Medical Research, Nursing, Health and Midwife Participation
https://medalionjournal.com | ISSN: 2986-7754

RELATIONSHIP OF HYPERTENSION WITH AORTIC CALCIFICATION IN CHEST X-RAY IMAGES OF PATIENTS AT RSUP KEYWORDS HAJI ADAM MALIK MEDAN

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Abstract

Hypertension serves as an independent risk factor for atherosclerosis development and is linked to factors that predispose to aortic calcification. Furthermore, hypertension has the potential to cause the acute rupture of existing plaques by elevating mechanical pressure on them. Chest X-ray imaging is a commonly employed method for identifying aortic calcification during routine examinations. Medial arterial calcification is visualized as radiopaque findings resembling tram-tracks, while calcification within the intima is observed as radiopaque spots.A cross-sectional study involving 92 hypertensive individuals who underwent chest X-ray imaging at RSUP Haji Adam Malik Medan aimed to assess the distribution of study subjects in terms of age, gender, hypertension severity, and aortic calcification degree. Hypertension history was extracted from patients' medical records, and aortic calcification measurements were conducted in the aortic arch by both the researcher and a radiologist. The majority of hypertensive patients were aged over 65, accounting for 40.2% of the sample, with a predominant female population of 57.6%. Stage 1 hypertension was the most prevalent, affecting 52.2% of the subjects, and grade one aortic calcification was the most common, observed in 63% of cases.A weak yet statistically significant positive correlation between hypertension and aortic calcification was identified ($p < 0.05$; $r = 0.196$) in the patient population at RSUP Haji Adam Malik Medan.

Keywords: ***hypertension, aortic calcification, chest X-ray.***

INTRODUCTION

Hypertension is a condition where an individual experiences a prolonged increase in blood pressure. The criteria for hypertension, as per the JNC VII diagnosis criteria, refer to a systolic blood pressure measurement of ≥140 mmHg or a diastolic blood pressure measurement of ≥90 mmHg, which applies to individuals aged ≥18 years. According to the World Health Organization (WHO), more people die each year from cardiovascular diseases than from any other cause. More than three-quarters of heart disease and stroke-related deaths occur in low and middle-income countries. Hypertension is a serious medical condition that significantly increases the risk of heart, brain, kidney, and other diseases. It is estimated that 1.4 billion people worldwide have high blood pressure, but only 14% have it under control. Hypertension is an independent risk factor for the development of atherosclerosis and is associated with predisposing factors for aortic calcification. Most cardiovascular disease prevention efforts include controlling blood pressure, which is known to reduce the risk of cardiovascular diseases. Hypertension can also lead to acute plaque rupture by increasing mechanical pressure on already formed plaques.

This is in line with the study by Irribaren et al. in 2000, which stated that risk factors such as age, race/ethnicity, hypertension, and smoking habits are related to aortic calcification on chest X-rays. However, there were different results in the study conducted by Farhanah in 2019, which showed no significant relationship between hypertension and aortic calcification on chest X-rays. The use of chest X-rays is generally very useful in detecting aortic calcification in routine

examinations. Medial artery calcification appears as tram-track-shaped radiopaque findings, while calcification in the intima is identified as radiopaque spots. Based on the findings above, the researcher aims to determine if there is a relationship between hypertension and aortic calcification in chest X-ray images of patients at RSUP Haji Adam Malik Medan.

RESEARCH METHODS

This study is an observational analytical research with a cross-sectional design conducted on patients who underwent chest X-ray examinations at RSUP Haji Adam Malik Medan. The study was conducted at the Radiology Department of RSUP Haji Adam Malik Medan in the year 2023. The study's population consists of all patients who underwent chest X-ray examinations at the Radiology Department of RSUP Haji Adam Malik Medan in the year 2022. The research sample was drawn from this population, using non-probability sampling, specifically the consecutive sampling technique. This means that samples were selected sequentially based on inclusion and exclusion criteria until the minimum required sample size was achieved. Our study included patients who were 18 years of age or older, had a documented diagnosis of hypertension in their medical records, and had undergone PA/AP chest X-ray imaging at RSUP Haji Adam Malik's Radiology Department. However, patients with incomplete medical record data were excluded from the study. Based on the sample size calculation, a total of 92 patients were included in the study.

RESULTS AND DISCUSSION

From the research findings on the frequency distribution of hypertension based on age, it was observed that the data revealed the highest frequency in the age range above 65 years, with 37 individuals (40.2%), followed by the age range of 56-65 years with 30 individuals (32.6%), 46-55 years with 22 individuals (23.9%), 36-45 years with 1 individual (1.1%), and 26-35 years with 2 individuals (2.2%). This aligns with a study by Zhang et al. (2021) involving 33,997 research samples in Tianjin, which indicated that the most common age group for hypertension had an average age of 69.45 years. The research findings from Singh (2017) involving 647 research samples in India also indicated that age is a significant risk factor for the occurrence of hypertension ($p < 0.01$).

From the research results on the frequency distribution of hypertension based on gender, it was found that out of the 92 hypertension patients in the study, 39 were male (42.4%), and 53 were female (57.6%). This corresponds with a study by Hanif et al. (2021) in Bangladesh, where 42% of hypertension patients were male, and 56% were female. In the male group, the most prevalent age range among subjects with hypertension was above 65 years, with 19 subjects, and the most common degree of hypertension was stage 1, with 9 subjects. In the female group, the most common age range for subjects with hypertension was also above 65 years, with 18 subjects, and the most common degree of hypertension was stage 1. Overall, the most frequent age group with hypertension was above 65 years, with 37 subjects, and the most common degree of hypertension was stage 1.

These findings align with RISKEDAS data from 2007 and 2013, where in 2007, the prevalence of hypertension was 31.3% in women and 22.8% in men, and in 2013, the prevalence of hypertension was 31.9% in women and 28.8% in men. Choi et al. (2017) also noted that overall, hypertension occurred more frequently in men (34.6%) than in women (30.8%). However, in the age group above 60 years, hypertension was more common in women. In the research results on the distribution of aortic calcification based on the degree of hypertension, it is evident that in the pre-hypertension category, 22 subjects had aortic calcification degree 1, 8 subjects had aortic calcification degree 2, and no subjects had aortic calcification degree 3. In the stage 1 hypertension group, 30 subjects had aortic calcification degree 1, 18 subjects had aortic calcification degree 2,

and no subjects had aortic calcification degree 3. In the stage 3 hypertension group, 6 subjects had aortic calcification degree 1, 7 subjects had aortic calcification degree 2, and 1 subject had aortic calcification degree 3. There was a significant correlation between hypertension and aortic calcification with a weak positive correlation (p-value = 0.049; r-value = 0.149). This is consistent with research conducted by Muhammad (2022) on 110 patients with ischemic stroke, which indicated a correlation between hypertension and aortic calcification (p-value = 0.01).

Tsakiris (2007) also demonstrated in a study involving 290 subjects with left ventricular hypertrophy that there was a relationship between essential hypertension and aortic calcification (p-value = 0.025). The limitations of this study include the fact that the sample selection was based solely on the degree of hypertension, without considering the duration of hypertension, hypertension patterns, and the treatment received. Additionally, factors such as comorbidities that can influence aortic calcification, such as body mass index, smoking, genetic factors, and diseases like diabetes mellitus and chronic kidney disease, were not taken into account. Therefore, the correlation examined in this study is influenced by these uncontrolled variables. In a study conducted by Messerli (2017), it was found that the sensitivity of CT scans for detecting aortic valve, ascending aorta, and aortic arch calcification was 93.5%, 96.2%, and 96.2%, respectively, whereas the sensitivity of chest X-rays in detecting aortic calcification was significantly lower at 52.3% compared to CT scans (p = 0.001). Hence, the absence of calcification on chest X-rays does not necessarily imply the absence of calcification because chest X-rays only detect broader areas of calcification, and generally, atherosclerosis of the thoracic aorta is often overlooked.

CLOSING

In the research conducted at RSUP Haji Adam Malik Medan, several key findings emerged. The most prevalent age group among hypertensive patients exhibiting aortic calcification on chest X-rays was those aged above 65 years. Furthermore, a significant majority of these patients were female. When it came to the degree of hypertension, stage one hypertension was the most frequently observed among patients at the medical center. Aortic calcification degree one also dominated the results, with it being the most common degree of aortic calcification among the study participants. Importantly, the study revealed a meaningful yet weak positive correlation between hypertension and aortic calcification in patients at RSUP Haji Adam Malik Medan. These findings shed light on the demographic and health factors associated with hypertension and aortic calcification in the studied patient population. Further research is necessary, taking into consideration the duration of hypertension, hypertension patterns, and the treatment received. Additionally, more in-depth studies are warranted to explore comorbid factors that can influence aortic calcification, such as body mass index, smoking, genetic factors, and diseases like diabetes mellitus and chronic kidney disease, through multivariate analysis. Advanced examinations using CT scans should also be considered to enhance the accuracy of aortic calcification detection. These steps would help to provide a more comprehensive understanding of the factors contributing to aortic calcification and its relationship with hypertension.

REFERENCES

Adrian, S. J. Tommy. (2019). Hipertensi Esensial: Diagnosis dan Tatalaksana Terbaru pada Dewasa. Vol. 46. No. 3. Cermin Dunia Kedokteran.

Albanese, I., et al. (2018). Atherosclerotic calcification: Wnt is the hint. Journal of the American Heart Association, 7(4). Available at: https://doi.org/10.1161/jaha.117.007356.

Aziz, M., & Yadav, K. S. (2016). Pathogenesis of Atherosclerosis. Med Clin Rev, 2:3.

Bendix, E. F., et al. (2018). Diabetes and abdominal aortic calcification—a systematic review. Current Osteoporosis Reports, 16(1).

Budoff, M. J., Shaw, L. J., Liu, S. T., et al. Long-term prognosis associated with coronary calcification: observations from a registry of 25,253 patients. Journal of the American College of Cardiology, 49(18).

Chobanian, A. V., et al. (2003). The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: the JNC 7 report. JAMA, 289.

Claudie Petit, S. Jamaleddin M, Stéphane A. (2019). Chapter 6 - Review of the Essential Roles of SMCs in ATAA Biomechanics. Advances in Biomechanics and Tissue Regeneration.

Demer, L. L., & Tintut, Y. (2008). Vascular calcification: pathobiology of a multifaceted disease. Circulation.

Demer, L. L., & Tintut, Y. (2008). Vascular calcification: pathobiology of a multifaceted disease. Circulation.

Extracellular vesicle signalling in atherosclerosis - Scientific Figure on ResearchGate. Available from: https://www.researchgate.net/figure/Atherosclerotic-plaque-formation-A-Lipoprotein-retention-to-the-vascular-wall-and_fig1_343901409.

Farhanah, RD. (2019). Korelasi Derajat Hipertensi dengan Derajat Kalsifikasi Arkus Aorta pada Foto Toraks di RSUP Dr. Mohammad Hoesin Palembang. Fakultas Kedokteran Universitas Sriwijaya.

Guideline for the pharmacological treatment of hypertension in adults. Geneva: World Health Organization; 2021. Licence: CC BY-NC-SA 3.0 IGO.

Hak, A. E., Pols, H. A., Stehouwer, C. D., et al. Markers of inflammation and cellular adhesion molecules in relation to insulin resistance in nondiabetic elderly: the Rotterdam Study. Journal of Clinical Endocrinology and Metabolism, 86(2).

Hjortnaes, J., New, S. E. P., & Aikawa, E. (2013). Visualizing novel concepts of cardiovascular calcification. Trends in Cardiovascular Medicine, 23(3).

Hiroko Hashimoto, Katsuya Iijima, Masayoshi Hashimoto, Bo-Kyung Son, Hidetaka Ota, Sumito Ogawa, Masato Eto, Masahiro Akishita, Yasuyoshi Ouchi. (2009). Validity and Usefulness of Aortic Arch Calcification in Chest X-Ray. Journal of Atherosclerosis and Thrombosis, 16(3).

HS, F.R. (2014) "Diagnosis and Management of Hypertension in the Elderly Patient," Medical Journal of Lampung University, 3(7).

Iqbal, A. M., & Jamal, S. F. (2022). Essential Hypertension. StatPearls. Available from: https://www.ncbi.nlm.nih.gov/books/NBK539859/.

Iribarren, C., et al. (2000). Calcification of the aortic arch: risk factors and association with coronary heart disease, stroke and peripheral vascular disease. Journal of American Medical Association, 283(16).

Jarjou'i, A., Bogot, N., Kalak, G., Chen-Shuali, C., Rokach, A., Izbicki, G., & Arish, N. (2021). Diffuse pulmonary calcifications: A case series and review of literature. Respirology case reports, 9(10).

Jebari-Benslaiman, S. Galicia-García, U. Larrea-Sebal, A. Olaetxea, J.R. Alloza, I. Vandenbroeck, K. Benito-Vicente, A. Martín, C. (2022). Pathophysiology of Atherosclerosis. Int. J. Mol. Sci.

Jung, J. G., Wu, L. T., Kim, J. S., Kim, E. D., & Yoon, S. J. (2019). Relationship between Smoking and Abdominal Aorta Calcification on Computed Tomography. Korean journal of family medicine, 40(4).

Kramann R, Schüler P, Risler T, et al. Mechanisms of vascular calcification. Am J Physiol Renal Physiol. 2019.

Kuswardhani RAT. (2006). Penatalaksanaan hipertensi pada lanjut usia. Jurnal Penyakit Dalam, 7(2).

Lombardi M, Severi P, Mazza A et al. (2017). Sex differences in hypertension: A question worth asking? Ann Clin Hypertens,1.

Mahayuni, KS. (2021). Gambaran Tingkat Pengetahuan Tentang Hipertensi Pada Pasien Hipertensi Di RSUD Kabupaten Klungkung Tahun 2021. Diploma thesis, Jurusan Keperawatan Poltekkes Denpasar.

Messerli, M., Giannopoulos, A. A., Leschka, S., Warschkow, R., Wildermuth, S., Hechelhammer, L., & Bauer, R. W. (2017). Diagnostic accuracy of chest X-ray dose-equivalent CT for assessing calcified atherosclerotic burden of the thoracic aorta. The British journal of radiology.

Muhammad, M. (2022). HUBUNGAN HIPERTENSI DENGAN KALSIFIKASI ARKUS AORTA PADA FOTO TORAKS PASIEN STROKE ISKEMIK DI RSUP. H. ADAM MALIK MEDAN [Preprint].

Nakanishi, R., Baskaran, L., Gransar, H., Budoff, M. J., Achenbach, S., Al-Mallah, M., Cademartiri, F., Callister, T. Q., Chang, H. J., Chinnaiyan, K., Chow, B., DeLago, A., Hadamitzky, M., Hausleiter, J., Cury, R., Feuchtner, G., Kim, Y. J., Leipsic, J., Kaufmann, P. A., Maffei, E., … Berman, D. S. (2017). Relationship of Hypertension to Coronary Atherosclerosis and Cardiac Events in Patients With Coronary Computed Tomographic Angiography. Hypertension (Dallas, Tex. : 1979), 70(2).

Nuraini, B. (2015). "Risk Factors of Hypertension," Jurnal Kedokteran UNILA, 4(5).

Nuraima A. (2012). Faktor risiko hipertensi pada masyarakat di Desa Kabongan Kidul kabupaten Rembang [Laporan Penelitian]. Semarang: Universitas Diponegoro.

Noviyanti. (2015). Hipertensi Kenali, Cegah, dan Obati. Diterbitkan Oleh Notebook. Bantul, Yogyakarta.

Odink, A., van der Lugt, A., Hofman, A., et al. Risk factors for coronary, aortic arch and carotid calcification; The Rotterdam Study. J Hum Hypertens.

Pinto E. Blood pressure and ageing. Postgrad Med J. 2007.

Shah, N. M., Dong, Y., & Cao, J. (2018). Association of androgen and estrogen with hypertension in postmenopausal women: a cross-sectional study from NHANES. Clinical and Experimental Hypertension, 40(7).

Shanahan CM. (2007). Inflammation ushers in calcification: a cycle of damage and protection?. Circulation.

Shanahan CM, Crouthamel MH, Kapustin A, et al. (2011). Arterial Calcification in Chronic Kidney Disease: Key Roles for Calcium and Phosphate. Circ Res.

Shanahan CM, Crouthamel MH, Kapustin A, et al. (2011). Arterial Calcification in Chronic Kidney Disease: Key Roles for Calcium and Phosphate. Circ Res.

Shanahan, C.M., Crouthamel, M.H., Kapustin, A. et al. (2011). Arterial Calcification in Chronic Kidney Disease: Key Roles for Calcium and Phosphate. Circ Res. 2011;109(6):697-711.

Supriyono, S., & Andriyanto, A. (2020). Relationship of characteristics (age, sex, level of education) with hypertension in training of healthy family trainers. Jurnal Ilmu Kesehatan, 8(2).

Tadic M, Cuspidi C, Grassi G et al. (2019) Gender-specific therapeutic approach in arterial hypertension—Challenges ahead. Pharmacological Research, 141.

Tadic, M., Cuspidi, C., Grassi, G., et al. (2019). Gender-specific therapeutic approach in arterial hypertension—Challenges ahead. Pharmacological Research, 141.

Tanzil, E.K., and Widjaya, I.F. (2022). Hubungan Jenis Kelamin dengan Kalsifikasi Aorta pada Radiografi Toraks. HUBUNGAN JENIS KELAMIN DENGAN KALSIFIKASI AORTA PADA RADIOGRAFI TORAKS, 6(3).

Themes, U. (2019, May 29). Vascular system. Radiology Key.

Tsakiris, A. et al. (2004). Aortic calcification is associated with age and sex but not left ventricular mass in essential hypertension, Journal of clinical hypertension (Greenwich, Conn.).

Woo, J. S., Kim, W., Kwon, S. H., Youn, H. C., Kim, H. S., Kim, J. B., Kim, S. J., Kim, W. S., & Kim, K. S. (2016). Aortic arch calcification on chest X-ray combined with coronary calcium score show additional benefit for diagnosis and outcome in patients with angina. Journal of geriatric cardiology: JGC, 13(3).

Yunitasari, PY. (2018). Hubungan Karakteristik Pasien Hipertensi Dengan Perilaku Kontrol Tekanan Darah Di Upt Kesmas Gianyar I Tahun 2018. Diploma thesis, Jurusan Keperawatan 2018.