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Original article

Increased Arterial PET/CT ^{18}F-Fluorodeoxyglucose Uptake in Obese and Overweight Patients

Augmentation artérielle TEP/TDM de l'absorption de 18F-fluorodésoxyglucose chez les patients obèses et en surpoids

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ABSTRACT

Objectives. – We aimed to investigate the association between BMI and early atherosclerotic activity in cancer patients. We also compared the inflammatory and macroscopic calcification processes of atherosclerosis in the aortic segments and large arteries by ^{18}F-FDG PET/CT of between normal and high BMI patients.
Methods. – We conducted a retrospective review of cancer patients presented to our institution within the period between February and May 2018. Patients were classified according to their BMI into two groups: normal BMI group and high BMI group. Data of average SUVmax and SUVmean for four segments of the aorta, common iliac arteries, and femoral arteries were estimated and compared between both groups. Moreover, the macroscopic calcification on CT images for each vascular section was also reported.
Results. – Ninety-eight patients were classified into two groups: normal BMI group ($n = 52$; 53.1%), and high BMI group ($n = 46$; 46.9%). Average SUVmax was significantly higher in obese participants in all arterial segments ($P < 0.05$). However, the SUVmean was significantly higher in obese patients in only three arterial segments aortic arch, left femoral artery and descending thoracic aorta ($P < 0.05$).Moreover, the differences between the two study groups in terms of the frequency of macroscopic calcifications were not statistically significant for all vascular segments. BMI positively correlated with SUVmax and SUVmean of the vascular segments (r value from 0,219 to 0,575/p value between 0,023 and 0,0001).
Conclusions. – Fluorine-18-FDG PET/CT imaging revealed that patients with high BMI have more accelerated atherosclerotic inflammatory process in their major vessels compared to their age-matched controls with normal BMI. Future studies should assess the associated between these findings and the cardiovascular events in the long term.

Mots clés :
Athérosclérose
TEP/TDM 18F-FDG
Indice de masse corporelle
Inflammation
Calcification

RÉSUMÉ

Objectifs. – Nous avons cherché à étudier l'association entre l'IMC et l'activité athérosclérotique précoce chez les patients cancéreux. Nous avons également comparé les processus de calcification inflammatoire et macroscopique de l'athérosclérose dans les segments aortiques et les grandes artères par TEP/TDM 18F-FDG entre des patients normaux et à IMC élevé.
Méthodes. – Nous avons effectué une revue rétrospective des patients atteints de cancer présentés à notre établissement entre février et mai 2018. Les patients ont été classés en fonction de leur IMC en deux groupes: groupe IMC normal et groupe IMC élevé. Les données du SUVmax (la valeur de fixation normalisée) et du SUVmean pour quatre segments de l'aorte, des artères iliaques communes et des

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artères fémorales ont été estimées et comparées entre les deux groupes. De plus, la calcification macroscopique sur les images CT pour chaque coupe vasculaire a également été rapportée.
Résultats. – Quatre-vingt-dix-huit patients ont été classés en deux groupes: groupe IMC normal (n = 52; 53,1%) et groupe IMC élevé (n = 4; 46,9%). La moyenne du SUVmax était significativement plus élevée chez les participants obèses dans tous les segments artériels ($P < 0,05$). Cependant, le SUVmean était significativement plus élevé chez les patients obèses dans seulement trois segments artériels de l'arc aortique, de l'artère fémorale gauche et de l'aorte thoracique descendante ($P < 0,05$). En outre, les différences entre les deux groupes d'étude en termes de fréquence des calcifications macroscopiques n'étaient pas statistiquement significatives pour tous les segments vasculaires. L'IMC corrélé positivement avec SUVmax et SUVmean des segments vasculaires (valeur r de 0,219 à 0,575/p valeur entre 0,023 et 0,0001).
Conclusion. – L'imagerie TEP/TDM au fluor-18-FDG a révélé que les patients avec un IMC élevé ont un processus inflammatoire athérosclérotique plus accéléré dans leurs principaux vaisseaux par rapport à leurs témoins d'âge correspondant avec un IMC normal. Les études futures devraient évaluer le lien entre ces résultats et les événements cardiovasculaires à long terme.

1. Introduction

Atherosclerosis is an inflammatory disease characterized by progressive thickening of the vascular wall of the large and medium-sized elastic and muscular arteries. This progressive thickening results from inflammation, calcification, and lipid-laden plaque development in the vascular wall [1].

Atherosclerosis is a major risk factor for ischemic heart diseases and stroke which account for more than 30% of all deaths worldwide [2]. Therefore, atherosclerosis has gained more attention in the fight for reducing the burden of cardiovascular disease (CVD). In the last decades, research into the pathology of atherosclerosis has improved our understanding of the disease.

A large body of evidence from epidemiological studies has established a connection between obesity and atherosclerosis [3]. Obesity was found to accelerate the progression of atherosclerosis in both adolescent and adult population [4,5]. The increasing incidence of obesity endangers to ruin the benefits attained by reducing cigarette smoking and hypercholesterolemia in the world population. The increase in obesity rates will increase the risk of CVD in the population which means more reduction in life expectancy of the population [6].

The association between obesity and atherosclerosis extends beyond their epidemiological correlation with cardiovascular events; researchers have shown that both obesity and atherosclerosis share some pathophysiological pathways. The impairment in lipid storage, inflammatory cell infiltration, cytokine production, and the activation of innate and adaptive immunity might explain the association between obesity and atherosclerosis [7,8].

The link between obesity and atherosclerosis might be useful to identify a population who are at risk of atherosclerosis and CVD. Also, reducing obesity might contribute to reducing atherosclerosis and CVD in the population. There is a large body of epidemiological evidence about this association. However, the association between obesity and early atherosclerotic inflammation in the population has not been established. Understanding the early stage of atherosclerotic inflammation might be helpful to control atherosclerosis in early stages of the disease.

Early atherosclerotic activity can be imaged with the positron emission tomography with Fluorine-18 (18F) fluorodeoxyglucose (FDG) integrated with computed tomography (^{18}F-FDG PET/CT). This ^{18}F-FDG PET/CT imaging is an approved non-invasive powerful imaging tool which can detect and quantify the atherosclerotic inflammatory disease [9–15]. The detection of macroscopic arterial atherosclerotic calcification is done by the CT portion of PET/CT [16,17] while the PET measurement of the standardized uptake value (SUV) of FDG predicts the severity of the atherosclerotic plaques [18,19]This could be explained that ^{18}F-FDG uptake is done by the inflammatory cells, especially the macrophages; therefore more FDG uptake indicates more inflammatory activity in the atherosclerotic plaques [20].

We conducted this study to investigate the correlation between BMI and the early atherosclerotic activity in the large blood vessels by using the ^{18}F-FDG PET/CT imaging technique as an indicator for the severity of the inflammatory activity. Besides, we aimed to compare the macroscopic calcifications observed in the aorta and large vessels between normal BMI participants and high BMI participants.

2. Methodology

We followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement guidelines when reporting this manuscript [21]This study was approved by the ethics committee of Dicle University (119-2019).

2.1. Study design, study setting, and duration

We performed an observational study to compare the inflammatory process of atherosclerosis in the aortic segments and large arteries of high BMI patients compared to their age-matched low BMI participants. The study took place in Gazi Yaşargil Research and Training Hospital Department of Nuclear Medicine.

2.2. Participant enrollment and Study groups

We conducted this study on cancer patients who underwent ^{18}F-FDG PET/CT imaging as part of the routine practice in our institution. All patients with available data of ^{18}F-FDG PET/CT imaging within the period between February and May 2018 were eligible for inclusion in this study.

We excluded patients with the following conditions:

- the presence of non-arterial ^{18}F-FDG uptake that interfered with arterial wall ^{18}F-FDG uptake measurement in any of the arterial segments;
- the presence of extensive pathological ^{18}F-FDG uptake that overlapped with any of the arterial sites assessed in this study.

Patients received immunotherapies.
Patients with known vascular disease (such as vasculitis).

Then, the study population was classified, according to their BMI, into two groups; the first group includes a group of patients

BMI less than 25 Kg/m^2 who are described in the study as "normal BMI group" (group-1) while the second group is a group of overweight and obese patients with BMI above 25 Kg/m^2 who are described in the study as "high BMI group" (group-2). From the hospital records, we retrieved the data of demographic characteristics, clinical presentations, and imaging of the eligible patients.

2.3. PET/CT scans

All patients underwent PET/CT scans after they had fasted for at least four hours and blood glucose levels below 200 mg/dL. The acquisition of images took place one hour after 3,7 MBq/Kg of ^{18}F-FDG was injected using a Siemens Biograph 6, Siemens Medical Systems, CTI, Knoxville, TN, USA. Low dose CT scan (Biograph 6: 40 mA, 120 kVp) was performed for attenuation correction and anatomical localization. The low-dose CT image acquisition was carried out without iodinated contrast material injection. PET scan was acquired in 3D mode from base of skull to mid-thigh [22].

2.4. Imaging analysis

We performed the image analysis on a specific Siemens Biograph 6 workstation. We used the axial slices of PET images of ^{18}F-FDG PET/CT; we measured the following:

- the maximum standardized uptake value (SUVmax);
- the mean standardized uptake value (SUVmean).

The SUVmax and SUVmean were measured for the following arteries:

- aorta, including the four segments (ascending, arch, descending, and abdominal);
- right and left common iliac arteries;
- right and left femoral arteries.

For SUV measurements, we first visually assessed the ^{18}F-FDG uptake in the wall of each arterial section. Fusion PET/CT images were used to verify that the absorption was indeed within the arterial wall. Arterial ^{18}F-FDG uptake was measured by drawing a region of interest (ROI) around the artery on every slice of the co-registered transaxial PET/CT images (Fig. 1 and Fig. 2). On each image slice, the mean and maximum standardized uptake values (SUVs) of ^{18}F-FDG in the ROI (containing the arterial wall) were calculated as the mean and maximum pixel activity. Both attenuation-corrected and non–attenuation-corrected PET images were visually evaluated for focal lesions of increased radiotracer uptake. The locations of these areas in relation to the vascular wall and to calcification detected by CT were determined from PET/CT fusion images. A lesion was excluded from the analysis if it was suspected of being an artifact caused by spatial mismatching of PET and CT (physiologic organ or patient motion) or by activity spillover from extravascular structures. Semi quantitative analysis was performed by obtaining the maximum standardized uptake value (SUVmax). For focal lesions, an individual region of interest was placed around the atherosclerotic plaque. For linear lesions, SUVmax were obtained from 4 representative, nonadjacent slices and then averaged.

Standardized uptake value measurements for ascending, arch, descending and abdominal aorta, right and left common iliac arteries, right and left femoral arterial segments were measured in both groups.

Target to Blood Ratio (TBR) was measured by SUVmax of all arterial segments 18F-FDG activity division by an average blood ROI SUVmax estimated from the vena cava superior.

For the detection of macroscopic atherosclerotic calcification:

- we qualitatively reviewed the axial low-dose CT images for each of the eight above-mentioned arterial segments in all subjects;
- we examined the presence or absence of calcification for each of the eight arterial segments and across all arterial segments between the two groups. The prevalence of vascular calcification on CT images and increased vascular wall radiotracer uptake on PET images were calculated;
- we also compared the presence or absence of calcification for each of the 8 arterial segments and across all arterial segments between group-1 and group-2.

2.5. Statistical analysis

Data normality was tested by the Kolmogorov-Smirnov test. Data were summarized as frequencies and percentages for categorical variables or mean and standard deviation (SD) for continuous variables. To compare two groups, we used the student-t test for continuous variables and the chi-square test for categorical variables. The bivariate correlation between continuous variables was calculated using the Pearson correlation.

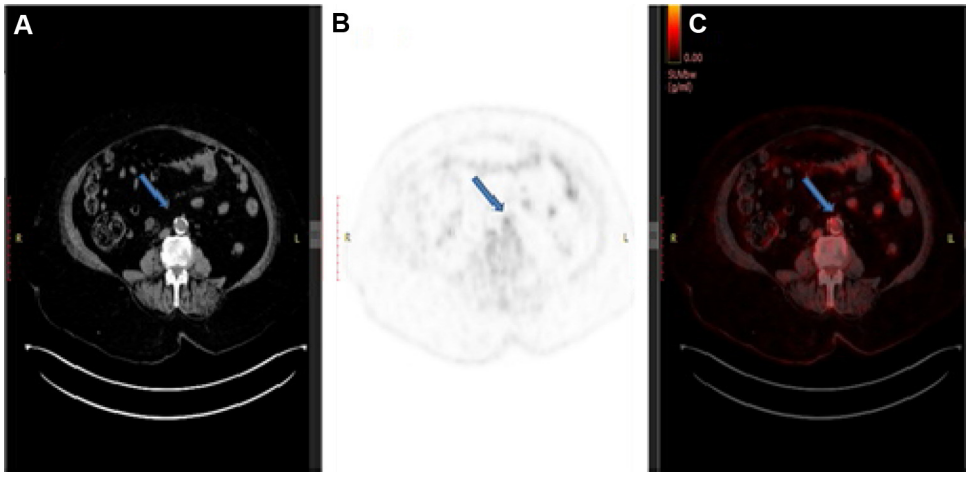

Fig. 1. Transaxial 18F-FDG PET/CT images of abdominal aorta in 60-y-old woman. A. CT image. (B) PET image. C. Fused PET/CT image. 18F- FDG accumulation in atherosclerotic lesion was colocalized with calcification. Arrows indicate calcified lesion.
Images TEP/TDM transaxiales 18F-FDG de l'aorte abdominale chez une femme de 60 ans. A. Image TDM. B. Image PET. C. Image TEP/TDM fusionnée. L'accumulation de 18F-FDG dans les lésions athérosclérotiques a été colocalisée avec calcification. Les flèches indiquent une lésion calcifiée.

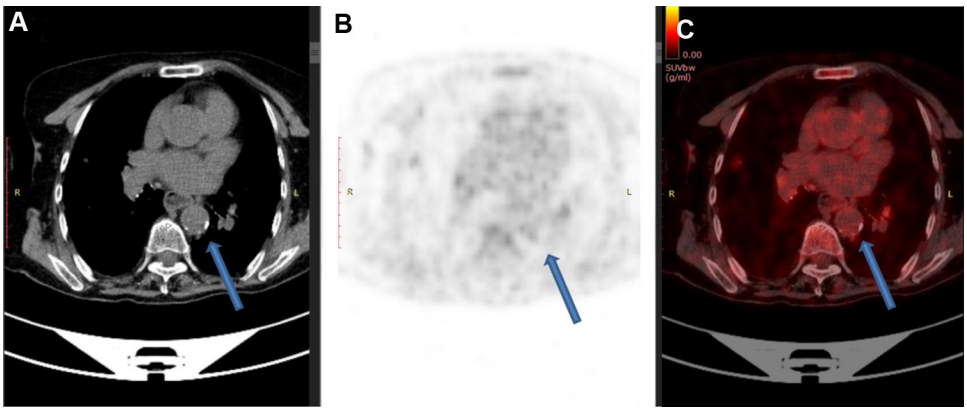

Fig. 2. Transaxial 18F-FDG PET/CT images of descending aorta in 55-y-old woman. A. CT image. (B) PET image. C. Fused PET/CT image. 18F- FDG accumulation in atherosclerotic lesion was colocalized with calcification. Arrows indicate calcified lesion.
Images TEP/TDM transaxiales 18F-FDG de l'aorte descendante chez une femme de 55 ans. A. Image TDM. B. Image TEP. C. Image TEP/TDM fusionnée. L'accumulation de 18F-FDG dans les lésions athérosclérotiques a été colocalisée avec calcification. Les flèches indiquent une lésion calcifiée.

Table 1
The demographic characteristics of the study participants ($n = 98$ patients).
*Les caractéristiques démographiques des participants de l'étude (*n *= 98 patients).*

	High BMI group ($n = 46$)	Normal BMI group ($n = 52$)	*P*-value
Age (year)	52 ± 14	51 ± 13	NS
Gender (Males)	22 (48%)	25 (48%)	NS
Gender (Females)	24 (52%)	27 (52%)	NS
BMI(Kg/m^2)	21.8 (2.57)	31.2 (4.94)	0.0001
Blood glucose (mg/dL)	108 (37.0)	106 (17)	0.72

BMI: Body Mass Index; NS: Not significant; Categorical variables are summarized as frequencies and percentages (n, %) while continuous variables are presented as mean (SD).

An alpha level below 0.05 was considered for statistical significance. All analyses were conducted by the statistical package of social sciences (SPSS version 21 for Windows, Chicago, IL, USA).

3. Results

3.1. Characteristics of the study population

Ninety-eight patients were included in this study (normal BMI group = 52 participants, and high BMI group = 46 participants). Normal BMI group included 25 males and 27 females while the high BMI group included 22 males and 24 females. The mean BMI of the study groups was 21.8 (2.57) for normal BMI group and 31.2 (4.94) for high BMI group. The mean age was 51 ± 13for the normal BMI group and 52 ± 14 for the high BMI group. The demographic characteristics of the study participants are shown in Table 1.

3.2. SUVmax, SUVmean and TBRSUV max measurements

The SUVmax was significantly higher in high BMI group participants in all segments (ascending aorta, aortic arch, descending thoracic aorta, abdominal aorta, right iliac artery, left iliac artery, right femoral artery, and left femoral artery).However, the SUVmean was significantly higher in the high BMI group participants in only three arterial segments aortic arch, left femoral artery and descending thoracic aorta ($P < 0.05$) but not for the other locations. The average SUVmax and SUVmean of the vascular segments of the two study groups are shown in Table 2.

TBR-SUVmax was significantly higher in high BMI group participants in all segments except abdominal aorta (ascending aorta, aortic arch, descending thoracic aorta, right iliac artery, left iliac artery, right femoral artery, and left femoral artery) (Table 3).

Table 2
18F-FDG PET assessment of atherosclerotic inflammation between the two groups.
Evaluation TEP 18F-FDG de l'inflammation athérosclérotique entre les deux groupes.

		Normal BMI group ($n = 52$)	High BMI group ($n = 46$)	*P*-value
Ascending aorta	SUVmax	2.06 (0.64)	2.50 (0.90)	0.006[a]
	SUVmean	1.29 (0.38)	1.40 (0.49)	0.21
Aortic arch	SUVmax	2.16 (0.77)	2.85 (0.99)	0.0001[a]
	SUVmean	1.42 (0.50)	1.79 (0.70)	0.003[a]
Descending thoracic aorta	SUVmax	1.47 (0.43)	1.70 (0.48)	0.016[a]
	SUVmean	2.14 (0.57)	2.71 (0.79)	0.0001[a]
Abdominal aorta	SUVmax	2.62 (0.68)	3.12 (1.13)	0.009[a]
	SUVmean	1.72 (0.48)	1.83 (0.65)	0.338
Right iliac artery	SUVmax	2.05 (0.62)	2.71 (0.90)	0.0001[a]
	SUVmean	1.30 (0.45)	1.47 (0.45)	0.69
Left iliac artery	SUVmax	2.12 (0.67)	2.65 (1.02)	0.002[a]
	SUVmean	1.36 (0.46)	1.45 (0.55)	0.36
Right femoral artery	SUVmax	1.63 (0.52)	1.92 (0.59)	0.01[a]
	SUVmean	0.96 (0.35)	1.04 (0.34)	0.24[a]
Left femoral artery	SUVmax	1.57 (0.48)	2.02 (0.64)	0.0001[a]
	SUVmean	0.95 (0.32)	1.11 (0.38)	0.03[a]

SUV: Standardized uptake value.
[a] Statistically significant.

Table 3
Target to blood ratio SUVmax (TBR-SUVmax) of the groups.
Cible du ratio de sang SUVmax (TBR-SUVmax) des groupes.

		Normal BMI group ($n = 52$)	High BMI group ($n = 46$)	*P*-value
Ascending aorta	TBR -SUVmax	0.86 ± 0.18	1.03 ± 0.33	0.005[a]
Aortic arch	TBR -SUVmax	0.91 ± 0.27	1.15 ± 0.30	0.0001[a]
Descending thoracic aorta	TBR -SUVmax	0.90 ± 0.19	1.14 ± 0.28	0.0001[a]
Abdominal aorta	TBR -SUVmax	1.15 ± 0.30	1.26 ± 0.34	0.17
Right iliac artery	TBR -SUVmax	0.89 ± 0.25	1.13 ± 0.37	0.001[a]
Left iliac artery	TBR -SUVmax	0.91 ± 0.25	1.07 ± 0.33	0.015[a]
Right femoral artery	TBR -SUVmax	0.71 ± 0.22	0.85 ± 0.25	0.013[a]
Left femoral artery	TBR -SUVmax	0.69 ± 0.24	0.89 ± 0.29	0.002[a]

TBR: Target to Blood Ratio SUV:Standardized uptake value; N.S: Non-Significant.
[a] Statistically significant.

Table 4
The low-dose CT assessment of macroscopic atherosclerotic calcification of two groups.
L'évaluation CT à faible dose de la calcification athérosclérotique macroscopique de deux groupes.

Arterial segment calcification	Normal BMI group *N* (%)	High BMI group *N* (%)	*P*-value
Right femoral artery calcification	15 (28.8%)	15 (32.6%)	N. S
Left femoral artery calcification	11 (21.2%)	16 (34.8%)	N. S
Ascending aorta calcification	19 (36.5%)	14 (30.4%)	N. S
Aortic arch calcification	27 (51.9%)	22 (47.8%)	N. S
Descending thoracic aorta calcification	19 (36.5%)	14 (30.4%)	N. S
Abdominal aorta calcification	32 (61.5%)	31 (67.4%)	N. S
Right iliac artery calcification	19 (36.5%)	22 (47.8%)	N. S
Left iliac artery calcification	21 (40.4%)	24 (52.2%)	N. S
All segments total calcification	163	157	N. S

N.S: Non-Significant; Categorical variables are summarized as frequencies (n) and percentages.

3.3. Macroscopic atherosclerotic calcification by the Low-dose CT assessment

There was no statistically significant difference between the two groups in terms of the frequency of macroscopic calcification for all vascular segments (Table 4).

3.4. Correlations between BMI and SUVmax and SUVmean

However, the Pearson correlation showed significant positive correlations between the BMI of the study participants and the measurements of SUVmax and SUVmean in all vascular segments (all *P*-value < 0.05). Therefore, patients with higher BMI were

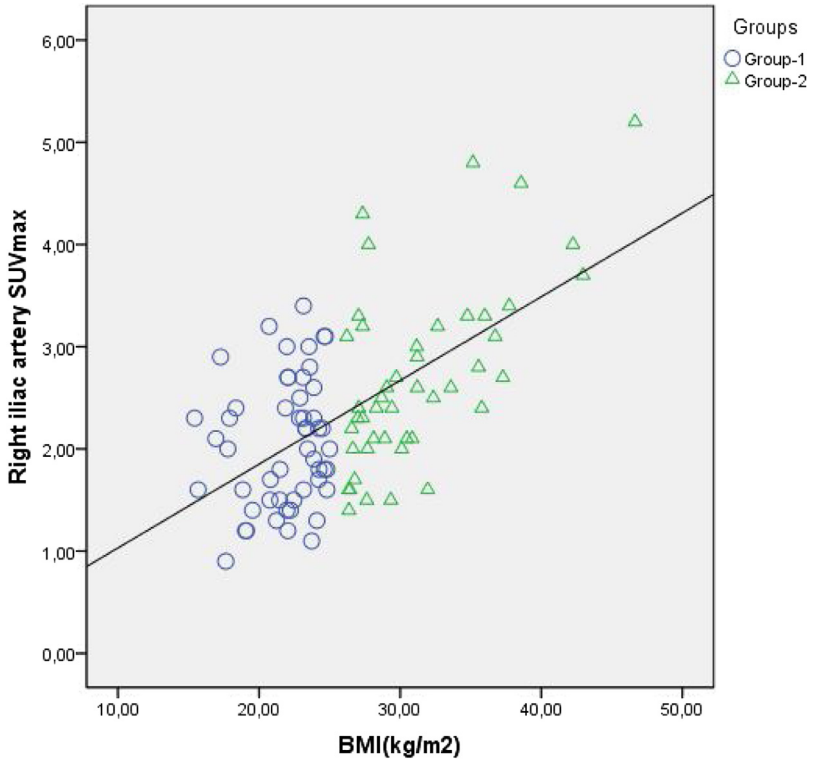

Fig. 3. Scatter plot of the correlation between the BMI and the SUVmax of the right iliac artery ($i = 0{,}573$ and $P = 0{,}0001$).
Nuage de points de la corrélation entre l'IMC et le SUVmax de l'artère iliaque droite (r = 0,573 et p = 0,0001).

likely to have higher SUVmax and SUVmean. The correlation between BMI and SUVmax of the aortic arch ($r = 0.560$) and the right iliac artery ($r = 0.575$) are represented in the scatter plots shown in Fig. 3 and Fig. 4, respectively.

4. Discussion

This study shows that BMI positively correlates with the SUVmax and SUVmean of ^{18}F-FDG PET/CT which indicated that patients with higher BMI have a more accelerated atherosclerotic inflammatory process in the vascular walls of the studied vessels compared to those with lower BMI. The ^{18}F-FDG PET/CT is a powerful imaging modality that has been used recently for studying atherosclerosis and the inflammatory process in blood vessels [12–16,23–25]. This study aimed to compare patients with normal and high BMI in terms of the inflammatory process and calcifications in their major blood vessels and to detect whether the atherosclerotic inflammatory correlates with the BMI.

Our results showed that patients with BMI >25 kg/m^2 have more accelerated inflammatory atherosclerotic process compared to their age-matched controls with normal BMI (BMI < 25 kg/m^2). Compared with the normal BMI group, the SUVmax measurements in the high BMI group were significantly higher in the ascending aorta, aortic arch, descending thoracic aorta, abdominal aorta, right iliac artery, left iliac artery, right femoral artery, and left femoral artery. However, the SUVmean measurements were significantly higher in the same group participants in only three arterial segments aortic arch, left femoral artery and descending thoracic aorta ($P < 0.05$) but not for the remaining vessels.

Additionally, we observed that the highest average SUVmax and SUVmean measurements were observed in the abdominal aorta in normal BMI group compared to abdominal aorta and aortic arch in high BMI group which means that these segments are the segments where most of the atherosclerotic inflammation occurs.

Vascular calcification is one of the key pathological processes of atherosclerosis [26]. The 'macrocalcification' and 'microcalcification' are two aspects of atherosclerotic calcification with different or even opposite histopathologic and clinical features [27]. Macrocalcification or gross calcium deposit is usually a stable plaque that is formed in the late stage of atherosclerosis [28]. However, microcalcification or active calcifying process is regarded as relatively early, unstable, and inflamed state of atherosclerosis [29,30]. On CT scan, macrocalcification is readily detectable, whereas microcalcification is not detected due to limited image resolution [31,32].

Calcification is an essential step in the atherosclerotic process; macroscopic calcification has been evident in blood vessel walls of atherosclerotic vessels. Macroscopic atherosclerotic calcification was more frequently present in arterial segments of subjects with high BMI group participants in the left iliac artery, right iliac artery, and left femoral artery. However, the difference in the frequency of presence of calcification between two groups was statistically insignificant for all arterial segments. In our study, no statistically significant difference was found between number of calcifications between the two groups, whereas arterial SUVmax and SUVmean values were higher in the group with high BMI. Thus, ^{18}F-FDG PET/CT may allow inflamed state of atherosclerosis to be recognized before it becomes calcific plaques.

We did not design the study with matching the gender between the two groups since Nakahara et al., showed that there is no significant difference in the inflammatory component of arterial atherosclerosis between males and females [33]. On the other hand, we consider age as a confounding variable; we designed this study with age-matched controls because several studies reported that the atherosclerotic inflammatory activity in the large arteries

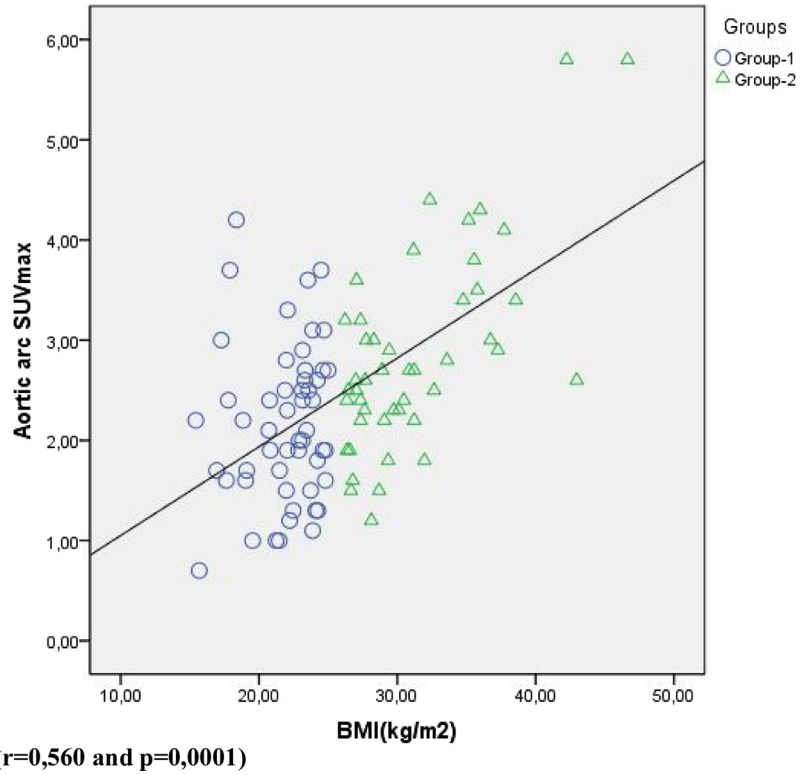

Figure 4. Scatter plot of the correlation between the BMI and the SUVmax of the Aortic arch($r = 0{,}560$ and $P = 0{,}0001$).
*Nuage de points de la corrélation entre l'IMC et le SUVmax de l'arc aortique (*r = *0,560 et* p = *0,0001).*

Table 5
The correlations between BMI and arterial SUVmax and arterial SUVmean.
Les corrélations entre l'IMC et le SUV artériel max et le SUVmean artériel.

	Correlation coefficient	*P*-value
Ascending aorta SUVmax	0.394	0.0001
Ascending aorta SUVmean	0.219	0.023
Left femoral artery SUVmax	0.372	0.0001
Left femoral artery SUVmean	0.226	0.018
Right femoral artery SUVmax	0.302	0.002
Right femoral artery SUVmean	0.204	0.035
Left iliac artery SUVmax	0.573	0.0001
Left iliac artery SUVmean	0.366	0.0001
Right iliac artery SUVmax	0.575	0.0001
Right iliac artery SUVmean	0.429	0.0001
Abdominal aorta SUVmean	0.331	0.0001
Abdominal aorta SUVmax	0.464	0.0001
Descending thoracic aorta SUVmax	0.502	0.0001
Descending thoracic aorta SUVmean	0.318	0.001
Aortic arch SUVmax	0.560	0.0001
Aortic arch SUVmean	0.496	0.0001

progresses with age [16,17,24,34]. Our study has adjusted for this confounding variable by comparing against an age-matched control group with normal BMI. Nonetheless, there was no significant difference between the two study groups in terms of the frequency of calcifications. But the SUVmax and SUVmean provide evidence of an accelerated inflammation process in the studied segments of patients with high BMI (Table 5).

Our findings agree with that of Pasha AK et al. who compared the SUV measurements in the aorta, iliac arteries, and femoral arteries in cases with at least single risk factor for atherosclerosis to a control group with no risk factors. They commented that average SUVmean was significantly higher in the abdominal aorta in cases with at least individual risk factor [18].

In a recent study by Bloomberg et al., the association between the risk of cardiovascular disease in a low cardiovascular risk population was assessed by using ^{18}F-FDG PET/CT imaging for arterial inflammation, 18F-NaF PET/CT imaging for arterial macroscopic calcification, and CT imaging of the thoracic aorta. Authors stated that thoracic aorta molecular calcification via NaF PET/CT is linked with progressed cardiovascular disease risk [35].

4.1. Strength points and limitations of the study

Our study has several strength points. First, the relatively larger sample size of our study compared to the previous reports. Secondly, we performed a correlation analysis of the relationship between BMI and arterial SUV measurements [36,37].

Our study expands the literature by providing evidence that BMI contributed to the atherosclerotic inflammatory process. Therefore, patients who are at risk of atherosclerosis should consider effective weight reduction methods. The study adds a new insight into the cardiovascular risks of obesity. However, our study design does not give information about whether the accelerated inflammatory process in the high BMI group was associated with more cardiovascular events. Although the medical literature has widely acknowledged that obesity is an important risk factor for atherosclerosis and other cardiovascular risks, an association between the inflammatory process and these events has not been established, yet. Also, this is an observational study which is susceptible to confounding bias with no follow-up duration.

5. Authors' Conclusion

^{18}F-FDG PET/CT imaging revealed that patients with high BMI have a more accelerated atherosclerotic inflammatory process in their major vessels compared to their age-matched controls with normal BMI. Future studies should assess the association between these findings and the cardiovascular events in the long term.

Disclosure of interest

The authors declare that they have no competing interest.

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