THE IMPACT OF CORONARY ARTERY DISEASE RISK FACTORS ON INNER DIAMETERS OF RIGHT RADIAL ARTERIES

A preliminary study

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Abstrak: Dewasa ini, akses transradial lebih banyak digunakan oleh para ahli kardiologi intervensi, baik untuk prosedur diagnosis maupun intervensi koroner. Diameter dalam arteri radialis kanan berperan penting dalam keberhasilan prosedur transradial ini. Faktor risiko penyakit arteri koroner (CAD) dapat memengaruhi diameter dalam arteri radialis kanan, antara lain melalui vasokonstriksi, pembentukan plak ateroma, dan arteriosklerosis. Penelitian ini bertujuan untuk mendapatkan korelasi diameter dalam arteri radialis kanan dengan faktor risiko CAD tertentu (hipertensi, diabetes melitus, dislipidemia, dan merokok). Sebagai subyek penelitian, digunakan pasien yang menjalani angiografi koroner di Rumah Sakit Awal Bros Makassar sejak Juli sampai dengan Desember 2012 secara retrospektif. Jumlah sampel sebesar 110 pasien; 43 pasien dengan fakor risiko 0 (skor 0); 32 dengan satu faktor risiko (skor 1); 23 dengan dua faktor risiko (skor 2); dan 12 dengan tiga atau lebih faktor risiko (skor 3). Korelasi diameter dalam arteri radialis kanan dengan jumlah faktor risiko dihitung dengan uji korelasi Spearman. Hasil penelitian memperlihatkan terdapat korelasi negatif yang kuat antara diameter dalam arteri radialis kanan dan peningkatan faktor risiko (korelasi Spearman -0,001). Uji Spearman menunjukkan bahwa hipertensi dan diabetes melitus berkorelasi negatif dengan diameter dalam arteri radialis kanan (koefisien korelasi -0,067 dan -0,176), sedangkan dislipidemia dan merokok tidak. **Simpulan:** Pada pasien yang menjalani angiografi koroner di Rumah Sakit Awal Bros Makassar sejak Juli sampai dengan Desember 2012 terdapat faktor risiko CAD yang berpengaruh negatif terhadap diameter dalam arteri radialis kanan. Hipertensi dan diabetes melitus memperkecil diameter dalam arteri radialis kanan secara bermakna, sedangkan dislipidemia dan merokok tidak memengaruhinya.
Kata kunci: diameter dalam, arteri radialis kanan, faktor risiko, penyakit arteri koroner

Abstract: Nowadays, the transradial access has become the preference of most intervention cardiologists, either for diagnostic or intervention coronary procedures. The inner diameter of the right radial artery plays a very important role in the success of this transradial procedure. Risk factors of coronary artery diseases (CAD) can influence the diameter of the right radial arteries (RRAs), e.g. by vasocontriction, atheroma plaque forming, and arteriosclerosis. This study aimed to find out the correlation of inner diameters of the RRAs to certain risk factors of CAD (hypertension, diabetes mellitus, dyslipidemia, and smoking). We retrospectively reviewed all patients that underwent coronary angiography in Awal Bros Hospital Makassar from July until December 2012. The total number of patients was 110: 43 patients with zero risk factor (scored 0); 32 with one risk factor (scored 1); 23 with two risk factors (scored 2); and 12 with three or more risk factors (scored 3). The correlation of inner diameters of the

right radial arteries with the number of risk factors was calculated by using the correlative test of Spearman. The results showed that there was a strong negative correlation between the inner diameters of RRAs and the increase of risk factors (Spearman correlation - 0.001). The Spearman test showed that hypertension and diabetes melllitus was negatively correlated to the inner diameters of RRAs (correlation coefficient - 0.067 and – 0.176, respectively), while dyslipidemia and smoking showed no correlation with the decrease of the inner diameters of RRAs. **Conclusion:** Among patients that underwent coronary angiography in Awal Bros Hospital Makassar from July until December 2012, there were certain risk factors that negatively affected the inner diameters of RRAs. Hypertension and diabetes mellitus significantly decreased the inner diameters of RRAs, while dyslipidemia and smoking did not affect the radial arteries.

Keywords: inner diameter, right radial artery, risk factors, coronary artery disease

Nowadays, the transradial approach has become the preference of most intervention cardiologists, either in diagnostic or intervention coronary procedures. Generally, complications due to this approach are rarely found and most are easier to be managed than other approaches. In addition, early ambulation, comfortability and satisfaction of the patients, and a relative low cost lead this approach to be the most preferable one.[1-3] Albeit, bleeding and other vascular complications e.g. hematoma, pseudo-aneurysm, arteriovenous fistule, and arterial perforation are still the most common complications found in this transradial procedure.[4] Caputo[5] presumed that these are caused, among others, by the small caliber of the radial arteries.

Although failures in transradial approaches are mostly caused by variants of radial arteries, stenosis, spasm, disection, injury of radial artery (resulting in occlusion), and the hesitation of the operator to try a different technique,[3-5] small sized individuals and certain ethnic backgrounds also play some considerable roles since they are reported to have smaller sizes of radial arteries.[3] Moreover, Rodriguez et al[6] reported that radial arteries with inner diameter less than 2 mm should not be considered for coronary artery bypass grafting. The inner diameter of the right radial artery has to be considered thoroughly to support the success of the transradial procedure.[3-5]

Cardiovascular diseases are still the leading cause of morbidity and mortality world-wide.[7] In America, it is estimated that more than 16 million people have coronary artery disease (CAD) and 8 million have had a myocardial infarction (MI). Moreover, every year approximately 1 million people will have a new myocardial infarction. Data of the Framingham trial showed that nearly 50% of males and 30% of females over the age of 40 would develop CAD.[8]

There are several risk factors of CAD, as follows: age, gender, family history of CAD, personal history of CAD, dyslipidemia, diabetes mellitus, hypertension, smoking, abdominal obesity, non-traditional factors (e.g. hsCRP, PAI-1, and adiponectin);[8,9] as well as low estrogen, elevated testoteron, and polycystic ovary syndrome (PCOS) in females.[10] Epidemiological studies have shown positive correlations between hypertension and smoking or impairment of glucose metabolism. These risks can influence the inner diameter of the elastic and muscular arteries, including the right radial arteries (RRAs), e.g. by atheroma plaque forming and arteriosclerosis.[11]

At present, there are still many conflicting reports about the influence of CAD risk factors on the inner diameter of arteries, including muscular arteries. Therefore, in this study we evaluated the correlation of certain risk factors (hypertension, diabetes mellitus, dyslipidemia, and smoking) to the inner diameters of radial arteries which are the most preferred access for coronary angiography.

The objective of this study was to find

out the correlation of inner diameters of the right radial arteries to several risk factors of coronary artery diseases (hypertension, diabetes mellitus, dyslipidemia, and smoking). The correlated risk factors can be used as predictors in supporting the success of transradial procedures and bypass grafting for coronary artery reconstruction.

METHODS

We reviewed retrospectively all patients that underwent coronary angiography in Awal Bros Hospital Makassar from July until December 2012. The inclusion criteria was all of these patients with or without risk factors of coronary artery diseases. The exclusion criteria in this study were patients who did not have right radial arteries.

The risk factors of coronary arterial diseases (CAD) that we observed in this study were hypertension, diabetes mellitus, dyslipidemia, and smoking. According to JNC 7 algorithm, hyper-tension is established if the systolic blood pressure is ≥140 mm Hg, or the diastolic blood pressure is ≥90 mm Hg. The diabetes mellitus criteria used in this study was adopted from Perkeni, which were fasting plasma glucose <100 mg/dL and post-prandial plasma glucose <140 mg/dL. The dyslipidemia criteria used in this study was adopted from NCEP ATP III for high risk patients. It was LDL cholesterol >100 mg/dL, total cholesterol >200 mg/dL, HDL cholesterol <40 mg/dL, and triglyceride >150 mg/dL. The smoking criteria concerned patients who were still smoking or had stopped smoking for less than 10 years.

All the risk factors were numbered by using scores. One risk factor was scored as 1; two risk factors were scored as 2; and three or more risk factors were scored as 3. Statistical analysis of this study was done by using SPSS version 19.

RESULTS

There were 111 patients that underwent coronary angiography (CA) in Awal Bros Hospital Makassar from July until December 2012. One patient did not have a right radial artery and the CA was done by using his left radial artery. This patient was exluded from this study.

From the four risk factors of the CAD used, hypertension was the most frequent found among the population (Table 1). Sixty-seven patients showed 1-4 risks of CAD (scored 1-3, and 43 patients had no risk factor (scored 0) (Table 2).

The inner diameters of right radial arteries were divided into three ranges: 1.99-2.49 mm, 2.5-2.99 mm, and >3mm. Most of the patients were in the range 1.99-2.49 mm (Table 3).

Statistical analysis showed that data of the internal diameters of right radial arteries (RRAs) were not distributed in the normal bell-shape. So, we used a Spearman correlation test to analyze the correlation between the inner diameters of RRAs and risk factor scores. This test showed a strong negative correlation between the inner diameters of RRAs and the increase of risk factor scores (Spearman correlation -0.001). It meant that the more the risk factors, the less the inner diameters of radial arteries.

The Spearman correlation test showed that there was a negative correla-tion between patients without hyper-tension (0 score) and patients with hyper-tension (1 score) with inner diameters of RRAs (correlation coefficient -0.067). It meant that hypertension was positively correlated to the decrease of the inner diameters of RRAs.

The Spearman correlation test showed that there was a negative correla-tion between patients without diabetes mellitus (0 score) and patients with diabetes mellitus (1 score) with inner diameters of RRAs (correlation coefficient -0.176). It meant that those with diabetes mellitus were positively correlated with the decrease of the inner diameters of RRAs.

The Spearman test showed that there was no correlation between dyslipidemia and smoking with the inner diameters of RRAs.

Table 1. Risk factors of CAD in coronary angiography (CA) patients: hypertension, diabetes mellitus, dyslipidemia, and smoking

CAD risk factors of CA patients	Number of patients	Percentage of total patients
Hypertension	41	37.27
Diabetes mellitus	14	12.78
Dyslipidemia	36	32.72
Smoking	24	21.89

Table 2. CA patients in Awal Bros Hospital Makassar from July until December 2012

Number of CAD risk factors of Coronary Angiography patients	Scoring	Number of patients
0 risk factor	0	43
1 risk factor	1	32
2 risk factors	2	23
≥3 risk factors	3	12
Total population		110

Table 3. Inner diameters of RRAs and number of CA patients

Internal caliber of RRAs	Number of CA patients	Percentage
>3 mm	2	1.82
2.5-2.99 mm	17	15.45
1.99-2.49 mm	91	82.73
Total population	110	100

DISCUSSION

Hypertension, neurohormonal activation, and endothelial cell dysfunction cause vascular remodeling, which further results in a higher blood pressure. At the beginning, vasoconstriction occurs to normalize wall stress and to avert a trophic response that initiates the small artery remodeling. In this remodeling process, normal smooth muscle cells rearrange themselves around a smaller lumen diameter, inward eutrophic remodeling.[12] Although the media-to-lumen ratio increases, the medial cross-sectional area remains unchanged, resulting in a decrease in the inner diameter of the vessel.[12,13]

In our study we found that there was a strong negative correlation between the inner diameters of RRAs and the increase of risk factor scores. It meant that the increase of the risk factor numbers were correlated with the decrease of the inner diameters of RRAs. Hypertension was the most frequent risk factor found in this study. Besides that, hypertension was positively correlated to the decrease of the inner diameters of RRAs. Benetos et al[14] proposed that in hypertensive cases, the diameter of the radial artery (peripheral muscular artery) is unchanged, whereas in the central arteries the diameter is increased. Chowdurhury et al[15] evaluated proximal and distal radial artery specimens obtained from patients who underwent myocardial revascularization and identified three significant predictors for intimal hyperplasia, as follows: age, smoking, and hypertension. According to Khder et al,[16] the radial artery inner diameters were increased in untreated as well as in treated hypertensive patients. Mourad et al[17] previously reported that the compliance of radial arteries in hypertensive patients was not significantly different from those with normotension, despite increased wall

thickness in the hypertensive patients. Mackay et al[13] assumed that radial artery intima-media hypertrophy was likely to be independent of blood pressure effects, and it was suspected due to endothelial dysfunction. Loh et al[18] found that risk factors that positively affected the size of the radial artery were sex, hypertension, and hyperlipidemia. Patients with hypertension showed a tendency to have significantly larger radial artery diameters. From the studies mentioned above, Chowdurhury, Mourad, and Mackay' studies did not support our result while studies of Khder and Loh were contrary.

Diabetes mellitus is a metabolic disease which causes hyperglycemia, dyslipidemia, and insulin resistance, resulting in arterial dysfunction and atherosclerosis tendency, impairment of the vasodilator function of endothelial cells, and decrease of the bioavailability of nitric oxcide.[19] Our results showed that there was a negative correlation between patients without diabetes mellitus (0 score) and patients with diabetes mellitus (1 score) with inner diameters of RRAs. It meant that diabetes mellitus was positively correlated with the decrease of inner diameters of RRAs in this study. Chowdhury et al[15] demonstrated that intimal hyperplasia and atherosclerosis in radial arteries were related to age and diabetes, resulting in the narrowing of the radial lumen. Loh et al[18] found that as patients grew older and developed diabetes mellitus, the radial artery showed a tendency to decrease in size; it meant that diabetes mellitus affected negatively the size of the radial artery. These studies of Chowdhury and Loh supported our observation of smaller inner diameters of RRAs in diabetic patients.

Cholesterol substantially alters the endothelial function, resulting in a decrease of the arterial dilatation which means a decrease in the inner diameters of the arteries.[14,20] The LDL receptor pathway and the vascular biology of atherosclerosis provides the biologic plausibility for the considerable role of LDL in the atherogenesis process while the role of triglycerides in atherosclerosis are still controversial.[20] In our study the Spearman test showed that there was no correlation between dyslipidemia and the decrease of inner diameters of RRAs. Loh et al[18] found that hyperlipidemia positively affected the size of the radial artery which was not in accordance with our result.

There are many adverse effects of smoking, inter alia: increase of blood pressure and sympathetic tone, decrease of myocardial oxygen supply, enhancement of the oxidation of low-density lipoprotein (LDL) cholesterol, provocation of atherothrombosis through several other mechanisms, and impairment of endothelium-dependent coronary artery vasodilation.[12,14,20] The nicotine in cigarette smoking transiently raises BP by 10-20 mm Hg with every single cigarette, therefore smokers show a propensity to have higher blood pressures.[12] In our study, we found that there was no correlation between smoking and the decrease of the inner diameters of RRAs. On the other hand, Chowdhury[15] found that smoking narrowed the distal part of radial arteries. Ashraf[21] reported that the measured size of radial artery was larger in smokers. Chiddawar et al[22] found that smokers showed a tendency of higher blood pressures while Binder et al[23] and Kool et al[24] reported that smoking influenced arterial stiffness, resulting in a decrease in the diameters of arteries. These studies above showed conflicting results with ours.

The limitation of our study are that we did not take into account the duration of the risk factors of coronary arterial diseases, and whether the patients were under treatment or not for their risk factors. Besides that, we did not include data of other risk factors, inter alia gender, ages, Body Mass Index, and ethnic background.

CONCLUSION

A number of risk factors were found to negatively affect the inner diameters of right radial arteries. Hypertension and diabetes mellitus significantly decreased

the inner diameters of right radial arteries while dyslipidemia and smoking did not affect the arteries.

Since there are still conflicting results, further studies with larger population are needed to determine other risk factors that may affect the inner diameters of right radial arteries.

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