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CT of Abdominal Imaging Characteristics of Abdominal Aortic Aneurysms Managed at TASH, A Retrospective Analysis

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Abstract

Background:

Abdominal Aortic Aneurysm (AAA) is a permanent aortic dilatation > 3 cm, > 50% larger than the coterminous normal dimension, or 1.2 - 1.5 times the size of the normal infra-renal aortic diameter. Imaging is crucial for the identification, characterization, and appropriate management of AAAs. The aim of this study is to analyze the imaging characteristics of abdominal aortic aneurysms which are managed at TASH and to evaluate imaging signs of complications

Method:

A retrospective cross-sectional observational study conducted from May 1st, 2022 to May 1st, 2023, enrolled 38 surgically naïve AAAs, assessed by a body imaging (BI) fellow and a BI subspecialist, and analyzed using IBM SPSS statistics version 25.

Results

The majority of patients were from Southern Ethiopia, with equal male to female ratio and ages ranging from 11 to 85 with a mean and median age of 54.68 and 60 for men; and 51.79 and 52 for women respectively. AAA was Infra-renal in 33 (86.8%), suprarenal in 2 (5.3%), and Juxtarenal in 3 (7.9%) cases. AAA was fusiform in 25 (65.80), saccular in 4 (10.5%), pseudoaneurysm in 8 (21.1%), and both fusiform and saccular in 1 (2.6%) of the cases. A transverse diameter > 40 mm was present in 36 cases (94.74%), ranging from 32.7 to 190 mm (mean: 66.50, median: 57.15, mode: 52.00; std: 28.34). A proximal neck length (PNL) of < 20 mm was present in 15 (39.47%) cases. IMA was involved in 28 (73.7%) cases, and bilateral or isolated right or left CIA in 14 (36.8%) cases. A thrombus observed in 30 cases was split 50/50 between eccentric and concentric, of which 3 (6.57%) had calcification. Thirteen (34.2%) cases showed rupture, most commonly at posterior 5(38.5%), or anterolateral 5(38.5%) wall of AA. Two AAAs (5.3%) showed fistula. Mural calcification was noted in 17 cases (44.73%), with rupture more frequently linked to discontinuous calcification.

Conclusions

Unusually big primarily infrarenal AAAs, potentially indicating delayed detection, with no sex predilection; low mural and thrombus calcification was a curious finding. Most AAA patients did not follow proper CTA protocol, and only open surgical management was employed for all cases who are surgical candidates.

Recommendations:

We recommend multicenter prospective studies to suggest early imaging signs of complications and possible risk factors.

Keywords: abdominal aortic aneurysm; calcification; abdominal CT-

angiography; ethiopia, ruptured abdominal aortic aneurysms

Background

An aortic aneurysm is a permanent, localized dilatation of a segment of the aortic wall. Aortic aneurysm is classified as thoracic, abdominal or thoraco-abdominal depending on the involved segment of the aorta. The standard reference limit reported in the literature describes AAA as a diameter greater than 3 cm, or more than 50% compared to adjacent normal dimensions, or greater than or equal to 1.2–1.5 multiples of normal infra-renal aortic diameter. (1-3) It affects about of elderly individuals, and is more common in men above 65 years of age (5-8%) compared to women of the same age (about 2%). (3, 4) Thoracoabdominal aneurysm is proximally bounded by the origin of the left subclavian artery while the distal extent could reach up to the aortic bifurcation. (5) The AAA is further classified as suprarenal (above the renal arteries), infra-renal (below the renal arteries), juxta-renal and complex. Juxta-renal abdominal aortic aneurysm is when the aneurysm extends up to the renal arteries leaving only a short neck (<10 mm), with no evidence of involvement of either renal arteries. (6) Complex AAA are aneurysms that involve the renal and/or mesenteric arteries. (7) The juxtarenal, suprarenal and type IV thoracoabdominal aneurysms (aneurysms reaching diaphragmatic level above celiac artery) all are usually grouped under complex aneurysms. (8) The reported incidence of AAA by type comprises of 90-95% infrarenal. (9-13) Different studies reported JRAAAs to comprise 2-20% of IRAAs. (14, 15). As a representative of clinical significance, aortic aneurysms are further classified as small and large (>4 cm). (4) Understanding the type of AAA is important for a comfortable and optimal repair of the AAA.

Studies have shown that physical examinations are 51% to 100% sensitive for detecting aneurysms, and that this sensitivity increases with aneurysm size, reaching 29% for aneurysms measuring 3.0 cm to 3.9 cm, 50% for those measuring between 4.0 cm to 4.9 cm, and 76% for aneurysms that are larger than 5.0 cm. (16) On the other side, imaging either ultrasound, CT or MRI alone or in continuum has a far better sensitivity and specificity.

Imaging helps in proper mapping of the AAA and specifically tells the site, size, proximal and distal neck lengths of AAA and thus helps in pre-interventional planning of the type of surgery [endovascular (EVS), modified EVS like chimney method or the fenestration method versus open], the site of cross-clamping, and preselection of appropriate graft size. (17) Ultrasound is used as a screening tool for AAA as it has high sensitivity and specificity (about 100%) in addition to its radiation free nature. The limitations related to ultrasound include operator dependence, hindrance of quality image from bowel gas, obesity, and shadow of calcification burden, limited characterization of renal and other visceral arteries. Thus, multi-slice CT especially CT angiography is a preferred imaging for AAA diagnosis, characterization and surveillance, despite its risk of radiation. MR angiography gives a better soft tissue resolution and thus better characterization but the high cost and less availability related to it limits its use in routine clinical practice. (4)

Although AAA is usually asymptomatic, the fact that it can lead to dismal complications including high risk of mortality, comprehension of its imaging features and its early detection are crucial steps towards the prevention of these complications. Once ruptured, a survival rate of AAA is reported to be only about 20%, even after intervention. (18)

The most crucial indicator of AAA complications is size which is a guiding factor for further intervention and monitoring; the other indicator of rupture being the expansion rate or the rate of growth of AAA. (19, 20)

According to the UK Small Aneurysm Trial, the annual risk of rupture was 0.3%, 1.5%, and 6.5% for aneurysms that were less than 4 cm, 4 to 4.9 cm, and 5 to 5.9 cm, respectively. (21) The annual rupture risk based on AAA diameter as of the Joint Council of the American Association for Vascular Surgery and Society for Vascular Surgery is put as follows(22):

- Below 4.0 cm – 0%
- 4.0 cm to 4.9 cm – 0.5% to 5%
- 5.0 cm to 5.9 cm – 3% to 15%
- 6.0 cm to 6.9 cm – 10% to 20%
- 7.0 cm to 7.9 cm – 20% to 40%
- 8.0 cm or greater – 30% to 50%

The recommended imaging surveillance (21) depending on this risk is as follows(23):

Aortic Diameter	Imaging Interval
- 2.5 - 2.9 cm	5 years (defined as ectatic)
- 3.0 - 3.4 cm	3 years
- 3.5 - 3.9 cm	2 years
- 4.0- 4.4 cm	1 year
- 4.5 - 4.9 cm	6 months, also consider surgical or endovascular referral
- 5.0 - 5.5 cm	3-6 months, also consider surgical or endovascular referral

According to European and American vascular societies, an elective repair is recommended for a fit individual when the aneurysm reaches a size of more than 5.5 cm. (24-26)

Another crucial aspect to take into account when monitoring and treating AAA is AAA morphology which is described as fusiform versus saccular.(26) Describing the type of aneurysm morphology in CT imaging reports is also important as it has clinical and management implications. For instance, in using endografts, use of a relatively short (less than 15-mm) landing zone would suffice for saccular aneurysms while a more generous landing zone is required for AAAs with fusiform morphology. (27)

Endovascular AAA repair techniques are becoming a preferred vascular repair intervention technique and were reported to have a lower mortality rate albeit higher re-intervention rate compared to open surgical repairs. Ruptured AAA require an immediate repair while elective AAA repair is indicated when AAA size is >55 mm in males and >50 mm in females, AAA is rapidly expanding (>10 mm/year) and when AAA becomes symptomatic.(28)

The size and angulation of the AAA proximal neck is the major factor in recruitment of patients for endovascular aneurysm repair (EVAR) so that treatments should be tied to the instructions for use (IFU) which is usually transgressed in many patients. (29-31) Shorter, bigger, and more angulated infrarenal aortic necks are more challenging to treat and have worse prognosis. (32-39) This also applies for open surgical repair in which adequate aortic exposure, proximal and distal vascular control as well as cross clamp site determines the successful repair; unfavorable neck anatomy making all these things problematic. (8)

Although an exact threshold is not recommended, the Society for Vascular Surgery practice recommendations for AAAs imply that elective surgical treatment of saccular AAAs is justified at lesser dimensions. (40)

It is also important to look for other arterial involvement while reporting CTA of AAA.
About 50% of cases of AAA can involve the iliac artery. (41) According to reports, CIA involvement is common 10–30% of AAAs show CIA involvement either unilaterally or bilaterally. (42-45) Assessment of AAA involvement of the iliac arteries, aortic bifurcation angle, or concomitant presence of isolated iliac artery aneurysm with determination of proximal and distal landing zone (neck) size and morphology can be reliably done by conventional CT and/or CTA and has treatment implications. (46)In one study of 74 AAAs, a troublesome iliac artery anatomy including concomitant involvement with or without proximity to the EIA or the hypogastric artery origin, non-aneurysmal ectasia of iliac arteries, tortuosity or stenosis of iliac arteries, extremely splayed aortic bifurcation complicated the AAA repair procedure in 35 (47%) of the cases. (45)

When evaluating CT of AAA, involvement of IMA, patency of IMA and whether a bowel ischemia is present in occluded IMAs should be looked for. Similarly, involvement and patency of lumbar arteries should be well-documented.

From about five types of Endoleaks following EVAR, type-II endoleaks which represent leaking into the aneurysm sac and are usually from patent Inferior mesenteric artery (IMA) or lumbar arteries occur in ≈10% of patients (with a reported incidence ranging from 8 to 44%). (47, 48) A CT scan reveals the presence of contrast material in the aneurysm sac's periphery, around the sites of the affected blood vessels (the anterior wall of the sac for the IMA and the posterior wall of the sac for the lumbar arteries) thus indicating whether these vessels are patent. A practically debatable prophylactic embolization of inferior mesenteric artery diameters >3.0 mm or lumbar artery diameters >2.0 mm have been shown to reduce the risk of type-II endoleaks. (49-52) Ligation is the other option especially in open surgical techniques. (53, 54) But, presence of adequate collaterals, usually from left colic artery should be looked for first, to prevent post-EVAR bowel ischemia, which is usually a result of embolus or endograft coverage of the IMA origin and commonly affects the left colon. (55, 56) Visceral ischemia occurs in 1-10% of individuals who have aortic surgery, and is related to a higher postoperative mortality rate, reaching almost 25%. (57)

As AAA rupture has invariably high mortality rate (58), early diagnosis of aneurysm rupture is crucial in the management of aortic aneurysm. Multiple studies have shown that clinical suspicion and diagnosis of AAA rupture was associated with significant missing rate as most ruptures are asymptomatic. On the other hand, imaging especially CTA was found to have a better sensitivity and accuracy and has even additional values in peaking early cues of impending rupture and the specific site of rupture. In one study, incidental detection of AAA cases accounted for more than 65% of all the AAA cases, which were clinically unsuspected, and even physical examination missed more than 37% of AAAs which were radiologically detected. (59)

Evaluation of CTA of AAA also should focus on early detection of features of rupture also called signs of imminent or impending rupture.

Increased attenuation within the AAA thrombus is referred to as a peripheral crescent sign (60-62) which represents dissection of blood in to the thrombus and was first described by NCECT (63) albeit it is better detected on CECT arteriogram/aortogram and is termed thrombus fissuration. Concentric calcification is common in AAA walls and a focal discontinuity which usually occurs in the left (63) posterolateral wall (64) is generally a common sign of imminent rupture. Although non-repaired cases with just an increase in size could show this and other signs of impending rupture, the rush to surgery in presence of these signs alone is questionable, especially in the absence of clinical symptoms or other aneurysm character changes. (65)

Aortic blebs or focal bulges of the aneurysm wall correlate histopathologically to focal inflammatory thinning of elastic fibers. (63)

The draped aorta sign indicates an aortic wall wrapping around the anterior vertebral bodies and represents a contained AAA rupture sealed by the adjacent vertebral body, indirectly signifying a posterior AAA rupture. The presence of this sign entails a risk of ongoing leak as the inflammation causes vertebral body scalloping and irregularity which further weakens/erodes adjacent aortic wall. (66)

Other CT features of AAA impending rupture or instability include: increased growth rate of aneurysm size seen on follow up images, decreased thrombus size (measured in thrombus to lumen ratio), thrombus heterogeneity and irregularity. (67)

Presence of thrombus and thrombus calcification and morphology should be documented in the report of AAA. Additionally, presence and pattern of aortic mural calcification, which usually represents the cause of the aneurysm, should be reported in CTA of AAA.

Intraluminal thrombosis of AAA has been reported in more than 75% of AAAs with a higher frequency as the aneurysm size increases more than 5 cm and the size of the thrombus was correlated with detrimental effects. (68, 69) The most common morphology reported is concentric. Although it has been said that a larger thrombus decreases AAA wall stress, the larger the size of the thrombus was found to cause the higher the growth of the AAA by exerting a direct wall weakening effect. (70) Furthermore, the presence of thrombus calcification which is a common finding in intraluminal thrombus of AAA is reported to have similar wall weakening effect and thus increased risk of rupture. (71, 72) This effect was related to the location of the calcification than the amount of calcification. But there are others who challenge this hypothesis raising that resistance of degradability (proteolysis) of the calcification in the aortic wall strengthens aneurysm wall and thus decreases rupture. (73)

As far as we know, in our institution and in our country, Ethiopia, no large study done on AAA and the reference limit for AAA is not yet settled.

Methodology

Thirty-eight cases of previously surgically naïve AAA were enrolled in this retrospective cross-sectional observational study over a period of May 1st, 2022 to May 1st, 2023.

The Abdominal CECT of the 38 patients were collected from the TASH medweb database and the image collections at the surgery department, and were assessed by an abdominal and pelvic imaging fellow, PI, and reviewed by an abdominal and pelvic imaging subspecialist.

All the patients were evaluated by a vascular surgeon in Tikur Anbesa Comprehensive Specialized Referral Hospital (TASH), a tertiary hospital in Addis Ababa, Ethiopia.

Data were entered, cleaned up, and analyzed using IBM SPSS statistics version 25. Descriptive statistics including frequencies, mean, median and mode as well correlations were checked.

Results

Sociodemographic characteristics

Of the enrolled 38 AAAs, most (85%) were from Southern Ethiopia, and all the cases showed equal male to female ratio. Age of the patients ranged from 11- to 85 – years (median 60 years for males and 52 years for females and mean of 54.68 and 51.79 respectively with overall mean age for both males and females of 53.24).

Site, extent and morphology of AAA

The AAA was infra-renal in 33 (86.8%), suprarenal in 2 (5.3%), and juxtarenal in 3 (7.9%) of the patients. This more or less fits to the reported incidences of type of aneurysms by location. Taylor et al reported 27(15.5%) JRAAA among 174 infrarenal aneurysmectomies and suggested that JRAA could practically be more common than previously reported. This is mainly because they often are misdiagnosed as complex thoracoabdominal or infrarenal aortic aneurysms. (74)

Thirty-six patients (94.74%) showed a transverse diameter more than 40 mm with a range of 32.7 to 190 mm (mean: 66.50, median: 57.15, mode: 52.00; std: 28.34). Thirty-three (86.84%) of the AAA had an AP diameter larger than 40 mm and the AP diameter ranged from 33.2 to 117 mm (mean 60.53 mm, median: 54.6). The longitudinal extent of the abdominal aneurysms was longer than 40 mm in 37 (97.37%) of the patients and a range of 31.8 mm to 170.4 mm (mean: 93.00 median: 84.95 mode: 66.00; std: 36.06). This was in comparison to a clinical audit of 40 patients in New Zealand which showed a mean AAA diameter of 52 mm (43–67 mm). (75) Morphologically, in our study, the majority of the cases i.e. 25 (65.80) were fusiform, while 4 (10.5%) were saccular, 8 (21.1%) pseudoaneurysm, and 1 (2.6%) both fusiform and saccular. This is in contrast to a New Zealand clinical audit which showed a predominant fusiform AAA (fusiform 90% vs saccular10%). (75) Another clinical audit in Netherlands, still showed, 94% (7188) fusiform and 6% (471) saccular AAAs among 7659 patients with abdominal aortic aneurysms (AAAs). (76) Other different studies showed 6-8% rate of saccular aneurysms among infrarenal aortic aneurysms. (75-77).

With the radiant viewer application we had we could determine the proximal aneurysmal neck length (PNL) and diameter but could not comfortably determine the angle. Nine cases (23.68%) showed a proximal neck length of <10 mm, and another 6 (15.79%) cases showed a PNL of <20 mm. A retrospective analysis of 111 patients who underwent CTA for AAA in Minneapolis, showed a PNL of < 10-15 mm in 72 patients, and a reciprocal relationship (rs= -0.2237; P=0.018) between aneurysm size and PNL. (78) It was difficult to determine PNL for two cases while the remaining 21 (55.26 %) cases showed adequate PNL of 23.00 mm and above reaching 88.00 mm.

Other arterial extension

In this study, in one case both the renal arteries were involved and the aneurysm was complex thoracoabdominal type juxtarenal aneurysm for which the proximal neck length could not be determined because the image was cut while the proximal neck diameter was 26.60 mm. Also in another case, in which the aneurysm was juxta renal pseudoaneurysm, the aneurysm extended to involve the left renal artery causing left renal infarction, and the suprarenal aorta assumes normal size, no measurable proximal neck length was left.

In our study, 28 cases of AAA involved IMA which in turn was seen arising from the thrombosed part of AAA – in 7 (18.4%) and from the non-thrombosed lumen of the AAA – in 21 (55.3) of the total 38. In all cases normal contrast opacification of the IMA noted and no evidence of bowel ischemia seen.

In our study, of the 38 total, no involvement of the common iliac arteries noted in 24 (63.2%), both right and left common iliac arteries were involved in 4 (10.5%), only the right and the left CIA were involved in 7 (18.4%) and 3 (7.9%) of the cases respectively. The length and diameter of the iliac arteries to determine tortuosity and ectasia was looked for. The RCIA length ranged from 13.80 mm to 107.70 mm with mean value of 51.19 while the LCIA showed 28.60, 97.00, and 52.89 mm respectively. The CIA diameters were determined at the maximum ectatic level and the right showed a maximum of 34.4, a median of 14.0 and a mean of

15.95 mm while the left measured 34.00, 13.50 and 14.30 respectively. This coincides with another study which showed the median CIA diameter as 17 (range 6-75) cm and a relatively wider right than left CIA. (45)

Features of imminent rupture and Complications

The presence and site of rupture and signs of impending rupture has been checked in this study. Twenty-four (63.2%) of the total AAA cases were intact; 13 (34.2%) were ruptured among which 10 (26.3%) cases were contained while 3 (7.9%) were non-contained. In 5 patients of the 13 ruptured (38.5%), the site of rupture was in posterior location while it was anterolateral in the other 5 (38.5%) and was difficult to tell the site of rupture in 3 (23.1%) of the 13 patients. One of the 13 patients (2.6%) show features of impending rupture. In a retrospective CT study which consisted of 41 patients with at least one sign of impending rupture, a focal wall step-off of circumferential calcification was seen in 46.3% (19/41) and was the most common sign of impending rupture, the others seen including aortic bleb/bulge and crescent sign. (65)

Thrombus and calcification burden

In this study thrombus was present in 30 (78.9%) of the total, of which 15 (50%) showed eccentric and the other 15 (50%) concentric location. The thrombus morphology was homogeneous in the 21 of the 30 (70%) cases with thrombosis; while the other 9 of the thirty showed heterogeneous thrombus morphology. The remaining 8 (21.1%) showed no evidence of thrombus.

An ultrasound and CT study of 59 patients with AAA by Harter LP et al. showed a 75% incidence of intraluminal thrombus within AAA sacs. (79)
A study which compared the CT features of AAA of 52 ruptured to 56 non-ruptured controls showed homogeneous thrombus with comparable frequencies 25/52 (50%) and 24/53 (45%) respectively (p =.21) while heterogeneous thrombus was significantly less common in the later 26/53 (49%) vs 12/52 (23%) (p = .002). 25% (14/56) of the control and 13% (7/52) of the rupture groups both had thrombus calcification (p =.01). (80)

Only three cases (10% of AAAs with thrombosis) representing 6.57% of the total showed evidence of thrombus calcification which is very low as compared to the previous reports. (71)

Ten of the AAAs ruptured had a thrombus, of which 8 were contained ruptures.

Of the 3 AAA with thrombus calcification, 2 were intact and the remaining 1 showed a contained rupture.

Of all the cases, 17 (44.73 %) showed mural calcification of which three were continuous and 14 discontinuous and the remaining 21 (55.26 %) showed no evidence of mural calcification. Only one of the three AAAs with continuous mural calcifications showed evidence of non-contained rupture, while 7 of those with discontinuous mural calcifications were ruptured (6 contained, 1 non-contained).

Of the 21 patients who had no evidence of mural calcification, 5 showed evidence of rupture (1 non- contained, 4 contained) and 1 showed evidence of imminent rupture.

Discussion

Most (85% of all cases) of our patients were from the southern part of Ethiopia. We are not sure of the real risk factors as only 25 (65.78%) of the patients had ages above 50 years, unless this report is affected by not specifically knowing the exact age and hiding exact age, which is a cultural trend among the community in the countryside and in the cities of Ethiopia respectively. CT evidence of atherosclerosis is noted in only about 17 cases (44.73%), also questioning atherosclerosis as a possible risk. Furthermore, no sex was preferentially affected in this study. The well-documented risk factors for AAA include: age (incidence markedly increases after 60 years, with males being predisposed a decade earlier than females), sex (4-6 males: 1 Female), smoking, atherosclerosis, hypertension, positive family history. (4)

Most were infrarenal and unusually large as 23 (60.52%) had a size more than 55.4 mm i.e. in the range of imminent rupture by size criteria. Although our patients were not on follow up and did not have baseline imaging to risk stratify based on size, we do not know why this unusually large diameter was seen in the majority of the cases, in a manner which does not fit in to the previous reports and the recommended imaging surveillance indicated above (23). Although fusiform aneurysms were correlated with decreased wall stress and thus decreased risk of rupture (81, 82), this unusual trend might click for a further cohort study on a larger sample size to better understand the local AAA size patterns and develop local and national recommendations.

Thrombosis was seen in the majority of AAAs (30 (78.9%)) in this study. Although we could not tell whether the thrombus was there prior to rupture because the patients were not on imaging follow up, the majority of AAAs with rupture also showed thrombosis. This is in comparison with previous studies which reported thrombosis in about 75% of AAAs and above.

Lumen to thrombus ratio was calculated and was in the range of 0.8 to 7.43 (mean: 2.40, std: 1.44; mode: 2.00), 6 contained ruptures were seen in L:T of 2.18 and above, while 4 AAAs were ruptured at L:T of 1.90 and below (2 non-contained: at L:T 1.25 and 1.9; 2 contained at L:T 0.82 & 1.55). The other 3 ruptures of AAA occur in absence of thrombus. This data somehow fits in to the speculations that a thinner thrombus (less than or equal to 10 mm) contributes to rupture of AAA due to high oxidative stress to the AAA wall.

In only 3 (6.57 %) of the AAAs was thrombus calcification seen, signifying an extremely lower thrombus calcification burden compared to the previous reports in which a thrombus calcification encompasses about 25% of the cases. (72)

Large number of patients with large size in the range of an imminent rupture and with obvious rupture.

Except those which present with CT evidences of imminent, contained or non-contained rupture, most of the patients were indicated for an elective intervention because of the large size of the AAA and/or the associated age of the patient. But unfortunately most of asymptomatic patients were not intervened.

Additionally, most of the patients had a favorable anatomy and clear indication for EVAR. Unfortunately, due to the lack of the devices, open surgical technique was employed for all cases indicated for intervention.

Conclusion

Unusually big primarily infrarenal AAAs, with no sex predilection; and showing lower mural and thrombus calcification burden was a unique finding in this study. The larger size of the AAA, most in the range of the size indicating imminent rupture as put in literatures, could potentially imply a delayed detection. And the lower calcification burden, although difficult to conclude on this small pool of cases, could be related to the nutritional, environmental or genetical factors.

Most AAA patients did not follow proper CTA protocol up on investigation and the report of the AAAs was not systematic. A proper abdominopelvic scan in accordance with CTA protocol should be an ideal procedure for patients suspected and/or diagnosed to have AAA. The ideal radiological report of An AAA should include the type of AAA by site and by morphology, the proximal and distal neck length and angulation; involvement of other arteries including visceral arteries like renal and inferior mesenteric arteries, whether there is concomitant iliac artery aneurysm either by direct extension or synchronous skip involvement including its extent, angulation and tortuosity. Additionally especially when an EVAR technique is planned, whether the involved IMA and lumbar arteries are intact should be documented. And most importantly, the related complications especially the presence of signs of imminent rupture should be distinctly reported so that the vascular surgeons are alerted for early repair of the AAA. Finally, whether thrombus is present, its size and morphology along with thrombus calcification burden should also be reported.

Another observation in this study was that an open surgery than EVAR was used for those AAAs which required intervention.

Recommendations:

Depending on the AAAs seen with no age or sex predilection, we highly recommend a community-based targeted ultrasound screening for AAAs in Ethiopia. Different reasons might have contributed to the prevalence of the AAAs in the southern Ethiopia, but depending on our findings, we recommend a priority in this division of the country in a search for AAAs.

As the great vessels are usually disregarded in abdominal ultrasound evaluation, we also suggest that a standard reporting template which takes the size of abdominal aorta into account is followed during abdominopelvic ultrasound examination not to miss AAAs.

As most of the AAAs were indicated for EVAR, we recommend that the hospital administration and all the stake holders take an active engagement to avail all the necessary facilities so that the morbidities and mortalities related to AAAs are less-invasively early hampered.

All cases which showed a non-contained or contained rupture were surgically intervened, while most were fit for endovascular techniques.

Almost all the abdominal CTs were done with just post-contrast abdominal and pelvic examination than the standard CTA. As the latter is preferred for adequate evaluation of the AAAs, we recommend clinicians to order a proper CTA protocol (

Table **1**) which also should be followed in the department of diagnostic radiology. Subsequently, report of CTA of AAAs should follow a certain format (

Table **2**).

Table 1 A: Recommended proper CTA protocol for evaluation of AAA

Technique	Notes
Scanogram	Collimation: lower thorax to the bilateral common femoral arteries
NCECT+ of Abdomen and pelvis (optional)	To detect and characterize mural and/or thrombus calcifications
CT Angiographic/Aortogram	To evaluate the lumen of the aorta and proximal portions of its major branches
Portal vein phase	To look for aneurysms and complications including leaks and visceral or bowel infarctions
Delayed phase (optional)	In selected cases, where a giant aneurysm, or a certain type of delayed leak or fistula is suspected, especially aorto-renal/ureteric fistula
MPR reformats	To measure the size, and characterize other findings like PNL*

+ NCECT: Non-contrast enhanced Computed tomography *PNL: proximal neck length

Table 2 A: recommended radiology report template for CTA of AAA

Aorta and other Vessel-related findings	Type of AAA*	Site Morphology Size
	Proximal neck length (PNL)	Length, diameter, angulation
	Distal neck length	Length, angulation
	Mural calcification	Whether present or not and type including eccentric or concentric; continuous or discontinuous if present
	Thrombus	Whether present or not and type including intramural or intraluminal, eccentric or concentric
	Thrombus calcification	Whether present or not with further characterization including lumen: thrombus ratio
	Aortic bifurcation angle	
	Involvement of other arteries	Visceral: Renal, IMA and/or SMA/Celiac arteries Iliac artery: concomitant continuous or synchronous skip involvement with its extent, angulation and tortuosity Lumbar arteries # Specifically document whether the involved IMA and Lumbar arteries are intact particularly when EVAR is considered.
	Complications	Signs of imminent rupture or rupture Fistulas including Aortocaval, aortoenteric …
	AAA expansion rate	In patients who have follow up
Non-vascular findings	Any AAA related or un-related basal lung, abdominal and pelvic findings including complications	

Abbreviations

AA: Abdominal Aorta
AAA: Abdominal Aortic Aneurysm
CIA: Common Iliac Artery
CT: Computed Tomography
CTA: Computed Tomographic Angiography
DNL: Distal Neck Length
EVAR: Endo-Vascular Aneurysm Repair
IMA: Inferior Mesenteric Artery
NCECT: Non-contrast enhanced CT
PI: Primary Investigator
PNL: Proximal Neck Length
RA: Renal Artery
US: Ultrasound

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Contribution of the authors

All the three authors collected the cases. First phase image review and data entry to SPSS as well as manuscript preparation was done by the first author. The second author helped in second phase image review, correction of the SPSS data and editing of the manuscript.

Disclosure

The authors of this manuscript have no conflict of interest and there is no financial disclosure to be made.

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Authors of this manuscript declare that they have followed the ethical standards of the institution on the publication process.

Informed Consent Statement:

Statement of informed consent was not applicable as the manuscript does not contain direct patient data.

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No new data were created or analyzed in this study. Data sharing is not applicable to this article.

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