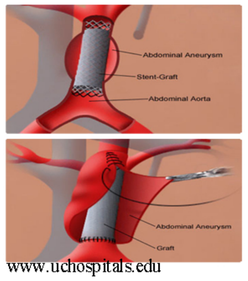

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Analyzing Endoleaks and Predicting Outcomes after Aneurysm Repair

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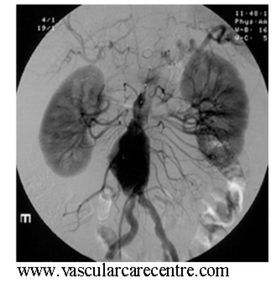
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Abstract

Abdominal aortic aneurysms (AAAs) occur when a large blood vessel, the aorta, which supplies blood to the abdomen, pelvis, and legs, becomes exceedingly large. Treatments for AAAs have become increasingly effective, and with proper detection, grafts may be used to surgically fix the aneurysm. The goal of this research is to analyze and integrate the results of follow-up studies on patients who have had AAA repairs aneurysms, utilizing text mining and statistical software. Radiological reports were analyzed initially using Piranha. Documents clustered based on common words and phrases, and those relating to the occurrence of an endoleak were identified. These trends in the text were tested for statistical significance using JMP. This study will contribute to the development of multi-modal mathematical models to predict the outcome of an abdominal aortic aneurysm repair.

Introduction

- AAAs at risk for rupture require surgical repair
- Follow-up for complications continues 2-5 years
- Possible complications include endoleaks, graft kinking
- Predictors for graft complications and intervention needed

Endoleaks after Repair

Type I endoleak	• Ineffective seal at graft site • Requires immediate intervention
Type II endoleak	• Collateral blood flow • Intervention with increase in aneurysm size
Type III endoleak	• Graft defect at junctions • Requires immediate repair
Type IV endoleak	• Blood flow through graft material • Typically resolves without intervention

Research Goals

- Study the comorbidities and contributing factors relating to endoleak after AAA repair
- Utilize ORNL-developed Piranha for text analysis
- Supplement research with genetic algorithm analysis
- Support findings through statistical analyses
- Contribute to the classification of endoleaks and prediction of the need of surgical intervention

Piranha Visual Analysis

- Divided patients by the occurrence of endoleak, or absence of endoleak
- Detected trends in key words such as sigmoid diverticulosis, ascites, cholelithiasis, and renal lesions

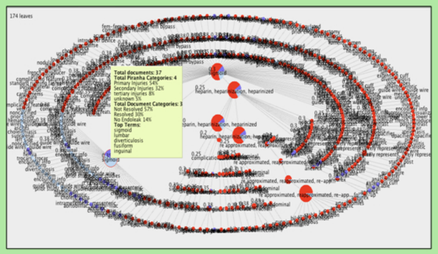


Figure 1. Piranha cluster of radiological reports. Sigmoid diverticulosis is noted as a top word in the cluster of endoleak documents (blue).

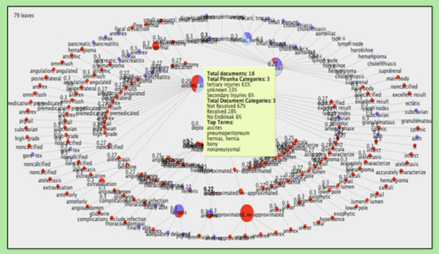


Figure 2. Piranha cluster of radiological reports. Ascites is noted as a top word in the cluster of endoleak documents (blue).

Application of Genetic Algorithms*

- Utilized to contribute to the visualized word commonalities among patient reports
- Found mutually exclusive words and phrases within dataset
- Applied findings to Piranha

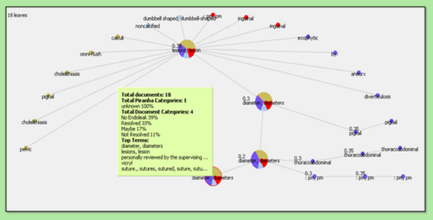


Figure 3. Piranha cluster of radiological reports, searched by cholelithiasis (gallstones). Returned patients primarily with endoleaks.

Endoleak	No Endoleak
• periumbilical hernia • pars defects • liver lesions • multiple gallstones	• dacron • fibroid • hepatic cysts • bilateral common iliac

Figure 4. Sample list of words and phrases found using genetic algorithms.

*Genetic algorithms developed by Robert Patton, ORNL

Re-categorizatinon of Patient Data

- Refined categories by problematic endoleaks, or those requiring further intervention
- Observed few commonalities with non-interventional endoleaks

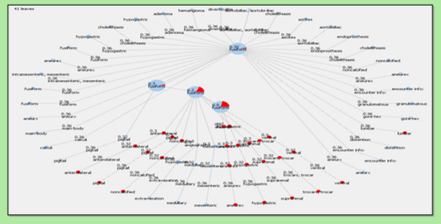


Figure 5. Cluster in Piranha of patients with endoleaks, divided by problematic (red) and non-problematic (blue)

Statistical Analyses

- Applied contingency analysis, Kaplan-Meier survival
- Utilized key words and phrases indicated in visual analysis
- Found significant correlations: Sigmoid diverticulosis (p=0.0459), gallstones (p=0.0282), multi-categorical (p=0042)

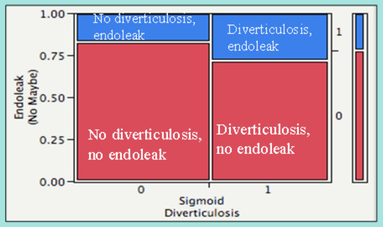


Figure 6. Contingency table of sigmoid diverticulosis by endoleak, where 1 is the occurrence of the condition, 0 is the absence.

Figure 7. Contingency table of gallstones by endoleak, where 1 is the occurrence of the condition, 0 is the absence.

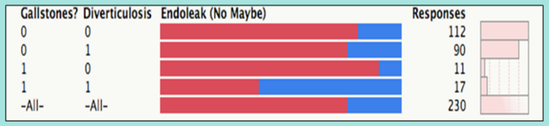
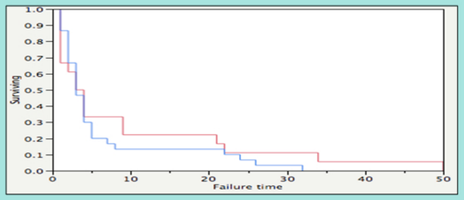


Figure 8. Multi-categorical analysis of both conditions by endoleak, where 1 is the occurrence of the condition, 0 is the absence

- Plotted time points of endoleak occurrence
- Observed earlier endoleak occurrence in patients with sigmoid diverticulosis

Figure 9. Plot of percent patient "survival," or absence of endoleak, over time. Cohort divided by the presence of sigmoid diverticulosis, where blue is the occurrence of the condition, and red is the absence



Conclusions

- Provided a clearer interpretation for patients with graft repair
- Defined possible comorbidities relating to endoleaks
- Contributed text analysis to a multi-modal study on radiological reports and CT scans

Future Research

- Find definitive predictors for endoleak after graft repair
- Integrate text and images for a multi-modal study
- Develop predictive models for endoleaks after surgery

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