ABDOMINAL AORTIC ANEURYSM (AAA) RUPTURE, PRESENTATION AND COMORBIDITY.
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ABSTRACT:

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TITLE: Abdominal Aortic Aneurysm (AAA) rupture, presentation and comorbidity.

AIM AND OBJECTIVE: The purpose of this study was to find correlation of the co-morbid conditions and Aortic diameter of the native Aorta on the outcomes of AAA rupture.

METHODS: Between the years 2008 01 01 – 2015 12, 31, 52 medical history books and CT scans of patients with the diagnosis of AAA rupture were analyzed.

RESULTS AND CONCLUSION: Our review has found that Males have a higher incidence of AAA rupture compared to women, no correlation was found between gender and mortality rate, the mean age of AAA rupture in our study was 76.36, the mean AAA cross section area was 45.17 cm2. 97.17 cm2 was the largest AAA measurement and 13.06 cm2 was the smallest, the strongest risk factor in our review was Hypertension, weak positive correlation (+0.134) with no statistical significance p=0. 424 between AAA cross section size and aortic size at the level of the diaphragm, weak negative correlation (-. 090) with no statistical significance p=0. 611 between AAA cross section size and aortic size at the level of superior mesenteric artery, the most common complaints during the presentation were abdominal pain We found a statistical significance between MAP and mortality (p=0. 007, 95%) We found no relation between HR and mortality (p=0. 302, 95%), no relation was found between the location of the rupture and mortality rate.

KEY WORDS: Aortic Aneurysm; Thoracic Aortic Aneurysm; Abdominal Aortic Aneurysm;

ETHICS:
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Bioetikos centro vadovas

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ABBREVIATIONS:
AA- Aortic Aneurysm
TAA-Thoracic Aortic Aneurysm
AAA-Abdominal Aortic Aneurysm
LA- Ligamentum Arteriosum
CT- Computer Tomography
TTE-Transthoracic Echocardiography
TEE-Transesophageal echocardiography
CXR- Chest X-Ray
MRI- Magnetic Resonance Imaging
US- Ultra-Sound
AUS- Abdominal Ultra Sound
INR- International Normalized Ratio
CRP- C-Reactive Protein
BMI -Body Mass Index
HR- Heart Rate
BPM- Beats per Minute
MAP- Mean Arterial Pressure
HT-Hypertension
DM-Diabetes Mellitus
SM-Smoking (SM),
IHD-Ischemic heart disease
CVA-Cerebrovascular
HCM-Hypertensive Cardiomyopathy
RP- retroperitoneal
INTRODUCTION:
Aortic disease is a general term which includes a wide spectrum of different conditions, one of them is Aortic aneurysm. By definition a true aneurysm occurs whenever there is at least 50 percent, full thickness dilation of the blood vessel compared with the diameter of and normal blood vessel. Aortic Aneurysm (AA) classified according to its location in the Aorta, it divides into Thoracic aortic aneurysm (TAA) and abdominal aortic aneurysm (AAA).

AA is usually insidious condition in its course and thus it is usually detected incidentally during imaging due other causes, in high risk patient with multiple comorbidities (6) or at time of rupture.

In this study, we will mainly focus on the Abdominal Aortic Aneurysm type and AAA rupture, we tried to analyses, risk factor, correlation between native aortic diameter and AAA cross section area, vital signs and laboratory data at time of presentation and main complaints.

**AIM:**
To find correlation between the co-morbid conditions, aortic diameter of the healthy aorta on the outcomes of AAA rupture and diameter of AAA.

**OBJECTIVES:**

1. To analyse the most affected population with AAA rupture.
2. To analyse AAA diameter during rupture in various patients.
3. To analyse the most common co-morbid condition in patients with diagnosed AAA rupture.
4. To analyse the most common presenting clinical symptoms and complaints in patients with diagnosed AAA rupture.
5. By using CT scans which were performed in patients with AAA rupture short time before or at time of rupture, we will analyse any relation between the native aortic diameter at the level of Thoracic aorta and Superior mesenteric and the AAA size, morbidity and mortality.

**LITERATURE REVIEW**

**Introduction-** Aortic disease is a general term which includes a wide spectrum of different conditions; Aortic Aneurysms (AA), Aortic dissection, traumatic aortic injury, intramural hematoma and penetrating
atherosclerotic ulcer. In this review, we will focus mainly on AA; definitions, types of AA, AA prevalence, risk factors, pathogenesis, diagnosis, AA rupture, management of AA and its outcomes.

**Definition** - By definition a true aneurysm occurs whenever there is at least 50 percent, full thickness dilation of the blood vessel compared with the diameter of a normal blood vessel from the same site. A pseudoaneurysm (also known as false aneurysm) occur when there is a looming containing blood outside the arterial wall confined by the surrounding tissue, which have communication with the arterial lumen, pseudoaneurysm may occur due variety of processes; aortic trauma, aortic dissection or other acute aortic syndromes. Pseudoaneurysm will not revised in this review.

**Classification** - AA aneurysm classified mainly according to its location in the Aorta, it divides into Thoracic aortic aneurysm (TAA) and abdominal aortic aneurysm (AAA). TAA further divided into its location within the thoracic aorta; ascending aorta, aortic arch and descending aorta. AAA develops most commonly in the infra-renal segment of the aorta and may extend into the iliac arteries.

**Epidemiology and risk factors** -

- **TAA** - in most cases is a silent disease and as such it is difficult to assess the correct incidence and prevalence of TAA in the general population, one study found that the annual incidence of TAA was estimated to be 10.4 cases per 100,000 population (1). in study performed on postmortem patients unrelated to TAA it was found a significant increase in the incidence of TAA during the past years (2) the rupture of TAA seems to be also on the rise during the past years (3). Well established risk factors for development of TAA are; hereditary connective tissue disease (i.e. Marfan and Ehlers-Danlos syndromes), chest trauma, Infectious agents (Septic emboli, bacteremia, Treponema pallidum), inflammatory disorders (i.e. Takayasu/giant cell arteritis, Lupus, Behcet's disease) and congenital conditions such as bicuspid aortic valve. Also well known risk factor is a genetic predisposition, one study found that about 20 percent of patients with TAA have a history of TAA in the family (4).

- **AAA** - According to the CDC, AAA ranked as the 15th leading cause of death in the United States in patient age 60-64 in year 2014 (5). Established risk factors that are associated with the development of AAA are; advanced age, male gender, coronary artery disease (CAD), atherosclerosis, high cholesterol levels, hypertension, and, in particular, smoking, an AAA is seven folds more likely to develop in a smoker patient than in nonsmoker, family members are also at significant risk, African Americans, and diabetic patients (6). One study performed on
randomized 41,000 males age 65-85 using ultrasound did found a crude estimation of 4-6% prevalence of AAA in such population (7).

An inverse association between diabetes mellitus (DM) and abdominal aortic aneurysm (AAA) risk have been reported. Apart from a lower AAA prevalence among patients with vs without DM, there are data showing that DM may exert a protective role on aneurysmal growth in patients with small AAAs, thus decreasing the risk of rupture. As atherosclerosis has almost the same risk factors as aneurysms, the decreased AAA prevalence in patients with DM may indicate that atherosclerosis is an associated feature and not a cause of the aneurysms. Alternatively, DM may be associated with factors that influence AAA formation. In this narrative review, we discuss the inverse association between DM and AAA. We also comment on underlying cellular and genetic pathophysiological mechanisms of DM, AAA and atherosclerosis. The effects of drugs, commonly prescribed in DM patients, on AAA development and growth are also considered. (27)

Pathogenesis and anatomy - in simple terms and due embryonic differences, the thoracic aorta can be divided into two main segments; the part which is proximal to the ligamentum arteriosum (LA) and the part which distal to LA. One study found that TAA proximal to the LA can be can be attributed mainly to non-atherosclerotic etiologies as discussed above, where TAA distal to LA can be strongly related to atherosclerotic etiology (8), this unique finding can be attributed to the embryonic origin of those two parts, the proximal part is derived from neural crest cells where the distal part is derived from the paraxial mesoderm, as such, different histological features can be observed in those segments. Most of the TAA is degenerative in their origin, which in term, may lead to defects in the structural integrity of the aortic wall, Cystic medial degeneration of the aortic wall occurs normally with aging but is accentuated by hypertension and other factors. AAA as mentioned before occur mainly in the infra-renal segment of the aorta, this segment is derived from the paraxial mesoderm, and as such this area is highly susceptible to development of aneurysm (9). As aorta move distally, the thickness of the aortic wall and the elastic tissue, decrease significantly, the amount of collagen is also significantly lower in the infra-renal segment of the aorta which may predispose this segment to expand and develop an aneurysm (10)

Normal aortic diameter – as measured by using CT scans of healthy subjects

Diameters of the thoracic aorta (11)

- Aortic Annulus Diameter : 2.30 cm
- Aortic valve sinus : 2.98 ± 0.46 cm
- Ascending aorta : 3.09 ± 0.41 cm
• Proximal to the brachiocephalic trunk: 2.94 ± 0.42 cm
• Proximal transverse arch: 2.77 ± 0.37 cm
• Distal transverse arch: 2.61 ± 0.41 cm
• Isthmus: 2.47 ± 0.40 cm
• Diaphragm: 2.43 ± 0.35 cm

Diameters of the abdominal aorta (12)
• Superior mesenteric artery: 2.13 ± 0.29 cm
• Midpoint: 1.93 ± 0.25 cm
• Bifurcation: 1.86 ± 0.22 cm
• Common iliac artery: 1.04 ± 0.19 cm

Note: The diameter of the aorta varies with age and between genders, another important factor of the aortic diameter is the BMI of the patient.

**Diagnosis**
• TAA is usually insidious in its course and thus it is detected incidentally during imaging due other causes in most of the cases (for example; CXR, heart murmurs using Echo, During CT scans (13)). In cases where TAA does produce symptoms (Aortic dissection or even rupture, pain due compression or chronic pain) patient should be evaluated urgently. The most significant features of TAA on CXR are widening of the mediastinum, enlarged aortic bulb, displacement of the trachea and calcification. Certain conditions such as Marfan, Loeys-Dietz syndrome, Turner syndrome, Bicuspid aortic valve and patients with giant cell arteritis should undergo complete Aortic imaging at the time of diagnosis of their condition. TAA is best diagnosed initially using transthoracic echocardiography (TTE) further evaluation using CT or MR is warranted in patient with positive results on TTE. Transesophageal echocardiography (TEE) can also be utilized, but it mainly used in acute situations as AD. The CT scan can be performed as the initial imaging modality in acute symptomatic conditions, MR mainly used in patients requiring repeated imaging studies in patients with high risk of TAA as mentioned above, as MR have no risk of ionizing radiation.
• AAA is also a silent condition in most of the cases, sometimes patients do complain about back pain, flank pain, abdominal pain or pulsatile abdominal sensation. Asymptomatic patients with known risk factors as mentioned above should undergo routine Abdominal Ultra Sound (AUS)
imaging, The U.S. Preventive Services Task Force recommends one-time screening for abdominal aortic aneurysm (AAA) for men aged 65-75 who have smoked at least 100 cigarettes in their lifetime. An Evidence-Based Analysis did find that AUS lower mortality and is cost effective in detection of AAA (14). If the AUS is questionable due to obscuring factors (for example, dilated bowels), another imaging study should be performed, such as CT scan. AAA that is suspected based upon clinical symptoms or signs, or incidentally discovered during other imaging (e.g., spine MRI) should be confirmed with definitive vascular imaging modalities.

**Aortic aneurysm rupture**

The most devastating complication of aortic aneurysm is rupture. In this review we will focus mainly on AAA rupture.

It is logical that small size aneurysm (less than 4cm in diameter) has a lower incidence of rupture than larger aneurysm (more than 6cm in diameter), but it is not always true as many cases did find that some of the smaller diameter aneurysms rupture at a higher rate as well, and some of the larger diameter aneurysms do not rupture at all. In addition to size, the risk of AAA rupture depends upon the rate at which the aneurysm is expanding, it is estimated that average expansion is between 0.3 – 0.4 cm annually, aneurysm that expand at a higher rate per year have a higher incidence of rupture (15)

The risk of AAA rupture depend on aneurysmal diameter:

- AAA < 4.0 cm in diameter- the annual risk of rupture is < 0.5 percent
- AAA of 4.0 to 4.9 cm in diameter- the annual risk of rupture is 0.5 to 5 percent
- AAA of 5.0 to 5.9 cm in diameter- the annual risk of rupture is 3 to 15 percent
- AAA of 6.0 to 6.9 cm in diameter- the annual risk of rupture is 10 to 20 percent
- AAA of 7.0 to 7.9 cm in diameter- the annual risk of rupture is 20 to 40 percent
- AAA of greater than or equal to 8.0 cm in diameter- the annual risk of rupture is 30 to 50 percent

Aneurysmal expansion is much higher in smokers than in non-smoker patients, but less rapid in patients with preexisting peripheral artery disease and diabetes mellitus type II compares to non-diseased patients. One retrospective study found that the risk of AAA rupture is higher in female subjects compare to male subjects, the difference is even higher at larger size aneurysms – 18% compares to 12% (16)

**Complaints during presentation with AAA rupture**
The signs and symptoms that accompany ruptured AAA are usually dramatic. Sudden abdominal pain that radiates to the back seems to be present in nearly 70% according to the literature, and is associated to a throbbing abdominal mass during physical examination in 80% of cases. In one our study, the presence of abdominal pain and abdominal mass was 100 and 54%, respectively (26)

Management of Aortic aneurysm-
Management of AA depends on whether the AA is symptomatic, ruptured or asymptomatic.

- Ruptured or complicated AA (AD) are treated on the basis of hemodynamic status; unstable patients with a known AA diagnosis or classic signs of AA rupture should be taken emergently to the operating room (OR) for urgent resuscitation and bleeding control. Hemodynamically stable patients should be confirmed with imaging prior enter to OR, most time with CT scan.

- Symptomatic AA- patients in whom the clinical symptoms can be related to the aneurysms should undergo surgical repair. If the patient is a candidate for repair, a determination needs to be made about whether an open surgical or endovascular approach is more appropriate, especially in case of AAA, based upon an anatomic assessment of aorto-iliac anatomy.

- Asymptomatic AA- management of asymptomatic AA depend on the degree of the dilation of the aorta at the aneurysmal segment. Thoracic aorta is wider than the abdominal aorta, and as such different criteria exist. For degenerative TAA, a diameter >6 cm of the ascending aorta and >7 cm of the descending aorta is an indication for elective surgical repair. Based on a few studies, whenever aortic diameter expends beyond 6 and 7 cm of the ascending and descending respectively, the risk of complication increase drastically (17). Genetic causes of TAA are warranted in lower diameters; 5 and 6 cm of the ascending and descending aorta respectively. (17). AAA should be electively repaired whenever the diameter is >5.5 cm, this number is based on randomized trials which demonstrated that the risk of complication increase drastically whenever the abdominal aorta diameter exceed 5.5 cm (18)

Surgical repair-

Open surgical repair- method which involve the replacement of the dilated aortic part with a prosthetic graft through an open incision. Open repair of thoracic aortic aneurysm of the ascending aortic part or aortic arch is done via a median sternotomy. Open repair of descending thoracic aortic aneurysm is done via a thoracotomy. The abdominal aorta can be exposed through a midline trans-peritoneal or retroperitoneal approach Morbidity and mortality following TA repair are high
and the numbers fluctuating depending on the hospital, surgical approach age and gender of the patient (19)

In a retrospective studies a 30 day mortality after elective open AAA repair was established between 1 and 5 percent depend on gender (20).

Complications related to the AAA repair procedure includes lower extremity ischemia, bowel ischemia, pelvic ischemia, renal dysfunction, and late complications include incisional hernia, anastomotic aneurysm and graft infection/aortoenteric fistula. In one retrospective study the late complications of the open AAA procedure include lower extremity ischemia, bowel ischemia, pelvic ischemia, renal dysfunction, and late complications include incisional hernia, anastomotic aneurysm and graft infection/aortoenteric fistula. In one retrospective study the late complications of open AAA surgical repair were identified in 9.5 percent (21)

Endovascular aneurysm repair (EVAR) is an important advance in the repair of AAA, it is done by inserting a folded graft through the lumen of an access vessel, usually the common femoral artery. Upon reaching the aneurysmal part, the graft expands, contacting the aortic wall proximally and iliac vessels distally to exclude the aortic aneurysm sac from aortic blood flow and pressure. Compared with open AAA repair, EVAR is associated with a significant reduction in perioperative mortality, primarily because EVAR does not require operative exposure of the aorta or aortic clamping. The rise in EVAR, have decreased dramatically the incidence of ruptured AAA and the associated morbidity and mortality, probably the reason also is due to the ability to offer EVAR to patients who would not be candidates for open surgical repair (22) A review of 1532 patients who were considered suitable candidates for both endovascular approach or open repair of AAA. The 30-day mortality rate was significantly lower with endovascular repair - 1.6 percent with endovascular approach versus 4.8 percent with the open repair). (23)

**Follow up**

Following TAA repair, if no postoperative complication had occurred, the patient should obtain a CT scan or MRI at discharge, then at 1, 3, 6 and after 12 months post-operation, if those images were normal the patient should be routinely imaged annually for any complication (24)
Patient which underwent open AAA repair should be closely monitored for any complications due to anastomosis abnormalities which may lead to ischemic changes, the patient should also be assessed for incisional hernia and distal pulses. Any development of claudication or other symptoms may indicate anastomosis failure. If no early complication occurs the patient should be routinely imaged in the following 5 years post-operation. Following EVAR the patient may walk after 24 hours, and the patient may be discharged 1 day post operation.

**Mortality**

In spite of improvements in prehospital care, cardiovascular anesthesia, and critical care, postoperative mortality following repair of ruptured AAA remains about 40 to 50 percent.

The mortality associated with ruptured AAA may be as high as 90 percent when patients who die at home or upon arrival to the hospital are taken into account.

Factors that worsen survival during open surgical repair of ruptured AAA include supraceliac aortic clamping >30 minutes, volume of blood administered >3500 mL, intraoperative urine output <200 mL, thrombosis of other vascular beds, and intraoperative hypotension. Endovascular aneurysm repair (EVAR) has the potential to minimize these variable complications and may improve survival following ruptured AAA, but this has not been definitively established. In one review, open surgery was an independent risk for perioperative (30 day) death compared with endovascular repair for both hemodynamically unstable patients (odds ratio [OR] 1.74, 95% CI, 1.16 to 2.62) and hemodynamically stable patients (OR 1.64, 95% CI, 1.10-2.43) (25)

**PATIENTS AND METHODS**

*Object:* Patients in Hospital of Lithuanian University of Health Sciences Kaunas Clinics who have been diagnosed with AAA rupture.
**Patient selection and amount:** Patients were identified by using the following criteria:

- Hospitalized in Hospital of Lithuanian University of Health Sciences Kaunas Clinics
- Diagnosed with AAA rupture
- Patients with AAA rupture that underwent a CT scan.
- Time period 2008 01 01 – 2015 12 31
- Registered in the database of Kaunas Clinics data base software.

Accordingly, data from medical history books of these patients and CT scans; the following data was evaluated:

- Gender and age
- Comorbid conditions
- Mortality
- Dilated aortic segment
- Location of the AAA rupture.
- Symptoms and vital signs during presentation
- Laboratory results such as CRP and INR.
- Native aortic diameter on CT scan.
- AAA diameter
- Complication

In total, 52 medical history books and CT scans of patients with the diagnosis of AAA rupture were analyzed.

**Methodology:** the collected data from medical books were aggregated in standard Excel summary table and evaluated statistically using SPSS software that helped to find correlations between different parameters.

Microsoft Excel 2013 and IBM SPSS 22.0 software were used for analysis. Various parameters were calculated in order to analyze the data and find out distribution, mean values, standard deviation (X±SD), correlation and statistical significance were calculated of:

- Population (gender, age)
- Involved aortic segment
• Vital signs
• Laboratory investigation
• Imaging investigation
• Additional diagnostic findings

Correlations between different parameters will be investigated:
• AAA size and Mortality
• AAA size and native aortic diameter
• AAA size and gender
• Mortality and comorbid conditions
• Mortality and vital signs/laboratory findings
• Mortality and site of AAA rupture

**RESULTS:**

• Distribution by AAA size-

Note- for the purpose of the analysis, we calculate the AAA area instead of diameter by using a formula.
We measured 52 AAA sizes, the mean AAA area was 45.17 cm². 97.17 cm² were the largest AAA measurement and 13.06 cm² was the smallest AAA measurement.

<table>
<thead>
<tr>
<th>AAA size</th>
</tr>
</thead>
<tbody>
<tr>
<td>N Valid</td>
</tr>
<tr>
<td>Missing</td>
</tr>
<tr>
<td>Mean</td>
</tr>
<tr>
<td>Median</td>
</tr>
<tr>
<td>Mode</td>
</tr>
<tr>
<td>Range</td>
</tr>
<tr>
<td>Minimum</td>
</tr>
<tr>
<td>Maximum</td>
</tr>
</tbody>
</table>

Table n.1

• Distribution by gender
41 out of 52 subjects were males, 11 out of 52 subjects were females, which accounts 78.8% males and 21.2% females. With male to female ratio 3.72/1.

- Distribution of AAA size in males and females.

The male group had a mean aortic aneurysmal area during rupture of 47.3 cm$^2$, while female group had a mean aortic aneurysmal area of 37.13 cm$^2$. 
t= 1.417, p=0.153, 95%

By using t-test we found that there is no statistical significance when we compared the AAA means of the male and female subjects, meaning no existing correlation between gender and AAA size in our study.

- Correlation between AAA size and Native Thoracic Aortic diameter

Table n.5

We measured the Native aortic diameter of all subjects at the level of Diaphragm, using Pearson correlation, we found a weak positive correlation (+0.134) with no statistical significance p=0.424.
Correlation between AAA size and Native abdominal Aortic diameter

Correlations

<table>
<thead>
<tr>
<th></th>
<th>AAA</th>
<th>SMA</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAA</td>
<td>Pearson Correlation</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>52</td>
</tr>
<tr>
<td>SMA</td>
<td>Pearson Correlation</td>
<td>-0.090</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>34</td>
</tr>
</tbody>
</table>

Table n.6
We measured the Native aortic size of all subjects at the level of Diaphragm, using Pearson correlation, we found a weak negative correlation (-.090) with no statistical significance p=0.611.

- Correlation between AAA size and Mortality.

**Group Statistics**

<table>
<thead>
<tr>
<th>Mortality</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAA passed</td>
<td>31</td>
<td>4911.8387</td>
<td>1993.96979</td>
<td>358.12755</td>
</tr>
<tr>
<td>live</td>
<td>21</td>
<td>3934.1429</td>
<td>2221.14969</td>
<td>484.69460</td>
</tr>
</tbody>
</table>

Table n.7

In our study 31 subjects passed and 21 subjects survived, a subject which passed following AAA rupture had larger aneurysmal size mean compare to the subject which survived following AAA rupture.
Using t-test, there was no statistical significance between the two groups with a p=0.104, 95%

- Correlation between mortality and blood pressure.

**Group Statistics**

<table>
<thead>
<tr>
<th>Mortality</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAP passed</td>
<td>29</td>
<td>67.93</td>
<td>21.078</td>
<td>3.914</td>
</tr>
<tr>
<td>live</td>
<td>17</td>
<td>84.88</td>
<td>17.175</td>
<td>4.166</td>
</tr>
</tbody>
</table>

Out of 52 subjects 46 subject had data regarding first BP measurement at arrival to the hospital, out of 46, 29 subject passed and 17 subjects survived. Subjects which survived had a higher MAP mean (84.88) compare to subject which passed (67.93)

Using t-test, there was a statistical significance between MAP and mortality p<0.05, 95% meaning subject with higher MAP had better survival rate.
- Correlation between mortality and heart rate.

### Group Statistics

<table>
<thead>
<tr>
<th>Mortality</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR passed</td>
<td>29</td>
<td>83.7931</td>
<td>22.63748</td>
<td>4.20368</td>
</tr>
<tr>
<td>live</td>
<td>17</td>
<td>77.0588</td>
<td>18.11239</td>
<td>4.39290</td>
</tr>
</tbody>
</table>

Table n.11

Out of 52 subjects 46 subject had data regarding first HR measurement at arrival to the hospital, out of 46, 29 subject passed and 17 subjects survived. Subjects which survived had a higher HR mean (83.79 BPM) compare to subject which passed (77.05 BPM)

Using t-test, there was no statistical significance between HR and mortality \( p=0.302, 95\% \)

- Age distribution and correlation to mortality:

### Age and Mortality

<table>
<thead>
<tr>
<th>Mortality</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>AOE passed</td>
<td>31</td>
<td>78.9365</td>
<td>5.58764</td>
<td>1.18315</td>
</tr>
<tr>
<td>live</td>
<td>21</td>
<td>72.5714</td>
<td>7.70136</td>
<td>1.66123</td>
</tr>
</tbody>
</table>

Table n.12

### Age and Mortality

<table>
<thead>
<tr>
<th>AOE</th>
<th>Levene's Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
<th>95% Confidence Interval of the Difference</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>Sig</td>
<td>df</td>
</tr>
<tr>
<td>AOE</td>
<td>Equal variances assumed: 0.69</td>
<td>0.747</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>Equal variances not assumed: 3.986</td>
<td>0.043</td>
<td>48.92</td>
</tr>
</tbody>
</table>

Table n.13
In our study the mean age was 76.36 years old with maximal age of 90 years old and minimal of 56 years old. The subjects that passed following AAA rupture had mean age of 78.9 while those subjects that survived following AAA rupture had a mean age of 72.5. Using t-test we did find a statistical significance between age and mortality rate with p<0.05, 95 % meaning that in our review age was a strong predictor of mortality.

- Risk factors:

We analyzed 6 main risk-factors as can be seen in chart n.7: hypertension (HT), diabetes mellitus (DM), smoking (SM), Ischemic heart disease (IHD), cerebrovascular (CVA) and hypertensive cardiomyopathy (HCM).
In our study out of 52 subjects, 38 had data regarding hypertension history, out of 38, 38 had hypertension as a previous comorbidity representing 100 present.

28 had data regarding diabetes mellitus history, out of 28, only 5 had diabetes mellitus as a previous comorbidity representing only 18.5 present.

26 had data regarding smoking history, out of 26, only 11 had smoking as a previous risk factor representing only 42.3 present.

31 had data regarding Ischemic heart disease history, out of 31, 19 had Ischemic heart disease as a previous comorbidity representing only 61.2 present.

31 had data regarding cerebrovascular accident history, out of 31, only 7 had cerebrovascular accident as a previous comorbidity representing only 22.5 present.

31 had data regarding hypertensive cardiomyopathy history, out of 31, only 11 had hypertensive cardiomyopathy as a previous comorbidity representing only 33.3 present.

Main complaint during first presentation:

From chart n.8 we can conclude that the main complaint during the first encounter with the patient was abdominal pain (Abd). Second most common complaint was weakness (We), third
most common complaint was back pain (Ba) and forth most common complaint was dyspnea (Dy).

- Relation between INR and mortality:

**INR * Mortality Crosstabulation**

<table>
<thead>
<tr>
<th></th>
<th>Mortality</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>passed</td>
<td>live</td>
</tr>
<tr>
<td>INR HIGH</td>
<td>15</td>
<td>9</td>
</tr>
<tr>
<td>NORMAL</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
<td>15</td>
</tr>
</tbody>
</table>

Table n.14

During first presentation 35 out of 52 subjects had data regarding international normalized ratio (INR) measurement, out of 35 24 subjects had higher than normal INR results.

**Chi-Square Tests**

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
<th>df</th>
<th>Asymp. Sig. (2-sided)</th>
<th>Exact Sig. (2-sided)</th>
<th>Exact Sig. (1-sided)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Chi-Square</td>
<td>.895^a</td>
<td>1</td>
<td>.344</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Continuity Correction^b</td>
<td>.334</td>
<td>1</td>
<td>.563</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Likelihood Ratio</td>
<td>.890</td>
<td>1</td>
<td>.345</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fisher's Exact Test</td>
<td>.890</td>
<td>1</td>
<td>.467</td>
<td></td>
<td>.281</td>
</tr>
<tr>
<td>Linear-by-Linear Association</td>
<td>.869</td>
<td>1</td>
<td>.351</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N of Valid Cases</td>
<td>35</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table n.15

Using Chi-Square test we did not found any statistical significance between High/Low INR measurement and mortality with a p=0.344, 95%
• Relation between CRP and mortality:

**CRP * Mortality Crosstabulation**

<table>
<thead>
<tr>
<th></th>
<th>Mortality</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>passed</td>
<td>live</td>
</tr>
<tr>
<td>CRP HIGH</td>
<td>13</td>
<td>9</td>
</tr>
<tr>
<td>CRP NORMAL</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
<td>13</td>
</tr>
</tbody>
</table>

Table n.16

During first presentation 33 out of 52 subjects had data regarding C-reactive protein (CRP) measurement, out of 33, 22 subjects had higher than normal CRP results.

**Chi-Square Tests**

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
<th>df</th>
<th>Asymp. Sig. (2-sided)</th>
<th>Exact Sig. (2-sided)</th>
<th>Exact Sig. (1-sided)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Chi-Square</td>
<td>.063a</td>
<td>1</td>
<td>.801</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Continuity Correction</td>
<td>.000</td>
<td>1</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Likelihood Ratio</td>
<td>.064</td>
<td>1</td>
<td>.801</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fisher's Exact Test</td>
<td></td>
<td></td>
<td>1.000</td>
<td></td>
<td>.554</td>
</tr>
<tr>
<td>Linear-by-Linear Association</td>
<td>.062</td>
<td>1</td>
<td>.804</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N of Valid Cases</td>
<td>33</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 4.33.

Table n.17

Using Chi-Square test we did not found any statistical significance between High/Low CRP measurement and mortality with a p=0.801, 95%
• Relation between Gender and Mortality Rate:

<table>
<thead>
<tr>
<th>GENDER</th>
<th>Mortality</th>
<th></th>
<th></th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>passed</td>
<td>live</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MALE</td>
<td>23</td>
<td>18</td>
<td></td>
<td>41</td>
</tr>
<tr>
<td>FEMALE</td>
<td>8</td>
<td>3</td>
<td></td>
<td>11</td>
</tr>
<tr>
<td>Total</td>
<td>31</td>
<td>21</td>
<td></td>
<td>52</td>
</tr>
</tbody>
</table>

Using Chi Square test there was no relation (p=0.318, 95%) between gender and mortality rate.

• Location of rupture:

In our study 41 subjects had data regarding the site of AAA rupture, 34 subjects had retroperitoneal rupture (RP) and 7 subjects had intraperitoneal rupture (IP) which represent 82.9% and 17.07% respectively.
Using Chi-Square test we did not found any statistical significance between Site of rupture and mortality Rate with a p=0.301, 95%
CONCLUSION:

- Our review has found that Males have a higher incidence of AAA rupture compared to women subjects, no correlation was found between gender and mortality rate. The mean age of AAA rupture in our study was 76.36, a statistical significance was found between age and mortality rate with p<0.05, 95%.

- The mean AAA cross section area was 45.17 cm². 97.17 cm² was the largest AAA measurement and 13.06 cm² was the smallest AAA measurement, in our review no statistical significance was found between AAA cross section size and mortality rate (p=0.104, 95%).

- The strongest risk factor in our review was Hypertension, with 100% prevalence among our subject group. Second strongest was peripheral artery disease represented by Ischemic heart disease and cerebrovascular events with a prevalence of 61.2% and 25.5% respectively. The third strongest was smoking with 42.3% prevalence, forth was Hypertensive cardiomyopathy with 33.3% prevalence (which is in part of hypertension consequences) and fifth was Diabetes with 18.5% prevalence.

- Weak positive correlation (+0.134) with no statistical significance p=0.424 was found when we compared between AAA cross section size and aortic size at the level of the diaphragm, a weak negative correlation (-0.090) with no statistical significance p=0.611 was found when we compared between AAA cross section size and aortic size at the level of superior mesenteric artery. Meaning that the aortic diameter during rupture not depend on the diameter of the healthy aortic segments.

- The most common complaints during the presentation were abdominal pain (74.5%), weakness (25%) back pain (19.23%) and dyspnea (13.46%).

- We found a statistical significance between MAP and mortality (p=0.007, 95%) meaning subject with higher MAP had a better survival chance.

- We found no statistical significance between HR and mortality (p=0.302, 95%),

- No correlation between INR, CRP levels and mortality were found in our study. No data was found from different reviews about this finding.

- Regarding the location of the ruptured aneurysm, 82.9% cases were in the retroperitoneum, with 17.07% occurring in the free peritoneum, no correlation was found between the location of the rupture and mortality rate.
DISCUSSION:

- Regarding gender, our review had similar results to most studies that evidence gender incidence, which varies with the ratio of 4:1 for men (6,26), the male group had a mean aortic aneurysms cross section area larger than women with 47.3 cm², while the female group had a mean aortic aneurysms cross section area of 37.13 cm². As in the literature, the gender factor alone does not seem to have a strong correlation with the prognosis following AAA rupture.

- Regarding age, there are others who believe age has no association with morbidity. In our study, we observed that the age group is a factor that presents a strong connection with morbidity, being directly proportional variables. In the literature review age has been cited as an important variable for the prognosis, even though it is mainly considered a contributing factor and not an independent one.

- Regarding aortic aneurysm diameter and its correlation to mortality, the same results were found in the literature review where no evidence that the aneurysm size has any correlation with a better or worse prognosis after rupture (26)

- Regarding comorbidity and AAA rupture, very similar results were found in the literature review (6), smoking was not higher as in other reviews, this finding is most probably because not all patients presented with AAA rupture in our review responded accurately about their history of smoking or this data was missing. In our review Diabetes mellitus had the weakest comorbidity association with AAA rupture, according to the latest literature an inverse association between diabetes mellitus and abdominal aortic aneurysm risk have been reported. Apart from a lower AAA prevalence among patients with versus without DM, there are data showing that DM may exert a protective role on aneurysmal growth in patients with small AAAs, thus decreasing the risk of rupture (27).

- Regarding the correlation between AAA diameter and Native aortic diameter, no data was found from different reviews about this association. This conclusion was made for small subject group-52 subjects, in order to make a solid conclusion, a larger subject group is mandatory.

- Regarding the presenting signs and symptoms, the same results were found in the different literature, where the signs and symptoms that accompany ruptured AAA are usually dramatic with sudden abdominal pain that radiates to the back seems to be present in nearly 70% according to the literature (26)

- Regarding MAP and its association with mortality, same result was found in the literature review, “low-pressure levels during hospital admission are strong predictors of morbidity” with the higher
relation between low-pressure levels during hospital admission and mortality which are strong predictors of morbidity (26).

- Regarding CRP and INR measurement during admission, our review did not find any correlation between INR/CRP to mortality rate, no data was found from different reviews about this finding.
- Regarding the site of rupture of AAA, our review has found higher incidence of rupture in the retroperitoneal, in general, a higher incidence of rupture in the free peritoneum is described with a higher mortality rate in the literature (26). Our review did not find such association.
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