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Research Article

Retrospective Cross-sectional Study of Aortic Aneurysm after Introducing Electronic Health System at King Hussein Medical Hospital

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Abstract

Objective: To evaluate the clinical presentation and current management of aortic aneurysm patients in a tertiary care hospital in Amman, Jordan.

Method: All patients diagnosed with aortic aneurysm at the King Hussein Medical Hospital using the electronic health records (EHR) database Hakeem were evaluated between May 2016 and May 2018. Patients were then categorized according to the time duration between their diagnosis date and definitive treatment into 3 categories: Emergent (treatment on the same day of presentation), urgent (within one week) or elective (scheduled appointment). Definitive treatment was defined as either endovascular repair or open surgical repair.

Results: There were 49 cases of aortic aneurysm cases found in the Hakeem EHR database during that 2-year time interval, of them 92% were male, 94% were above 50 years old, and 61% were smokers. Thoracic cases were 14%, thoraco-abdominal cases were 8% and abdominal cases were 78%. The mean abdominal aneurysm size at presentation was 6.8 cm. Patients that were discovered incidentally with the aneurysm, were 43%. Elective, urgent and emergent groups were not significantly different in frequency. 63% of treated patients had endovascular repair. Nine patients refused to accept the risk of endovascular or surgical treatment. CT angiogram was used in 55% as the first investigation. The mean stay in hospital was 10.7 days, with 2.3 days in ICU and 6.1 days post-operatively.

Conclusion: Our results show the increased risk of aortic aneurysm in male patients above the age of 50 year, especially with a positive smoking history. One third of the patients required same day surgery to avoid immediate mortality. This outlines the late presentation of these cases due to the absence of screening. Hence, we recommend a one lifetime screening abdominal ultrasound for male smokers. Considering the high rate of smoking and other prevalent risk factors for developing aortic aneurysms, more studies are needed to evaluate the ideal age of starting this screening in Jordan. Implementing the electronic health system Hakeem has increased the accessibility and accuracy of research data and has lead to the increased awareness of this important issue.

Keywords: Aortic aneurysm; presentation and screening

Introduction

An aneurysm is a widening or localized dilation that is permanent and irreversible of a vessel.(1) It is considered abdominal if sub diaphragmatic and thoracic if supradiaphragmatic. (1) The normal diameter of the abdominal aorta varies with age, sex, bodyweight, and decreases progressively from its entry into the abdominal cavity to the iliac bifurcation [1]. The infrarenal aorta ranges between 1.5cm and 2.4cm in the elderly group of 65 and 74 years old [2].

Abdominal aortic aneurysm (AAA) is defined as dilatation that is focal and more than 50% of the normal size of the normal diameter of aorta, or the size of the aorta is 1.5 times the normal size of the aorta [3]. Other resources define AAA as a dilatation of three cm or more of the abdominal aorta [4,5]. If this dilatation involves all three layers of the aortic wall; it is considered a true aneurysm. Most aneurysms are fusiform since the whole circumference of the artery is affected, whereas an aneurysm that includes only a part of the circumference is termed saccular. An inflammatory aneurysm is

characterized by extensive perianeurysmal, retroperitoneal fibrosis and dense adhesions to adjacent abdominal organs [1].

The prevalence of AAA increases with age. The US experience showed; it is uncommon in persons younger than 50 years; however, 12.5% of men and 5.2% of women 74 to 84 years of age have AAA [4]. There is an increase in the number of diagnosed cases through screening programs; especially programs that pursue high risk populations. Many screens showed that AAA is almost 5% prevalent in men and 1% in women over 60 years old [6-8]. Deaths due to AAA rupture is around 15,000 per year in the US population [9], and this showed only aortic rupture as cause of death, not counting other causes of death due to associated illnesses. Defined risk factors associated with the development of AAA are advanced age, male sex, Caucasian race, a positive family history, smoking, the presence of other large-vessel aneurysms, and atherosclerosis [10,11]. The key risk factors for aneurysm rupture include the diameter of aneurysm at first time diagnosis, progression of aneurysm size, and male gender [12].Treatment of AAA could be either through an open repair (aorto-bifemoral repair graft) or through endovascular aortic repair (EVAR). Recent data showed that EVAR is not cost-effective compared with open repair on the long term as noted in European centers [13]. On the short term, EVAR appeared to be cost-effective based on the OVER trial, conducted in USA [13].

Methods

After institutional review board (IRB) approval, the research protocol was submitted for consideration, comment, guidance to the ethical committee of Jordanian Royal Medical Services. An approval was given according to the regulations of the country and the international standards before the study onset. All patients diagnosed with aortic aneurysm at the King Hussein Medical Hospital using the electronic health records (EHR) database Hakeem were evaluated between May 2016 and May 2018. Retrospective review of aortic aneurysm data using the electronic health records (EHR) database Hakeem. Patients with the ICD-9 codes of aortic aneurysms and its complications; 441.1 to 441.9 from the period of May 2016 till May 2018, were included in the study. This includes referred patients from non-military hospitals for treatment at King Hussein Medical Hospital. The total number was 49 patients.

Patients were classified per sex, age group, site of the aneurysm (abdominal, thoracic or both). Patients were then categorized according to the time duration between their diagnosis date and definitive treatment into 3 categories: Emergent (treatment on the same day of presentation), urgent (within one week) or elective (scheduled appointment). Definitive treatment was defined as either endovascular repair or open surgical repair. Patients were organized according to their first presenting symptom of diagnosis into: incidental and symptomatic. Incidental patients presented with a symptom not related to the aneurysm, e.g. a victim of motor-vehicle- accident. While patients presenting with related symptoms to the aneurysm were considered symptomatic. The grey area here was back pain with disc prolapse noted on lumbosacral CT, with an incidental finding of abdominal aortic aneurysm. This patient was considered incidental unless the size was more than 5.5cm, and the patient underwent an urgent or emergent intervention, he was considered as a symptomatic case. The same was applied for cases presenting with non-specific abdominal pain.

Results

The forty-nine aortic aneurysm cases were as follows; 38 abdominal, 7 thoracic, and 4 thoraco-abdominal. The thoracic cases were as follows: 9 cases had ascending thoracic aorta aneurysm (average size was 5.8 +/-1.7 cm), one case of descending thoracic aorta, size 5 cm, one case of aortic arch aneurysm, size was 6.2cm. Average size of abdominal aortic aneurysm cases 6.8 +/-2.0 cm (Table 1) The imaging used at first diagnosis was as follows; one case first diagnosed with I.V. contrast chest CT (thoracic Aneurysm), 12 cases of abdominal CT (abdominal aneurysm), two cases of Coronary CT, of which 1 was abdominal and 1 had thoraco-abdominal aneurysm, 27 cases of CT angiography (23 abdominal, 3 thoracic and one case of both thoracic and abdominal aortic aneurysm). Table 2 Numbers of cases per severity vs. mode of presentation are explained in Table 3. According to the situation by which the patients were diagnosed with aortic aneurysm, whether incidental or symptomatic. 21 cases were incidental (43%) of them, 4 were treated with observation, EVAR: 11, Open repair: 4, Refused: 2 and according to the severity; (elective: 11, emergent: 7, urgent: 3). The patents who were symptomatic 28 patients (57%) and managed as follows;(EVAR: 11, TEVAR:2, Open repair: 6, refused:9), according to severity (7 elective, 11 urgent, and 10 emergent (Table 4).

Table 1: Average size of abdominal aortic aneurysm cases.

	Thoracic cases	No. of cases	Size in cm
Thoracic cases	Descending	1	5.0
	Arch	1	6.2
	Ascending	9	5.8+/-1.8
Abdominal cases (including thoraco-abdominal cases)		42	6.8 +/-2.0

Table 2: Numbers of cases per severity vs. mode of presentation.

Type of Aneurysm		First Diagnostic Imaging	Number of cases
Thoracic		Chest CT	1
Abdominal		Abdominal CT	12
Abdominal	1	CT Coronary	2
Thoracoabdominal	1		
Abdominal	23	CT Angiography	27
Thoracic	3		
Thoracoabdominal	1		
Abdominal		Lumbosacral MRI	1
Abdominal		US	6
Total		49	

Table 3: Numbers of cases per severity vs. mode of presentation.

	Incidental	Symptomatic	Total	Percentage
Emergent	7	10	17	34.7%
Urgent	3	11	14	28.6%
Elective	11	7	18	36.7%
Total	21	28	49	100%

Table 4: The patents who were symptomatic 28 patients (57%) and managed as follows;(EVAR: 11, TEVAR:2, Open repair: 6, refused:9), according to severity (7 elective, 11 urgent, and 10 emergent.

Intervention	Number of cases	Notes
TEVAR/EVAR	22	• EVAR: 19 and TEVAR: 3 cases.
Open Surgical Repair	13	• 1 thoracoabdominal underwent aortobifemoral bypass and conservative for the thoracic aneurysm. • 3 cases underwent Open Heart Surgery. • 9 cases had aorto-bifemoral bypass.
Failed EVAR	2	• 2 failed due to technical difficulty, then patients refused to do the open procedure.
Conservative	3	• Asymptomatic and size did not require repair.
Refused	9	• Refused to accept the risk of the intervention.

The demographics of the patients were; 45 male (92%) 4 Female (8%), Diabetes; 10 had diabetes (20%) and 39 cases did not (80%), hypertension; 31 cases has it 63%, 18 cases did not have 37%. IHD; 24 has IHD 49%, 25 no IHD 51%. Smoker 30(61%), 19 nonsmoker 39%. For calculating the incidence of aortic aneurysms among the population of patients at our tertiary hospital (King Hussein Medical Hospital), the whole patient population at the hospital were looked up and classified according to the age (Table 5a). Number of aneurysmal cases per age (Table 5b) and calculated age-related incidence (Table 5c). Total number of aneurysmal patients were not calculated as most were on the paper-document binders, hence prevalence was not calculated.

Table 5a: KHMH population in May 2018 per age group.

Age Range	Male	Female	Total
35 - 44	107268	98420	205688
45 - 54	81990	83727	165717
55 - 64	56405	59960	116365
65 - 74	42253	43521	85774
75 - 84	32107	29196	61303
85 - 94	9986	8839	18825

Table 5b: Number of aortic aneurysmal cases per age group in bet May 2016 and May 2018.

	Total	Male	Female
35-44	1	0	1
45-54	4	4	0
55-64	12	12	0
65-74	21	20	1
75-84	10	9	1
85-94	1	0	1

Table 5c: Incidence of aortic aneurysm cases per age group.

	Male	Female	Total
35-44	0	1.016E-05	4.9E-06
45-54	4.879E-05	0	2.4E-05
55-64	0.0002127	0	1.0E-04
65-74	0.0004733	2.298E-05	2.4E-04
75-84	0.0002803	3.425E-05	1.6E-04
85-94	0	0.0001131	5.3E-05

Table 6: A comparison between incidental and symptomatic per the age, medical history of diabetes Ischemic heart disease (IHD) and per social history of smoking.

Comparison Item	Incidental	Symptomatic
Average Age in years	67.8+/-9.8	66.9+/-10.6
Number of cases	21	28
P value	0.7527	
Average Age>65 years	73.4+/-5.5	72.8+/-6.0
Total number cases>65 years	14	18
P value	0.7731	
DM	4	6
Not DM	17	22
%	19.0	21.4
Total DM %	20.4%	
IHD	12	12
Not IHD	8	16
Both	21	28
%	57.1	42.9
Total HTN %	24	49%
Smoker	12	18
Not smoker	9	10
Total	21	28

*DM: Diabetes Mellitus, HTN: Hypertension and IHD=Ischemic Heart Disease

The diagnoses used by the doctors according to the ICD code 9 were abdominal aortic aneurysm 57%, thoraco-abdominal aortic aneurysm 2%. Thoracic aortic aneurysm 4% and aortic aneurysm 37%. The age range of patients were; up to 39 years: 2%, 40-49: 4%, 50-64: 29% and more than 65 years old: 65%. The results of the endovascular aortic repair whether abdominal or thoracic were: 22, Open surgical repair: 13, trial of EVAR failed technically: 2, conservative treatment: 3, and refused to take the risk of procedure: 9 cases. A comparison between incidental and symptomatic per the age, medical history of diabetes Ischemic heart disease (IHD) and per social history of smoking (Table 6). ICD codes of the cases per their first presentation diagnosis is mentioned for each group (Table7) and abdominal pain, unspecified site ICD code 789.00, was seen in 17 patients.

Table 7: ICD codes of the cases per their first presentation diagnosis is mentioned for each group.

	Symptomatic 28	No of cases	Incidental	Incidental 21	No of cases
578.9	Upper GI bleeding*	1	444.22	Embolism and thrombosis of arteries of the lower extremities	1
786	Symptomatic SOB	1	724.2	Low back pain	5
786.5	Chest pain	3	729.5	lower limb pain	1
786.51	Chest pain radiated to the back	1	786.5	Dyspnea on exertion	1
789.00	Abdominal pain, unspecified site	17	786.59	Atypical chest pain	1
789.04	Left lower Quadrant Abdominal Pain	1	787.1	Heart burn	1
789.06	Epigasteric Abdominal pain	1	787.91	Diarrhea	1
789.3	Pelvic swelling	1			
	788	Renal colic	3		
789.30	Pulsatile abdominal mass	1	788.3	Urinary incontinence	1
724.2	Low back pain	1	789.00	Abdominal pain, unspecified site	2
			789.06	Epigasteric Abdominal pain	1
			441.3	Ruptured AAA	1
			E819.0	Motor vehicle traffic accident of unspecified nature injuring driver of motor vehicle other than motorcycle	1
			724.5	Back pain radiated to LL	1

*History of EVAR, complicated with aorto-enteric fistula.

Table 8: Incidental cases were 6.4+/-1.3, elective cases were 5.6+/-1.5, urgent cases were5.8 +/-0.8 and emergent cases were 7+/-1.5 days.

	Symptomatic	Incidental
LOS in EVAR cases in days	5+/-5 days	10+/-6
EVAR/ Total cases	6 patients	11
LOS in Open Repair cases in days	15+/-6	12+/-4
ICU stay /EVAR	3+/-5 days	1+/-1 days
ICU stay /Open repair	3+/-1	3+/-1
Post-operative stay in days	5.9+/-3.9	6.4+/-1.3

*LOS: length of stay, EVAR: Endovascular aortic repair, ICU: intensive care unit.

Length of stay (LOS) in hospital ranged from 1 to 25 days, with average 9+/-6 days. Symptomatic cases' length of stay was 9+/-7 days. Average length of stay for the incidental cases was 9 +/-6 days. EVAR: 8+/- 6 days. Two cases of TEVAR averaged stay was 15 (one case was 5 and second was 25 days). Open repair was 13+/- 5days. LOS of stay post operatively was as follows in days; symptomatic cases were 5.9+/-3.9 days, Incidental cases were 6.4+/-1.3, elective cases were 5.6+/-1.5, urgent cases were5.8 +/-0.8 and emergent cases were 7+/-1.5 days (Table 8). Table 9 shows a comparison between elective, urgent and emergent cases. Comparison items are LOS in hospital, LOS ICU admission, LOS post operatively, and number of packed RBC needed for blood transfusion.

Table 9: Shows a comparison between elective, urgent and emergent cases.

	Elective	Urgent	Emergent
LOS in hospital	9+/-6	9+/-7	10+/-7
LOS ICU admission	2+/-1	3+/-5	2+/-1
LOS Post Operatively	5.6+/-1.5	5.8 +/-0.8	7+/-1.5
Blood Transfusion	0.2+/-0.5	0.4+/-1.2	1+/-2

*LOS: length of stay, EVAR: Endovascular aortic repair, ICU: intensive care unit.

Discussion

The prevalence of AAA ranges between 4 and 8 % in screening studies, with predominance male gender [14]. The screened AAA size was generally smaller than 5.5cm. While the incidence of those more or equal to 5.5cm, was prevalent between 0.4 to 0.6% of the screened population [15]. Considering the ICD-10; I71.3 (Abdominal aortic aneurysm, ruptured); I71.4 (Abdominal aortic aneurysm, without mention of rupture); I71.8 (Aortic aneurysm of unspecified site, ruptured); I71.9 (Aortic aneurysm of unspecified site, without mention of rupture), the CDC website shows a crude

death rate of ruptured aortic aneurysm of 3.7, 11.0 and 7.1 for the female, male and both respectively in the year 2008 of the age group in years 65 to 74 per 100,000 population. This changed 10 years later (2017) to 2.0, 6.2 and 4.0 respectively. For the period from 2008 to 2017, the crude rate was 2.7, 5.6 and 5.0 respectively [16]. The United States Preventive Services Task Force recommends that men aged 65–75 years who have ever smoked (more or equal 100 cigarettes) should get an ultrasound screening for abdominal aortic aneurysms, even if they have no symptoms [17]. Recognized risk factors whose presence increase the need for screening even more include; male sex, obesity, older age, tobacco use, atherosclerosis, hypercholesterolemia, hypertension, cerebrovascular disease, coronary artery disease, coronary artery disease, history of other vascular aneurysms, first-degree relative with abdominal aortic aneurysm [18]. Surgical intervention by open or endovascular repair is the primary option and is typically reserved for aneurysms 5.5 cm in diameter or greater [18].

The number of patents seen in the military hospitals are around two million patients of different age and gender. Calculating the incidence of total patient with aortic aneurysm per the military hospital patients came out as 2 patients in 10,000 patients of the age group 65 -75, we believe that this represent a less number than expected. Prevalence for those more than or equal 5.5cm of the 65 to 74 years old, 8 male cases out of 42 cases whose aneurysmal size was 7.3 +/- 1.8 cm, percentage of patients was 1.9 per 10,000 male population. We assume if we screen for AAA in the same population the prevalence will be higher due to many the many availability of risk factors in these patient- age group. For example, the prevalence of smoking is 70.2 % in the Jordanian adult population, in adult women 10.9% in Jordan, and in adult Arab males is around 51.3% [19]. In a prospective, population-based study (Oxford shire, UK, 2002–2014), the incidence and outcome of acute AAA events were determined. Over the 12-year period, 103 incident of acute AAA events occurred in the study population of 92 728. Incidence/100 000/year was 55 in men ages 65 to 74 years but increased to 112 at 75 to 85 and 298 at ≥85, with 66.0% of all events occurring at age ≥75 years. Incidence at ages 65 to 74 was highest in male smokers (274), with 96.4% of events in men <75 years occurring in ever-smokers. Extrapolating rates to the UK population, using trial evidence of screening efficacy, the current UK screening program would prevent 5.6% of aneurysm-related deaths (315 200 scans/year: 1426/death prevented, 121/year-of-life saved). Screening only male smokers age 65 and then all men at age 75 would prevent 21.1% of deaths (247 900 scans/year; 297/death prevented, 34/year-of-life saved). By 2030, 91.0% of deaths will occur at age ≥75, 61.6% at ≥85, and 28.6% in women.

Screening programs in the United States and Europe have shown that 5% of men older than 65 have an occult AAA.(20) Interestingly, individuals detected with AAA on screening, rarely have an aortic diameter associated with a short-term risk of aneurysm-related death (e.g., from rupture). On the other hand, recent data suggest the coexistence of atheroembolic risk like coronary heart disease and cerebrovascular ischemic events in the patients with AAA who were detected by screening. These cardiovascular (CV) events confer the major increased CV morbidity and mortality burden [20,21]. Late survival of patients with AAA is significantly lower than that of age- and sex-matched non-AAA populations, even after successful AAA repair [22-24]. Patients with AAA, have significantly higher rates of CV deaths, hospitalizations for atherothrombotic events in particular revascularization procedures (coronary angioplasty, carotid surgery, peripheral bypass surgery and new or worsening PAD [25]. Polyvascular disease is twice as frequent in patients with AAA as in patients without. Patients with AAA are more likely to establish symptomatic atherothrombosis in more than one vascular bed, in addition to AAA [26]. Therefore, early diagnosing patients with AAA, would prevent not only major complications of AAA, but can present a key to treat and prevent atheroembolic vessels diseases.

In an Australian study, Hayter et al, showed that the total hospital cost of EVAR in the US was $16,631 vs. $14,063 for the open repair. The increase in total hospital costs was due to a significant difference in graft costs, which was not offset by reduced postoperative costs in EVAR compared to the open repair group. The average follow-up cost per year after EVAR was US $999 [27]. Ruptured AAA repairs are more expensive ($38K) than elective AAA repairs ($28K), though no difference in length of hospital stay. A screening program that reduces the incidence of surgery for ruptured AAA could decrease the average inpatient cost of AAA repairs [28].

Screening patients younger than 65 and older than 75 years, is controversial as AAA is a disease of the aging population, and elderly group should be selected to get a reasonable rate of recognition. Patients who are older than 75 years diagnosed with AAA may not be suitable for surgical correction. They may refuse to accept the risk of the surgery as in 11 patients in our study, or not fit for general anesthesia and this major surgery. Some differences in recommending AAA screening, the U.S. Preventive Services Task Force (USPSTF) recommended a screening ultrasound once in life for men ages 65 and 75 who ever smoked [29]. The Society for Vascular Surgery (SVS) recommended screening all men ages 65 years or above, men ages 55 years or above with a family history of AAA, and women ages 65 years or above with a family history of AAA or past or present smoking use. (29) Given that two thirds of acute AAA occurred at ≥75 years of age, screening older age groups should be considered. Screening nonsmokers at age 65 is likely to have very little impact on AAA event rates. In our study, the significant limitation in the clinical presentation is the lack of consistent documentation in the records of “ex-smoker” status. Hence, we are unable to establish a localized screening guideline regarding screening of non-smokers, even though the international guidelines do not recommend it.

It is worth mentioning, if we start screening for abdominal aortic aneurysm at age 65 with an abdominal ultrasound as per other international guidelines, we would be missing a 33% patients who have either abdominal or thorcoabdominal aortic aneurysm (14 cases out of 42 cases were at age range from 46 and 64 years) with size range from 3.5 cm to 9.5 cm with average 6.2cm of abdominal aortic aneurysm. This means that we would miss 33% of

these large aneurysms by that screening if we waited till the age of 65. (Data not mentioned in results section) This seems substantial and perhaps screening at an earlier age would be warranted in Jordan.

Conclusion

In conclusion, our results show the increased risk of aortic aneurysm in male patients above the age of 50 year, especially with a positive smoking history. One third of the patients required same day surgery to avoid immediate mortality. This outlines the late presentation of these cases due to the absence of screening. Hence, we recommend a one lifetime screening abdominal ultrasound for male smokers. Considering the high rate of smoking and other prevalent risk factors for developing aortic aneurysms, more studies are needed to evaluate the ideal age of starting this screening in Jordan. Implementing the electronic health system Hakeem has increased the accessibility and accuracy of research data and has lead to the increased awareness of this important issue.

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