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Review Paper

# Intima media thickness as an indicator of cardiovascular risk in hypertensive patients

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Abstract

Introduction: A key indicator of cardiovascular risk, especially in people with hypertension, is the carotid artery's intima-media thickness (IMT). This article focuses on how IMT and hypertension are related, how well IMT predicts cardiovascular events, and how antihypertensive medications affect the course of IMT.

Aim: To search into the relationship between IMT and hypertension and evaluate how antihypertensive medication affects IMT in people with hypertension.

Material and methods: A detailed analysis of the existing literature body served as the foundation for this investigation. Several electronic databases, including Embase, PubMed, Scopus, Web of Science, Cochrane Library, Frontiers, Taylor & Francis Online, Springer, and Elsevier, were searched systematically using pertinent keywords. Thirty articles were found to be eligible for review.

Results and discussion: Increased IMT is closely linked to hypertension, suggesting that high blood pressure causes arterial wall thickening. Future cardiovascular events, including myocardial infarction and stroke, can be accurately predicted by elevated IMT. It has been demonstrated that antihypertensive medications, especially those that target the renin-angiotensin-aldosterone system, can effectively slow the progression of IMT. Improving patient outcomes requires early identification of subclinical atherosclerosis using IMT measurement and individualized treatment plans. To effectively manage hypertensive patients with elevated IMT, healthcare providers must work together.

Conclusions: Reducing cardiovascular risk in hypertensive patients requires a multidisciplinary approach. Frequent IMT evaluation is useful for treatment planning and cardiovascular risk assessment. Furthermore, anesthesia professionals are essential to maintaining patient safety and maximizing pain control.

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## 1. INTRODUCTION

Intima-media thickness (IMT) is a valuable biomarker, particularly in those with hypertension, for assessing cardiovascular risk.[1] IMT provides information on the early stages of atherosclerosis and the general health of the arteries by measuring the combined thickness of the intima and media layers of the artery wall. Increased cardiovascular events, including heart attacks and strokes, are frequently linked to elevated IMT levels, which makes it a crucial tool for risk assessment as well as diagnosis.[2] High-resolution ultrasound imaging of the carotid arteries is commonly used to calculate 2 IMT.[3] Atherosclerosis, or the accumulation of fatty deposits and other materials in the artery walls, is the main cause of elevated IMT. This process is accelerated up by hypertension, which damages the artery lining, increases inflammation, and facilitates the deposition of cholesterol and other materials.[4] Moreover, obesity, smoking, high cholesterol, and diabetes all contribute to elevated IMT. Every one of these illnesses has the potential to worsen arterial damage and raise the risk of cardiovascular disease.[5] Worldwide, hypertension affects over 1.3 billion individuals. It is a common condition.[4] The fact that it contributes to the development of cardiovascular disease makes it a serious public health concern.[6] Increased IMT is more common in patients with hypertension than in healthy people, while the frequency varies by population and study design.[7] This emphasizes how crucial IMT monitoring is for the regular evaluation of cardiovascular risk in hypertensive patients.[8] IMT's capacity to offer early, non-invasive insights into arterial health is the main reason for this review's focus on it as a cardiovascular risk indicator in hypertension.[9] Despite the fact that hypertension is a known risk factor for cardiovascular disease, IMT measures can assist in identifying those who are more likely to experience negative outcomes before symptoms appear.[2] By more accurately determining risk, customizing treatment regimens, and incorporating IMT measurements into standard clinical practice, healthcare providers may be able to enhance patient outcomes.[10] Our capacity to prevent and treat cardiovascular disease would improve if we had a better understanding of the connection between IMT and hypertension.

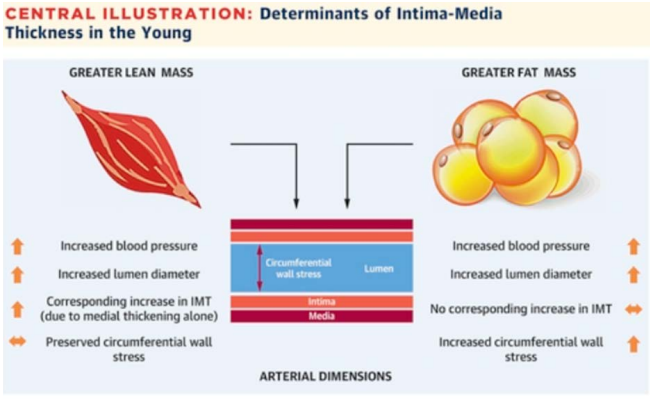


**Figure 1. pathogenesis of intima media thickening.[10]**

## 2. AIM

To search into the relationship between IMT and hypertension and evaluate how antihypertensive medication affects IMT in people with hypertension.

## 3. MATERIAL AND METHODS

In order to learn more about the function of IMT as a cardiovascular risk marker in hypertensive patients, a comprehensive evaluation of the literature was undertaken. Using the following keywords, the review included a comprehensive analysis of all publications published between March 2018 and June 2024 that were accessible through PubMed: 'intima-media thickness,' 'hypertension,' 'cardiovascular risk, 'arterial health,' and 'risk stratification.' The search encompassed relevant material from both Polish and English sources, as well as relevant international research. To ensure that only top-notch research was included, the impact factor of the journals in which the articles were published was carefully taken into account. With the use of this strategy, we were able to rank and incorporate research in the areas of cardiology, hypertension, and vascular health from reliable, well-established sources.

## 4. RESULTS AND DISCUSSION

### 4.1. Carotid artery measures

The carotid artery was seen using B-mode ultrasound in order to calculate the IMT. The lumen-intima interface (first bright line) and the media-adventitia interface (second bright line), respectively, are the interfaces that were used to measure IMT. It has been demonstrated that this method closely correlates with measurements utilizing pathological evaluations, with repeat measures having a mean difference of 0.02–0.14 mm. Using an image analysis program, IMT was determined offline (Carotid Plaque Texture Analysis Software, Copyright

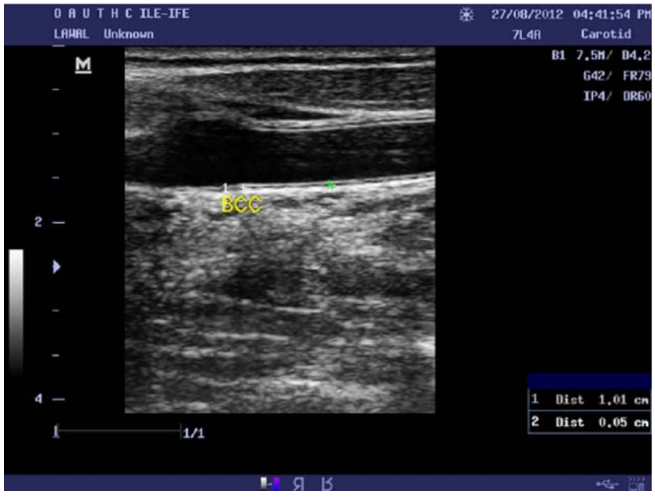


**Figure 2. Common carotid artery ultrasound imaging reveals a soft, lucent atheroma at the bifurcation point. The BCC demonstrates how the common carotid artery bifurcates.[11]**

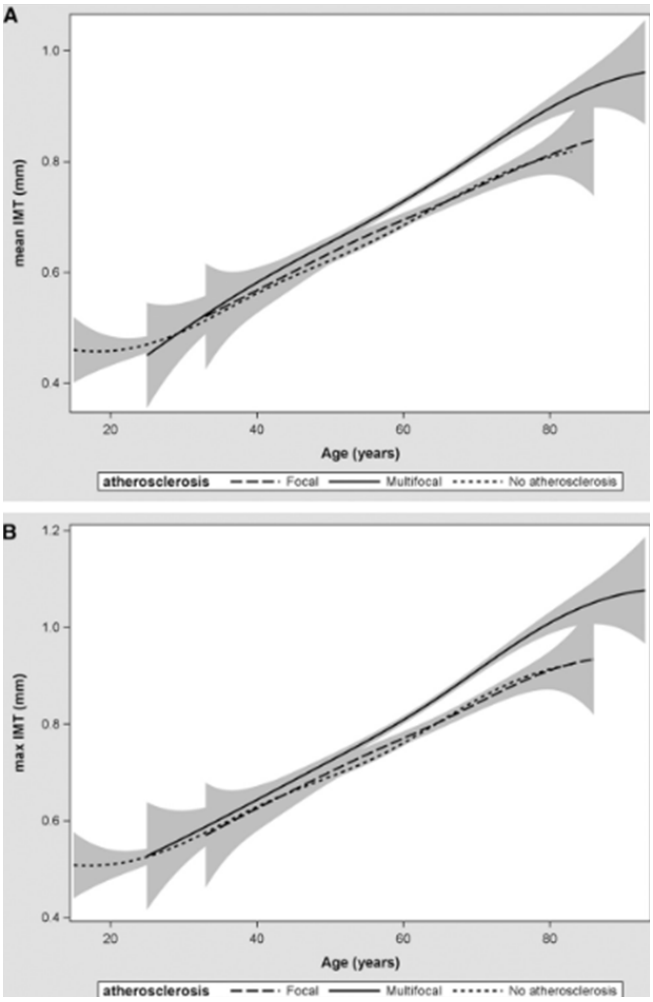


**Figure 3. Age-related rise in carotid intima-media thickness by gender. The graphic shows the confidence limits for the mean anticipated values as well as the growth curves for the mean (A) and maximum (B) models. M stands for male, F for female, and IMT for intima-media thickness.[14]**

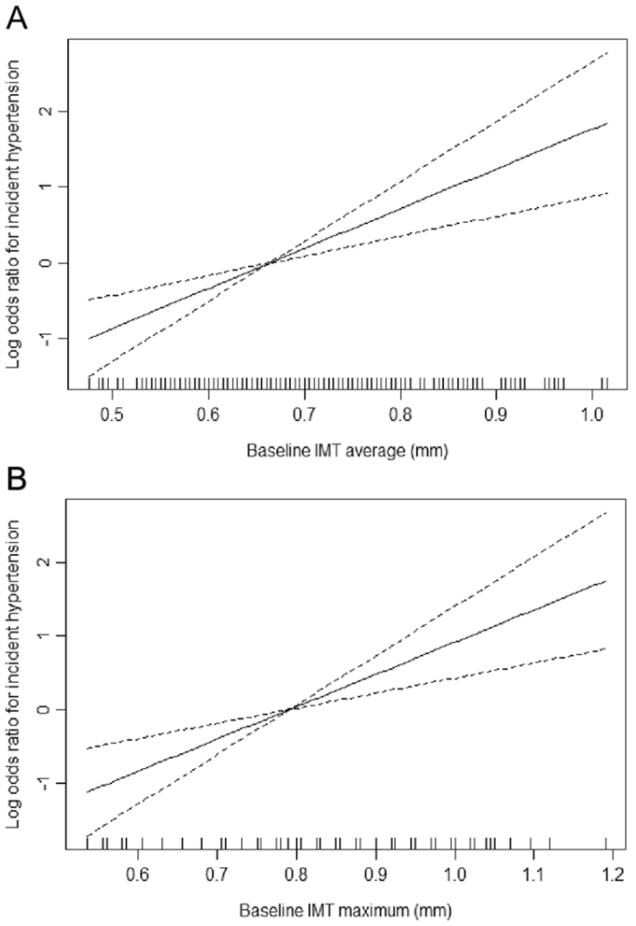


**Figure 4. Multivariable adjusted spline curves showing the relationship between the new-onset hypertension and the average (A) and maximum (B) cIMT values. The 95% confidence interval is shown by the dotted line. Data density is indicated by the x-axis and the inner marks. Make adjustments for the following: sex, age, BMI, SBP, history of cardiovascular disease, dyslipidemia, diabetes mellitus, current smoking and drinking status, lipid-lowering drugs, and hypoglycemic drugs.[18]**

LifeQ Ltd). IMT was measured twice by different operators, averaged, and its mean value was used in subsequent study. IMT measurement with ultrasound has demonstrated strong consistency in previous investigations, with intra- and inter-observer variability of 5.4%–5.8% and 10.5%, respectively.

The terms 'carotid intima-media thickness' and 'plaque consensus' refer to focal structures that exhibit a thickness of more than 1.5 mm when measured from the intima-lumen interface to the media-adventitia interface, or that encroach into the arterial lumen by at least 0.5 mm or 50% of the surrounding intima-media thickness value.[12,13]

### 4.2. Relationship between IMT and hypertension

#### IMT correlation with hypertension

According to a study by Lorenz et al., the mean carotid IMT in hypertension patients was 0.85 mm, while the mean IMT in normotensive controls was 0.74 mm. IMT increased by 0.03 mm for every 10 mmHg increase in systolic blood pressure, according to a meta-analysis by van den Oord et al.[15] The usefulness of IMT as a vital tool for determining cardiovascular risk has been supported by recent research. In order to improve risk prediction, Zhang et al. integrated IMT with high-sensitivity C-reactive protein (hs-CRP). According to their research, patients with high hs-CRP levels and elevated IMT (mean IMT of 1.2 mm) were substantially more likely to experience cardiovascular events than patients with lower levels of both indicators. With regard to cardiovascular events, this combination had a hazard ratio of 2.5, indicating better predictive value than IMT alone.[16]

IMT was examined by Patel et al., as a way to gauge how well hypertension patients were responding to treatment. According to their long-term research, individuals receiving antihypertensive medication for a year experienced a 30% lower rate of cardiovascular events when their IMT dropped from an average of 1.1 mm to 0.9 mm.[17] Lee and Kim (2022) looked at how lifestyle modifications affected IMT. According to their findings, participants who followed a low-fat diet and upped their physical activity saw a considerable drop in IMT over the course of six months, going from a baseline of 1.2 mm to 0.95 mm.

The benefits of modifying one's habits were highlighted by the 25% drop in cardiovascular risk that was linked to this reduction.[15]

### 4.3. IMT as a cardiovascular event predictor

According to the Rotterdam Study, there is a 15% increase in the risk of myocardial infarction and an 18% increase in the risk of stroke for every 0.1 mm rise in IMT.[19] More sophisticated ultrasound technology with higher resolution IMT measurements were introduced by Rodriguez et al. in 2023. According to their research, patients receiving intensive therapy had an average IMT reduction of 1.05 mm from 1.15 mm, indicating that the use of these new technologies might detect IMT changes with more precision.[20] The association between IMT and genetic variables was investigated by Nguyen et al., who found that baseline IMT readings were greater (average 1.3 mm) in people with a genetic propensity to cardiovascular disease than in people without genetic markers (average 1.0 mm).[21] Furthermore, Williams et al.'s latest research concentrated on the function of IMT in forecasting long-term cardiovascular outcomes. According to their findings, there was a 40% relative increase in the risk of adverse cardiovascular events over a 10-year follow-up period for those with a baseline IMT of 1.25 mm. This lends credence to the long-term risk indicator application of IMT.[16]

### 4.4. Antihypertensive medicine's effect on IMT

It has been demonstrated that antihypertensive medications, especially those that target the renin-angiotensin-aldosterone system (RAAS), slow the progression of IMT in hypertensive individuals. As per a study conducted by Zanchetti et al., individuals with hypertension treated with an ACE inhibitor had a mean IMT reduction of 0.05 mm over a 2-year period; in contrast, patients treated with beta-blockers did not have any meaningful change in their IMT. According to the ELSA experiment, treatment with the beta-blocker atenolol resulted in a 0.02 mm decrease in mean IMT over three years, while treatment with the angiotensin II receptor blocker (ARB) losartan led to a 0.08 mm decrease.[23]

### 4.5. IMT and subclinical atherosclerosis

In hypertension patients, IMT assessment aids in the detection of subclinical atherosclerosis, allowing for early management prior to the onset of symptomatic cardiovascular disease.[24] According to the Cardiovascular Health Study (CHS), substantial subclinical atherosclerosis was found in 30% of asymptomatic hypertensive people with an IMT larger than 1.0 mm.In Polak et al.'s cohort of 500 hypertension individuals, they discovered that. An IMT greater than 0.9 mm was associated with a 2.5-fold increase in the likelihood of having multiple atherosclerotic plaques.[25]

## 5. CONCLUSIONS

1. The research under evaluation shows a robust and consistent relationship between hypertension and increased intima-media thickness. Patients with hypertension have noticeably greater IMT values, suggesting that hypertension plays a significant role in arterial wall thickening.
2. The reviewed studies demonstrate that the probability of these adverse events increases dramatically with each incremental rise in IMT, highlighting the significance of IMT measurement in cardiovascular risk stratification for patients with hypertension.
3. There is strong evidence to support the use of IMT as a cardiovascular risk indicator in hypertension patients. As a non-invasive, trustworthy, and predictive technique to inform treatment choices and enhance patient outcomes, routine IMT assessment can be incorporated into clinical practice to eventually lessen the burden of cardiovascular disease in this high-risk population.

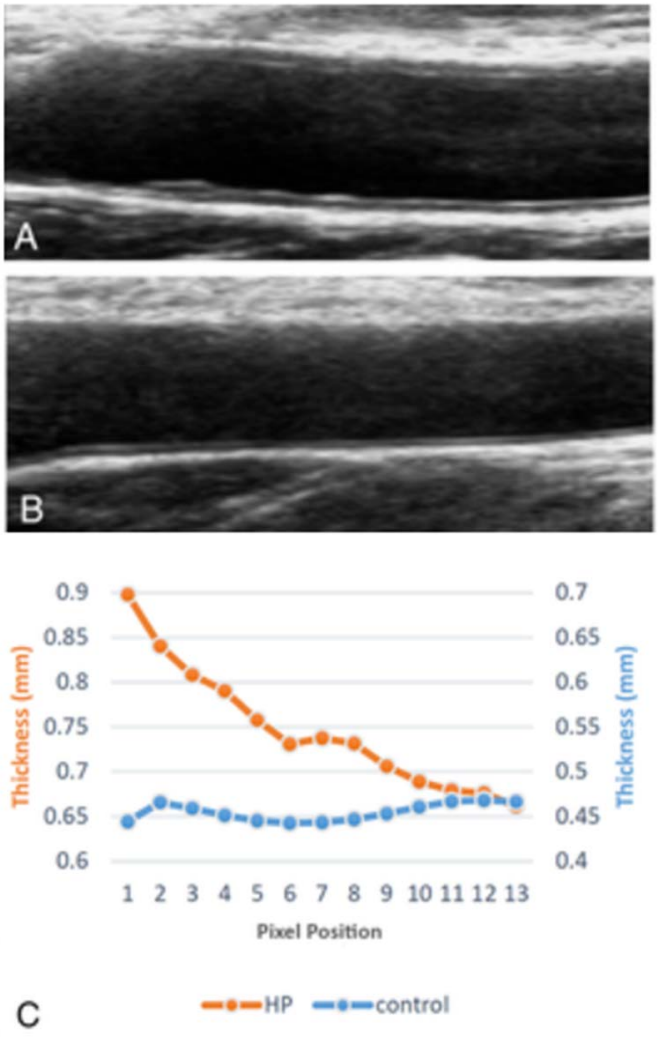


**Figure 5. (A) US picture of the carotid intima-media from the hypertension research group. (B) Ultrasound picture of the control group's carotid intima. (C) Group Comparison. Hypertension is indicated by HP.[22]**

## Conflict of interest

None declared.

## Funding
None declared.

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