence of tight carotid stenosis in the general population showed that age, male sex, hypertension, dyslipidemia and tobacco were predictors of significant carotid stenosis ($p < 0.001$). No study had evaluated the predictive factors of tight carotid stenosis in valvular disease patients.

In our study, we found a correlation between coronary artery disease and the presence of significant carotid stenosis. It is important to mention that 72% of patients with carotid involvement had three-vessel disease ($r = 0.145$). The study by Steinvil et al. [11] showed that there was a correlation between the extent of coronary involvement and the severity of carotid stenosis ($r = 0.255$). Thus, significant carotid stenosis was found in 7% of patients with left main coronary artery involvement vs. only 2.1% of controls. Similarly, the study of Chun [12] about screening for significant carotid stenosis in patients who received heart surgery found that three-vessel disease (OR=2.78) or the involvement of the left main coronary artery (OR=6.8) were predictors for significant carotid stenosis. Several studies [8-10] found that involvement of the left main coronary artery was a significant predictor of carotid stenosis.

Among the patients of group 2, only three (1.7%) had significant carotid stenosis. The mean age was 70.7 ± 15 (59-88). A male predominance with a sex ratio of 2M/1H was found. All 3 patients were over 59 years old and hypertensive. Patients with significant carotid stenosis accumulated more CVRFs compared to other patients from the same group. In fact, 67% of these patients had at least 4 CVRF vs. only 18.5% for the rest of the group ($p < 0.001$).

The study of Yoda [13] involving 79 patients with VR and significant carotid stenosis, found that 77% of patients were hypertensive, 54% were dyslipidemic and 25% were diabetic. Older age and hypertension appear as predictors of significant carotid stenosis in valvular disease patients.

Conclusion

The results of our study allow us to say that the prevalence of significant carotid stenosis is low in valvular heart disease patients. USAT indications should be limited to patients over 59 years, or suffering from arterial hypertension, patients with multiple CVRF (≥ 2) or a history of stroke and patients with pathologic coronary angiography. Thus, we can limit the indications of USAT make the economy of health and especially shorten the waiting time for surgery.

Conflicts of Interest

There are no conflicts of interest for the present study.

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