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(Original Article)

Assessment of Aortic Aneurysm Characteristics by Computed Tomography: A Single-Center Experience

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ABSTRACT

Background: Most Aortic aneurysms are asymptomatic, not detectable on physical examination, and silent until discovered during radiologic testing for other reasons. **Objectives:** This comprehensive study evaluated the efficacy of CT scans in diagnosing aortic aneurysms, including their location, type, and diameter. **Materials and Methods:** The research was conducted at Al Amal National Hospital. Data collected during sixth months. Patients of varying ages and genders, suffering from aortic aneurysm and other conditions, were randomly selected for CT scans. **Results:** In the study, 90% of the patients were male, while 10% were female. The CT scan was utilized for the diagnosis of aortic aneurysms. The peak incidence in this study occurred among individuals aged 61-70 years, representing 50% of the cases. The locations of aortic aneurysms were identified as follows: chest (20%) and abdomen (80%). Aortic aneurysms can be classified into sacular (20%) and fusiform (80%). The diameters of aortic aneurysms are categorized as follows: 3.1 – 4 cm (30%), 4.1 – 5 cm (35%), and greater than 5 cm (35%). **Conclusions:** CT scans can accurately, rapidly, and non-invasively reveal anatomical changes in aortic aneurysms, which is crucial for establishing treatment plans, postoperative observation, and follow-up care, thereby demonstrating the practical implications of this study.

1. INTRODUCTION

The prevalence of Aortic aneurysm (AA) is 4.8%, with 0.2 million mortality per year worldwide which is related to older age and gender (Katsanos et al., 2018; Kranz et al., 2019; Lai et al., 2021; Li et al., 2013). The prevalence of As is higher among men and lower among women, and the incidence is lowest prevalence is in Asia

(0.5%) and highest in Australia (6.7%), compared to Europe (2.5%) and America (2.2%) (Song et al., 2023; Umbreit et al., 2019). Aneurysms, which are localized dilations of blood vessels, can present significant health risks due to the potential for rupture. The early detection and accurate characterization of aneurysms are crucial for effective management and intervention. The strict definition of an aneurysm is a localized, irreversible dilatation of the aorta. In the elderly, the radiographic definition is typically reserved for focal dilatation greater than 3 cm (Aggarwal et al., 2011). Computed tomography (CT) imaging has emerged as a vital modality for aneurysm detection, offering rapid and precise evaluation that is imperative in emergency and planned settings. CT is vital in detecting aneurysms, highlighting its advantages and relevant literature. An aortic aneurysm is a frequently encountered disorder in cardiovascular practice (Tanaka et al., 2020). Its incidence has increased multifold, likely due to increased life span and improved detection. The most common cause of aortic aneurysm formation is atherosclerosis. Male gender, smoking, advanced age, and family history are risk factors for atherosclerotic aneurysms (Katsanos et al., 2018). Other causes include cystic medial necrosis (primary, Marfan's syndrome, Ehler-Danlos syndrome), vasculitis (Takayasu's arteritis, giant cell arteritis, rheumatoid arthritis), infection (syphilis, mycotic, tuberculosis), trauma or the result of dissection (Umbreit et al., 2019). CT angiography (CTA) combines a rapid bolus intravenous injection using a pressure injector with a timed breath hold and spiral CT acquisition during peak arterial opacification. Curved planar reformations and 3D reformations using maximum intensity projection (MIP) and shaded surface display (SSD) following segmentation and editing of bony and other unwanted structures give excellent visualization of the aorto-iliac circulation and the major branch vessels (Cerna et al., 2017). The patient must receive no oral contrast before CTA because it would hamper 3D editing. Hyperventilation just before the scan acquisition should be performed routinely to enable a good uninterrupted breath hold without discomfort to the patient. Preliminary scans without intravenous contrast are obtained to localize the dilated segment and demonstrate the aortic wall calcification. A non-contrast CT would also identify any acute thrombosis in the aneurysm lumen or a dissection's false lumen that appears hyperdense. This is followed by the CTA, which includes the normal aorta above and below the lesion. The ascending aorta and arch should always be included if the thoracic aorta is involved. If the patient has dissection, the entire aorta should be scanned. Because of its decreased scan time, CTA is the imaging study of choice in suspected leaking aneurysms, and rapid evaluation is imperative in such circumstances (Genovese et al., 2013). The evaluation of the location of the aneurysm and its extent is important for its management, and CTA exactly delineates the site and extent of the lesion. The longitudinal extent can be particularly well seen on 3D images. Aneurysm extension into common, external, or internal iliac arteries is also accurately demonstrated. This helps determine the type and length of the prosthetic graft. CTA displays the different shapes of the aneurysm, whether saccular or fusiform. Several diagnostic imaging modalities are available for detecting and serially monitoring abdominal aortic aneurysms (Schubert et al., 2020). Abdominal ultrasonography is perhaps the most practical way to screen for aneurysms. Its major advantages are that it is inexpensive, noninvasive, and does not require a contrast agent. Compared with ultrasonography, CT scanning has the advantage of better defining the shape and extent of the aneurysm and the local anatomic relationships of the visceral and renal vessels. It is also superior to ultrasonography in imaging suprarenal aortic aneurysms. Disadvantages include its cost and its use of ionizing radiation and intravenous contrast media. Nevertheless, although CT is less practical than ultrasonography as a screening tool, its high accuracy in sizing aneurysms makes it an excellent modality for serially monitoring changes in aneurysm size. It is important to note that CT measurements of aneurysm size tend to be larger than ultrasound measurements by a mean of 3 to 9 mm, according to the aneurysm size (Katsanos et al., 2018; Kranz et al., 2019; Manning et al., 2009). CT angiography (3-dimensional display of the aorta and its branches) is particularly useful in providing a more comprehensive evaluation of the anatomy of the abdominal aortic aneurysm and the renal, mesenteric, and iliac arteries. Limited studies are available compared to the incidence and risk of the procedures regarding the role of CT in the diagnosis of aortic aneurysms. The objectives of this study are to (i) evaluate the aortic aneurysms using CT examination and (ii) Determine the location, type, and size of the aortic aneurysms, thereby demonstrating the practical application of CT in the management of aortic aneurysms.

2. MATERIALS AND METHODS

2.1 Patient population

A total of 20 patients, of varying ages and genders, who suffered from Aortic aneurysms were included in this study. It's important to note that these patients were selected randomly for CT scans, ensuring an unbiased approach. The patients were registered (age and sex were recorded) at Al-Amal National Hospital, Khartoum North, Sudan, during the sixth month.

2.2. CT machine Equipment

The Toshiba Aquilion 64, an esteemed 64-slice CT scanner, is renowned for its precision and advanced features. It delivers accurate isotropic imaging, 64 simultaneous 0.5mm slices per rotation, 0.35mm spatial resolution for small vessel and coronary artery detail, and exceptional low-contrast resolution. The machine features a 40% dose reduction compared to similar systems, a 180cm long by 47cm wide patient couch, the Advanced Sure Workflow with PhaseXact, and 13cm coverage in patient axis direction. With faster rotation speeds, a more significant generator, and advanced cardiac workflow software for imaging the heart, the Toshiba Aquilion 64 is a testament to technological advancement in the field of medical imaging.

2.3. Imaging protocol

The imaging protocol for this study was as follows. Patients received injections of 120 and 150 ml of contrast at a rate of 3–4 ml/s. The scan delay time was adjusted between 12 and 16 seconds from the onset of contrast injection. Helical CT was performed during a single breath hold at 3–5 mm (mostly 5 mm) collimation and 7.5 mm/s table speed with a pitch of 1.5–2, depending upon the patient's volume of scan and breath holding capacity. Scanning was done in the cranio-caudal direction. Scan reconstructions were done at 2 mm (overlapping thin section) to create 3D images. The data set was then utilized to generate curved planar reformations and 3D rendering, where MIP and SSD were reconstructed. For further details, please refer to Table 1.

Table 1. Image acquisition protocol

Scout	AP
Start	Thoracic Inlet
End	Symphysis Pupic
kVp	120
mAS	350
Raw Slice Thickness	0.5
Window Width/Window Level	WW 250 WL 60
Intravenous Contrast	Thorcic 50ml Abdominal 100ml

3. RESULTS:

Aortic aneurysms are frequent globally. Most aortic aneurysms are detected after a medical test or treatment without symptoms. Sudanese patients often die undiagnosed. Although cardiac surgeons operate on the ascending aorta and arch and vascular surgeons address abdominal aortic aneurysms, cardiologists typically manage all forms of aortic illness. Al Amal Hospital did this investigation to determine the causes of the aneurysm. The data was collected using a data sheet based on patients admitted to the hospital. Figure 1 shows that most patients studied were males (90%), while females represent the % (10%). Figure (2). The peak incidence was among the age between 61-70 years of age, presenting a percentage of (50%). The common Location of aortic aneurysms in the Abdomen (80%) is shown in Table 2. The study revealed that 20% of aortic aneurysm distribution is saccular, while 80% of the sample is fusiform. Figure 4 shows the diameter of the aortic aneurysm distribution.

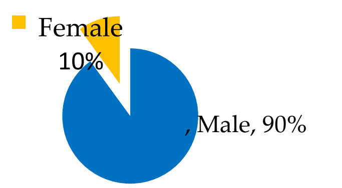

Figure 1. gender distribution

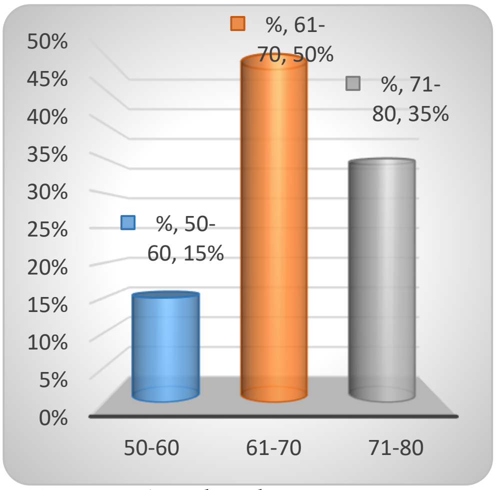

Figure 2. Age distribution

Table 2. Location of aortic aneurysms distribution

Location	No of patients	%
Chest	4	20%
Abdomen	16	80%

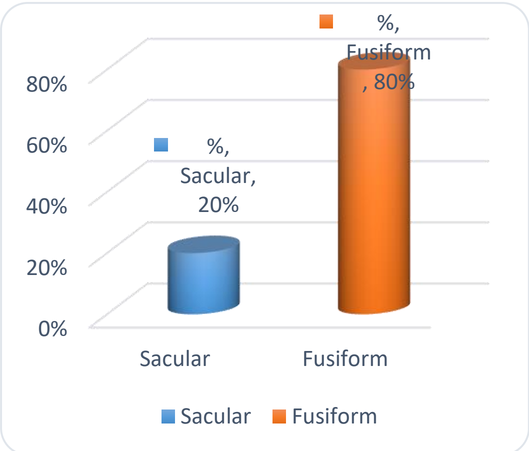

Figure 3. Type of aneurysm

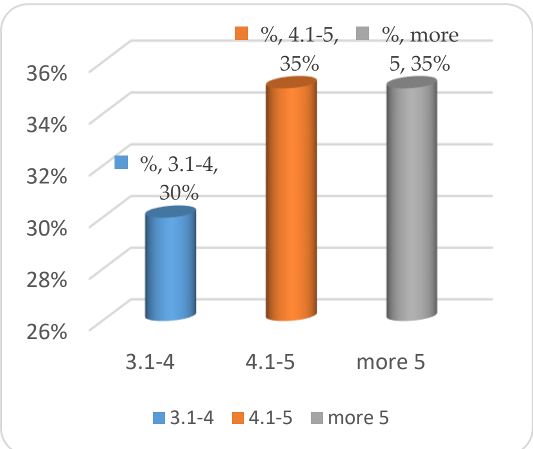

Figure 4. size of aortic aneurysms

4. DISCUSSION

This retrospective analysis was intended to assess the role of CT scans in patients with aortic aneurysms and to examine the best timing and factors predicting positive findings. The introduction of CT 64 slice technology has been significant in aneurysm diagnosis. It can produce simultaneous 0.5 mm slices and gives isotropic volumetric data with a resolution of 350 microns, allowing for more precise and detailed imaging. Thin-slice volume data is reconstructed, providing a comprehensive view of the aorta and its surrounding structures. Earlier CT technology was not fast enough to capture precise images of moving body parts such as the heart. The latest advancement in CT technology – 64-slice imaging – is now making it possible to evaluate the heart and surrounding structures. Therefore, Al Amal Hospital is one of four 64-slice machines available in Sudan, and most of the patients were admitted to this hospital.

This study evaluated modality CT scan examination in case of aortic aneurysms in 20 of the patients investigated, The majority of the samples under study were male, with 18 patients forming an incidence of (90%), and female, two patients forming an incidence of (10%). In this study, the peak incidence of aortic aneurysms was observed among those between 61 and 70 years of age, presenting a percentage of (50%) regarding distribution among age groups. (15%) were 50 -60, (50%) were in the 61 – 70 age group, and (35%) were in the 71 – 80 age group. The term' peak iridescence' refers to the highest incidence of aortic aneurysms observed in this study, which was in the 61-70 age group. The CT scan found the location of aortic aneurysms as the following in chest four patients (20%) and in the abdomen in 16 patient percent (80%). The types of aortic aneurysms as the following fusiform in 16 patient percent (80%) and saccular in 4 patient percent (20%), and the diameter of aortic aneurysms as the following diameter between (3,1 – 4)cm in 6 patient percent (30%), diameter between(4.1 – 5) cm in 7 patient percent (35%) diameter more 5 in 7 patient percent (35%).CT scan successfully detected aortic aneurysms and determined the location, type, and size of aortic aneurysms. This study provides a comprehensive understanding of aortic aneurysm characteristics in a small group of 20 patients, focusing on the utility of CT scans for diagnosis and characterization. CT scan was the chosen imaging modality, successfully detecting and characterizing aortic aneurysms. A significant male predominance (90%) was observed, with only 10% female. This aligns with known trends that males are more prone to aortic aneurysms. The peak incidence was in the 61-70 age group (50%), with a distribution showing increasing incidence with age: (50-60 years: 15%), (61-70 years: 50%), (71-80 years: 35%). This age distribution confirms that aortic aneurysms are more common in older populations. Abdominal aortic aneurysms (AAAs) were significantly more common (80%) than thoracic aortic aneurysms (TAAs) (20%). This is a very common finding in the general population. Fusiform aneurysms (80%) were much more prevalent than saccular aneurysms (20%). Fusiform aneurysms, which involve a diffuse dilation of the aortic segment, are the most common type. The diameter distribution was (3.1-4 cm: 30%), (4.1-5 cm: 35%), (5 cm: 35%). This distribution is important because aneurysm diameter is a critical factor in determining the risk of rupture. Larger aneurysms (>5 cm) carry a significantly higher risk.

The study confirms the effectiveness of CT scans in detecting and characterizing aortic aneurysms, providing crucial information about location, type, and size (Lo et al., 2013). This is consistent with established clinical practice. The strong male predominance highlights this population's need for targeted screening and prevention strategies. The age distribution reinforces the importance of considering age as a significant risk factor for aortic aneurysms. The higher prevalence of AAAs compared to TAAs is consistent with epidemiological data. AAAs are often asymptomatic until rupture, making screening vital. The diameter distribution is clinically relevant. Aneurysms exceeding 5 cm are considered high-risk for rupture, necessitating close monitoring or intervention (Umebayashi et al., 2018).

The study's limitations include the small sample size (20 patients), which limits the generalizability of the findings. This underscores the need for larger studies to confirm these results. The lack of a control group for comparison is also a limitation, and the study was carried out in a single modality. Comparing CT with other modalities (e.g., ultrasound, MRI) could provide valuable insights and is an area for future research.

The study's clinical implications reinforce the importance of CT scans in the diagnosis and management of aortic aneurysms. It highlights the need for increased awareness and screening, particularly in older men. The diameter distribution emphasizes the importance of monitoring aneurysm growth and considering intervention for larger aneurysms. In conclusion, this study provides valuable data on the characteristics of aortic aneurysms in a small patient population. However, larger, well-designed studies are needed to further validate these findings and improve our understanding of this potentially life-threatening condition. The study's findings, however, provide a solid foundation for future research and clinical practice.

5. CONCLUSIONS

Whereas aortic aneurysms are less common than many other cardiovascular conditions, the fact that they can be life-threatening and that even large aneurysms may not produce symptoms makes it all the more important for clinicians to be vigilant in their evaluation of patients at risk. Because aneurysms are often first detected on an imaging study ordered for other indications, any suggestion of an enlarged aorta should prompt follow-up with an appropriate dedicated imaging study. Fortunately, modern imaging techniques — especially CT— have now made the sizing and surveillance of aneurysms remarkably easy, providing a sense of reassurance in patient care. In the future, genetic screening may also play a role in screening those with a family history of thoracic aortic aneurysms. In conclusion, the study's findings are consistent with established knowledge about aortic aneurysms. However, the pronounced male predominance warrants further consideration and comparison with more extensive epidemiological studies.

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CONFLICTS OF INTEREST:

The authors declare no conflicts of interest.

REFERENCES

Aggarwal S, Qamar A, Sharma V, Sharma A. Abdominal aortic aneurysm: A comprehensive review. Exp Clin Cardiol. 2011 Spring;16(1):11-5. PMID: 21523201; PMCID: PMC3076160.

Cerna M, Kocher M, Thomas RP. Acute aorta, overview of acute CT findings and endovascular treatment options. Biomed Pap Med Fac Univ Palacky Olomouc Czech Repub. 2017 Mar;161(1):14-23. doi: 10.5507/bp.2016.060. Epub 2017 Jan 2. PMID: 28115748.

Genovese EA, Fonio P, Floridi C, Macchi M, Maccaferri A, Ianora AA, Cagini L, Carrafiello G. Abdominal vascular emergencies: US and CT assessment. Crit Ultrasound J. 2013 Jul 15;5 Suppl 1(Suppl 1):S10. doi: 10.1186/2036-7902-5-S1-S10. Epub 2013 Jul 15. PMID: 23902665; PMCID: PMC3711735.

Geske, N et al., 2025. Abdominal Aortic Aneurysms in Two Prosected Anatomical Donors: Correlations With Aortoiliac Occlusive Disease and Pelvic Congestion Syndrome, Cureus, (2025). https://doi.org/10.7759/cureus.77489

Katsanos, K. A., & Tsivgoulis, G. (2018). "Computed Tomography Angiography Versus Digital Subtraction Angiography for the Detection of Intracranial Aneurysms: A Systematic Review and Meta-Analysis." American Journal of Neuroradiology, 39(4), 735-740.

Kranz, P. G., et al. (2019). "Multi-Detector CT Angiography in the Diagnosis of Intracranial Aneurysms: Comparison with Digital Subtraction Angiography." Neurology Research International, 2019, Article ID 1923804.

Lai, P. M., et al. (2021). "Advancements in Three-Dimensional Computed Tomography Angiography for the Evaluation of Intracranial Aneurysms." Future Neurology, 16(6), 147-159.

Li X, Zhao G, Zhang J, Duan Z, Xin S. Prevalence and trends of the abdominal aortic aneurysms epidemic in general population--a meta-analysis. PLoS One. 2013 Dec 2;8(12):e81260. doi: 10.1371/journal.pone.0081260. PMID: 24312543; PMCID: PMC3846841.

Lo RC, Bensley RP, Hamdan AD, Wyers M, Adams JE, Schermerhorn ML; Vascular Study Group of New England. Gender differences in abdominal aortic aneurysm presentation, repair, and mortality in the Vascular Study Group of New England. J Vasc Surg. 2013 May;57(5):1261-8, 1268.e1-5. doi: 10.1016/j.jvs.2012.11.039. Epub 2013 Feb 4. PMID: 23384493; PMCID: PMC3633660.

Manning, B.J. et al. 2009. Abdominal aortic aneurysm diameter: A comparison of ultrasound measurements with those from standard and three-dimensional computed tomography reconstruction. Journal of Vascular Surgery, Volume 50, Issue 2, 263 – 268

Schubert, A., et al. (2020). "Non-Contrast Computed Tomography in the Emergency Department: A Valuable Tool in the Diagnosis of Intracranial Aneurysms." Emergency Medicine Journal, 37(7), 408-414.

Song P, He Y, Adeloye D, Zhu Y, Ye X, Yi Q, Rahimi K, Rudan I; Global Health Epidemiology Research Group (GHERG). The Global and Regional Prevalence of Abdominal Aortic Aneurysms: A Systematic Review and Modeling Analysis. Ann Surg. 2023 Jun 1;277(6):912-919. doi: 10.1097/SLA.0000000000005716.

Tanaka R, Yoshioka K, Abiko A. Updates on Computed Tomography Imaging in Aortic Aneurysms and Dissection. Ann Vasc Dis. 2020 Mar 25;13(1):23-27. doi: 10.3400/avd.ra.19-00127. PMID: 32273918; PMCID: PMC7140160.

Umbreit, A., et al. (2019). "Computed Tomography Angiography for the Diagnosis of Cerebral Aneurysms: A Retrospective Study." Journal of Clinical Neuroscience, 65, 145-150.

Umebayashi R, Uchida HA, Wada J. Abdominal aortic aneurysm in aged population. Aging (Albany NY). 2018 Dec 6;10(12):3650-3651. doi: 10.18632/aging.101702. PMID: 30523221; PMCID: PMC6326692.