

**DESIGN AND ANALYSIS STENTED ANEURYSMS FOR  
HUMAN BODY**

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HUMAN BODY**

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**This report is submitted as partial fulfillment  
Of requirements for the award Bachelor of Mechanical  
Engineering (Thermal-Fluids)**

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## SUPERVISOR DECLARATION

“I hereby declare that I have read this thesis and in my opinion this report is sufficient in terms of scope and quality for the award of the degree of  
Bachelor of Mechanical Engineering (Thermal-Fluids)”

Signature : .....

Supervisor : Mr.MohdRody Bin MohamadZin

Date : 23 MAY 2012

## DECLARATION

“I hereby declare that the work in this report is my own except for summaries and quotations which have been duly acknowledged.”

Signature : .....

Author : Song Jean Yau

Date : 23 MAY 2012

To my beloved parents,  
My siblings  
And also  
To all my trusted friends

## ACKNOWLEDGEMENT

Universiti Teknikal Malaysia Melaka graduated students should not forget to make our next generation more excellent, shining, progressive and struggle in education for responsible in future. Other than that, the knowledge we gained from UTeM, try our best to applied in industry to enhance reputation of UTeM.

First of all, I am very grateful and thanks my parents, lecturer and classmates, fellow who give me a lot of support in spirit, and confident to reach this stage to make this final project to be complete, to contribute some knowledge to mechanic-biologi field, where UTeM given me this precious chance to make this kind of analysis and research.

There are not easy to complete this report without some advice and knowledge from my supervisor. I believe that this report might not be so perfect. My supervisor Mr. Mohd. Rody Bin Mohamad Zin, provided much of precious experience in guide me to complete the report even the overall processing encounter some problem, and help me to conquer the problem. I am always appreciated and thankful to him.

Hopefully this report will be useful in mechanic-biologi field to assist more patient recover from their blood vessel aneurysms problem. Except of all above that, I wish UTeM can create more intelligent and potential students whom able to make UTeM reputation grow up at world ranking.

## ABSTRACT

Computational fluid dynamics (CFD) simulations are used to analyze stent after implant into human body, and analysis wall shear stress distribution and flow pattern at aneurysm area. There are 3 types of stent dimension cases established to investigate the blood flow conditions, and compare what is the difference of hemodynamic of these cases. Common iliac aneurysm has been selected as part of human body to do analyze. The diameter is based on previous biological scientist studies. Mean diameter of common iliac arteries is 2.4-3.8 cm. Based on this information there are three cases which are 2.2, 2.9, 3.6 cm developed. All the cases are analyzed under different stages of blood pressure. There are desirable, prehypertension and hypertension stage 1. Analysis and design a suitable stent for aneurysms which investigate the blood flow phenomena by define the blood flow type criteria before simulation into CFD, such as velocity profile, pressure, incompressible flow, pulsatile condition, isothermal condition, laminar flow and non slip condition. When there are inside pressure over the blood vessel, aneurysms exist in the blood vessel wall, and the vessel may rupture when it reach the critical stage.

The velocity results at center of diameter have a highest rising 33.97% at outlet throat for stent with diameter 2.2 cm thickness 0.85 mm to contrast to case 0.75 and 0.65 mm thickness stent. High Porosity to caused wall shear stress transform from inner to outer wall will be more effectively. The most significant reaction in wall shear stress is at inlet throat 00 mm to 20 mm. Case diameter 2.2 cm stent achieved highest ascended 2.44 % of total pressure. The static pressure drop on boundary layer at 1mm along of stent were not exceed than 1.5 % among three cases.

## ABSTRAK

Dinamik bendalir komputer (CFD) simulasi digunakan untuk menganalisis “stent” selepas dimasukkan ke dalam tubuh manusia, selain daripada itu, ia perlu analisis saluran darah, jenis corak aliran darah di kawasan dimana tumbuh aneurisme. Ia menubuhkan tiga jenis dimensi “stent” yang berlainan untuk menyiasat keadaan aliran darah, dan bandingkan perbezaan kes yang berkenaan. Saluran darah iliac telah dipilih sebagai sebahagian daripada badan manusia untuk melakukan analisis. Berdasarkan ahli sains biologi kajian tentang purata diameter saluran darah iliac adalah 2.4-3.8 sm. Oleh itu, berdasarkan maklumat ini, pengarang membangunkan tiga kes ini dengan merekabentuk “stent” yang diameter 2.2, 2.9, 3.6sm. Bagi ketiga-tiga kes ini, adalah analisis dibawah peringkat tekanan darah yang berlainan iaitu “desirable”, “prehypertension” dan “hypertension peringkat pertama”. Analisis dan rekabentuk “stent” yang sesuai untuk aneurisme yang menyiasat fenomena aliran darah dengan perlu menentukan kriteria jenis aliran darah sebelum simulasi ke dalam CFD, seperti halaju, tekanan, aliran ketumpatan tidak berubah, aliran berdebar-debar, keadaan sesuhu, aliran lamina dan keadaan bukan slip. Apabila terdapat tekanan yang tinggi di dalam saluran darah, ia mungkin berlaku aneurisme pada saluran darah, dan mungkin boleh pecah kalau sampai ke peringkat yang kritikal. “Stent” 2.2 sm dengan ketebalan 0.85 mm didapati yang paling tinggi menaikkan halaju berbanding kes “stent” dengan ketebalan 0.75 dan 0.85 mm berlaku pada pertengahan diameter “stent”. Keliangan yang tinggi menyebabkan tegasan licih pada dinding “stent” berkesan mengubah dari dinding dalaman ke luaran. Tegasan ricih berlaku paling tinggi pada bahagian darah masuk “stent” dari 00 mm ke 20 mm. Kes diameter 2.2 sm “stent” mencapai paling tinggi menaikkan 2.44% daripada tekanan seluruhan. Ketiga-tiga kes tersebut didapati tekanan statik menurun tidak melebihi 1.5 % berlaku di lapisan sempadan 1 mm dengan dinding dalam “stent”.



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## LIST OF SYMBOLS

$V$	=	volume of stent implant ( $\text{cm}^3$ )
$v$	=	velocity of blood ( $\text{cm/s}$ )
$\rho$	=	Density of blood ( $\text{kg/cm}$ )
$Re$	=	Renolds number
$\mu$	=	Blood dynamic viscosity
$D$	=	Diameter of blood vessel
$\Delta p$	=	differential pressure
$K$	=	kinetic energy
$U$	=	potential energy
$W$	=	work done by heart
$Q$	=	flow rate
$A$	=	cross section area of blood vessel
$T$	=	shear stress
$L$	=	length
$z, r$	=	direction



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## CHAPTER I

### INTRODUCTION

#### 1.1 BACKGROUND

Aneurysms is a situation where the wall arteries being expanded and growing up become like a ball, which will affect the arteries wall being weak when it dilatation of that area. Aneurysms can be grow up at any part of human body , the causes of diseased is including genetics , family history of high blood pressure , chronic kidney disease , adrenal and thyroid disorders and so on. The aneurysms can cause people to death if the blood vessel rupture . Now days in biomedical field was using technique such as endovascular coiling , balloon angioplasty and surgery for aneurysms treatment. The first decade of angioplasty balloons with stent was use in (1977-87) .In united states , there are around 15000 people die by aneurysms diseased for every year . Most of them are 55 years old above . This number is increasing by population increases . From researched ,men are more common to get aneurysms 4 times more to compare with women.

#### 1.2 ANEURYSMS

The blood pressure is the main point of blood vessel cause rupture or being aneurysms , the pressure force to the blood vessel wall and processing blood circulation pumps by heart . How does the aneurysms happen , it is happening when

the wall of arteries (blood vessels) unable support the tension which created by hypertension or there are some blocked inside of the arteries , which mean the diameter of arteries being small . When the blood flowing to the relevant region , the pressure increasing to certain stage , and aneurysms will be occur . An aneurysm is located dilatation of an artery of cause by a weakening of the arteries wall.

### 1.3 COMMON ILIAC ARTERIES

In this study human Common iliac arteries aneurysm have been selected as the analysis area . It is one of the large blood vessel supplying blood to the pelvis and legs . Aneurysms can occur almost anywhere, but the most frequent place is the aorta. Modeling and simulation of flow behavior of iliac common arteries with different diameter and different neck's aneurysm are requiring investigating.

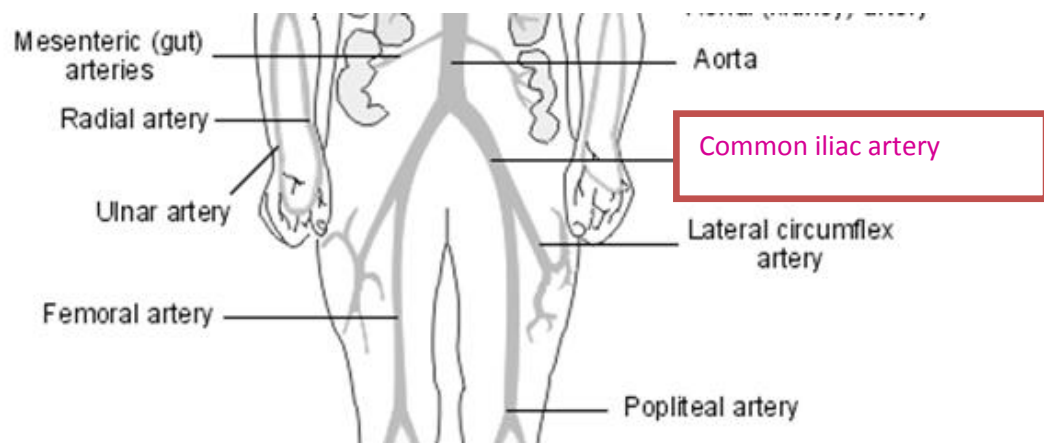


Figure1.1 :Common iliac artery in human body

Common artery exist as paired structures , there is one on the left side and one on the right. The diameter of this pair arties were 16-20 mm in range. Usually it occurs 1.5-2 times the normal diameter (distance across) of an artery.

#### 1.4 SYMPTOM OF COMMON ILIAC ANEURYSM

When iliac artery is blocked, oxygenated blood may not reach all areas of the body. In the case of the iliac artery, which supplies the pelvis and legs, The effect leg will experience a total sensation the pelvis or leg may feel numb and may hurt when walking or sitting and bending down or twisting.

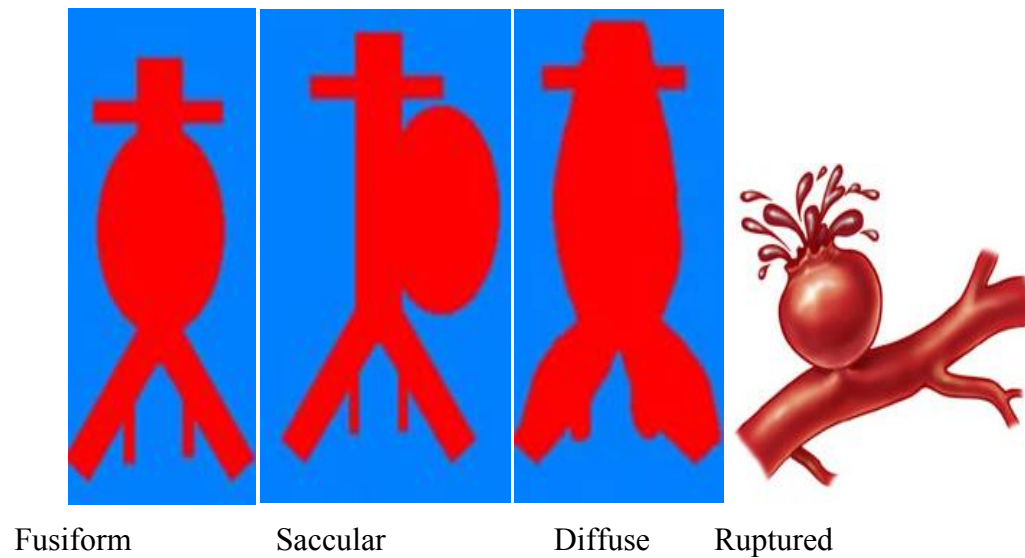


Figure: 1.2: Type of aneurysms in aorta and common iliac artery , source from ([www.daviddarling.info/images/aneurysms.jpg](http://www.daviddarling.info/images/aneurysms.jpg))

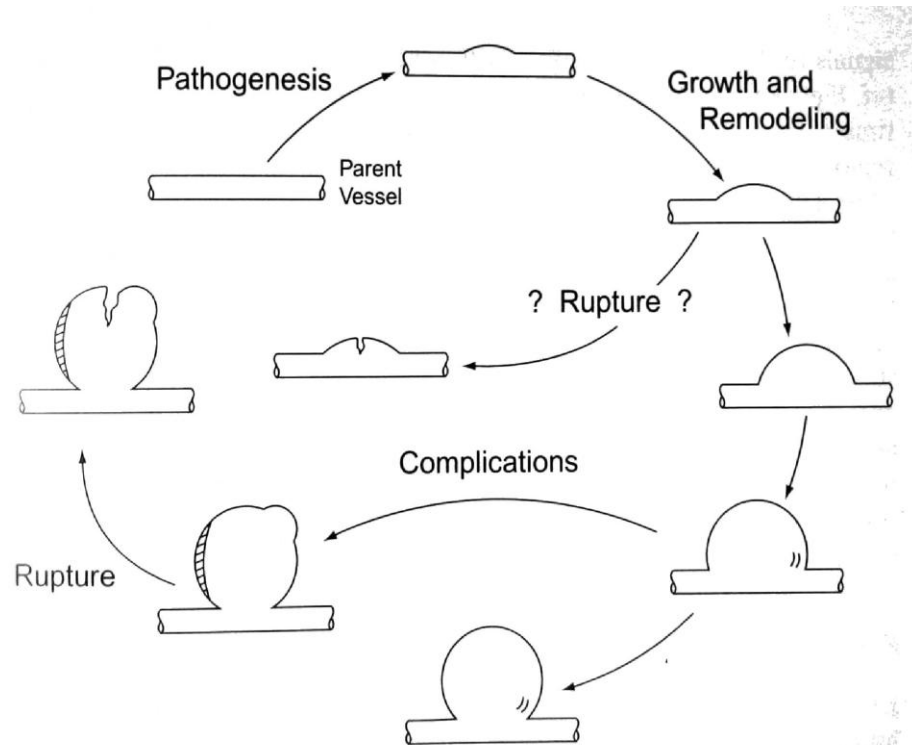


Figure 1.3: Aneurysms process, source from (academics.utep.edu/Portals/563/bimm-process.jpg)

## 1.5 SYMPTOMS OF ARTERIES ANEURYSMS

The exact causes of arteries aneurysms, several factors and conditions may play a role in its development, including:

- a. Smoking
- b. Being overweight or obese
- c. Lack of physical activity
- d. Too much salt in the diet
- e. Too much alcohol consumption (more than 1 to 2 drinks per day)
- f. Stress
- g. Older age
- h. Genetics
- i. Family history of high blood pressure
- j. Chronic kidney disease

- k. Adrenal and thyroid disorders

## 1.6 MEASURE TYPE OF BLOOD PRESSURE

- a. Normal: Less than 120/80
- b. Prehypertension: 121-140/80-89
- c. Stage 1 high blood pressure: 141-160/90-99
- d. Stage 2 high blood pressure: 161 and above/100 and above

## 1.7 DIAGNOSIS TO ANEURYSMS

There are several ways to trace and diagnosis the aneurysms in biomedical field, first one is,angiography. It is a methods of imaging medical technique which visualize the arteries viewing by a specialscan equipment, purpose to investigate the inside of arteriesor organs condition. But it is necessary injected a liquid into the blood vessel to make the arteries is more visible for the scanning viewing the arteries image.



Figure1.4: By using Angiography diagnosis,  
sourcefrom([www.meddean.luc.edu/lumen/meded/Radio/curriculum/Harrisons/Neuro/Aneurysm4a.jpg](http://www.meddean.luc.edu/lumen/meded/Radio/curriculum/Harrisons/Neuro/Aneurysm4a.jpg))

The second is magnetic resonance imaging (MRI), is also one of the methods to getting the view for arteries in human body, but it is not use the X-ray concept, it using a very strong magnet in the patient lies, by require to send signal to patient body using an radio wave antenna, the get the feed beck signal from human body, and the feed beck signal will convert into image by a computer connect with a scanner.

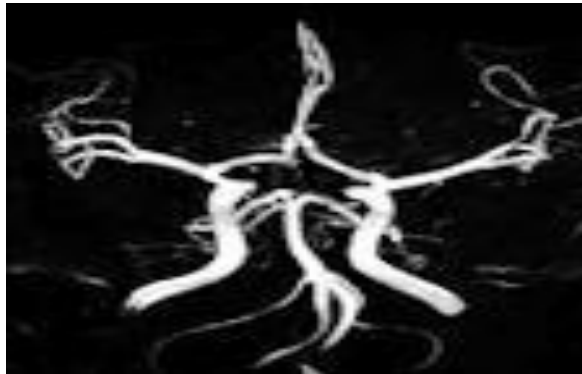


Figure 1.5: By using magnetic resonance imaging, source from (<http://blog.remakehealth.com/Portals/11143/images//MRAbrain1-resized-600.jpg>)

Another method is ,ultrasound method , it's using high frequency broadband sound wave (Megahertz) ,which send back by tissue to alter the degreesto produce the image, but this method may furnish , provide smaller anatomical details compare to MRI method.

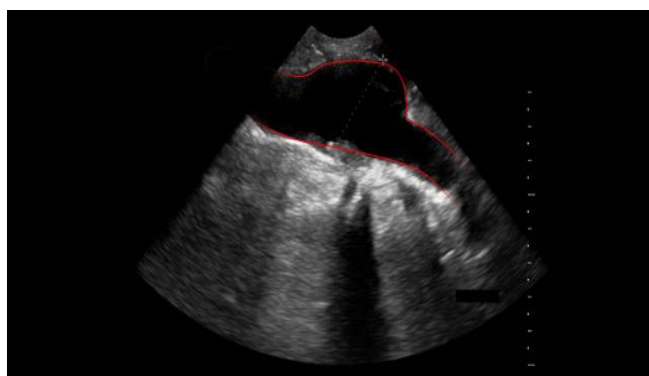


Figure 1.6: By using ultrasound ,source from: ([www.aorticstents.com/images/ultrasound-aaa.jpg](http://www.aorticstents.com/images/ultrasound-aaa.jpg))