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Opportunities for transfer of knowledge and technology know-how across Energy and Medical Sector

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Additive manufacturing day: Reality now

Tjodhallen, UiS, March 10th, 2020, 09:00 am – 3:00 pm

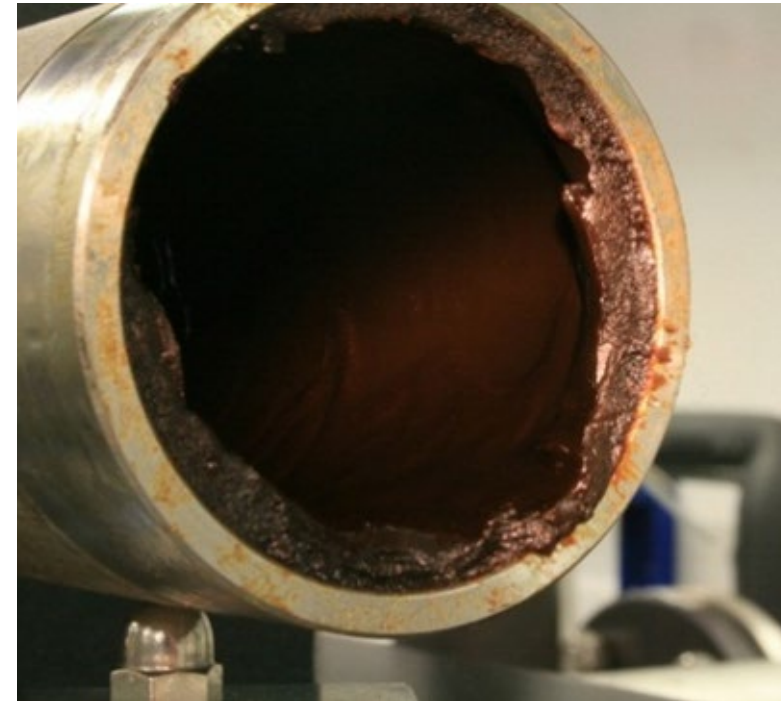
Main idea: Similar challenges – different approaches



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Photo: sciencepics/Shutterstock/NTB scanpix)



Pumps & Pipes - Houston



The solution to your problem may very well be in «The Other Guy's Toolkit»



Funding of projects



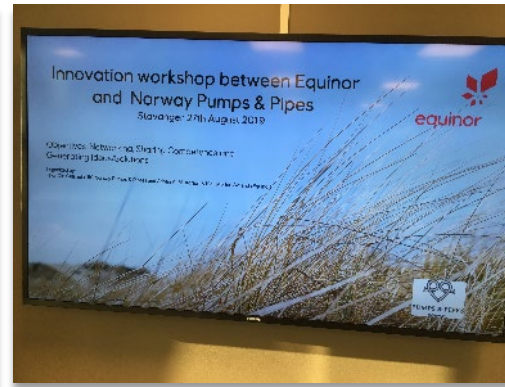
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Norway Pumps & Pipes – creative arenas



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- Regular lunch seminars
- Workshops on different topics
- Promote cross-industry collaboration to solve challenging problems
- Pumps & Pipes Norway

Challenge: Invasive stenosis evaluation by FFR measurement

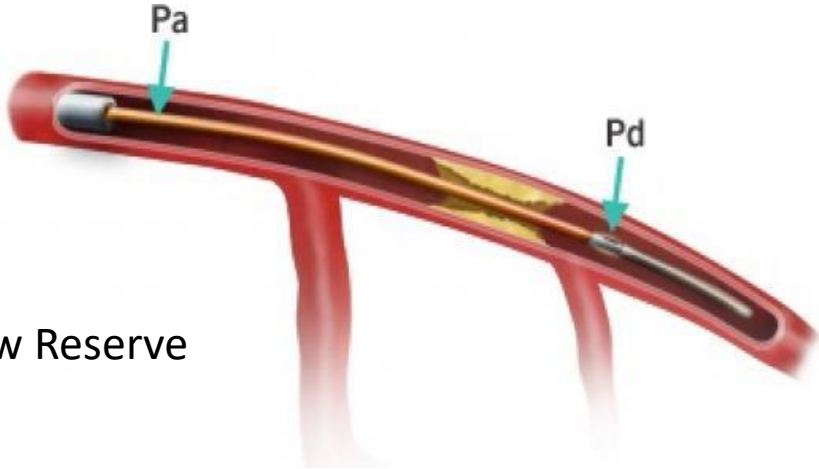


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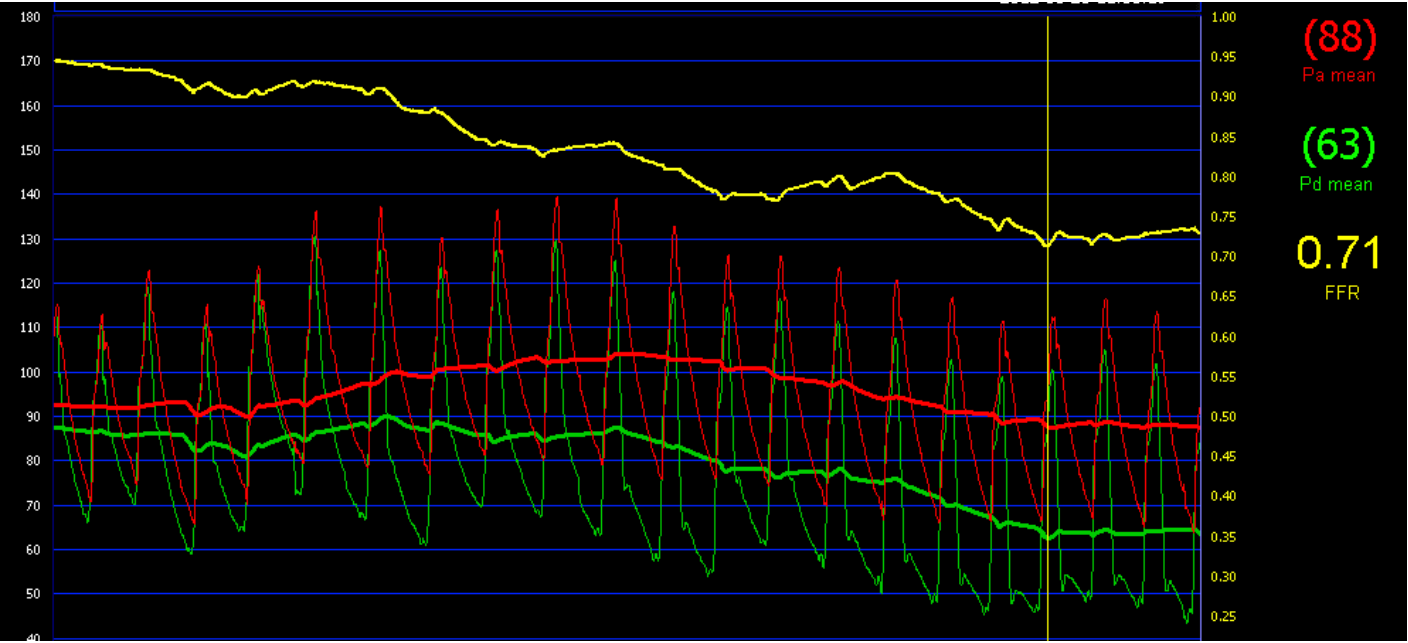
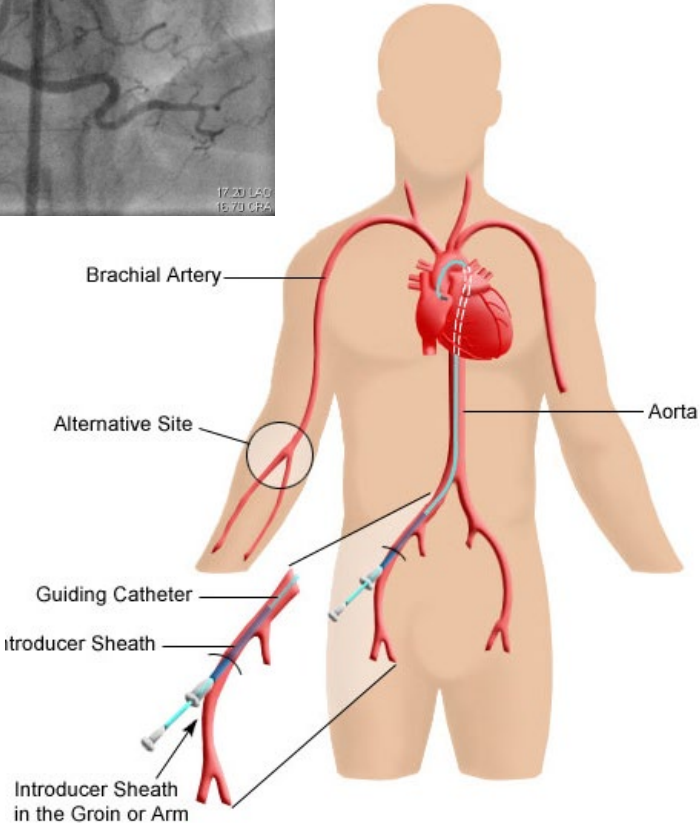


$$FFR = \frac{\text{Distal Coronary Pressure (Pd)}}{\text{Proximal Coronary Pressure (Pa)}}$$

(During Maximum Hyperemia)



FFR = Fractional Flow Reserve



From challenge to solution



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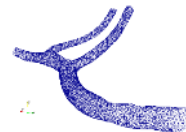
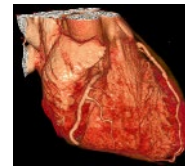
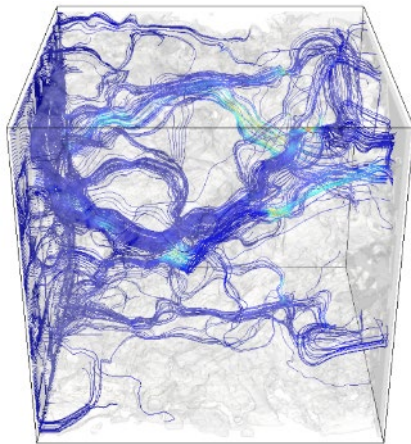
Challenge from the cardiologist:

- Calculate how much a given stenosis affects the supply of oxygen to the heart

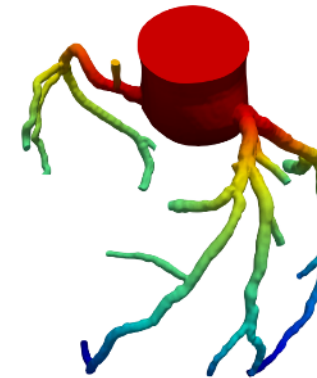
Solution:

- Non-invasive assessment of the coronary arteries based on data modelling and medical imaging

Flow model for Enhanced Oil Recovery



Non-invasive FFR-measurement



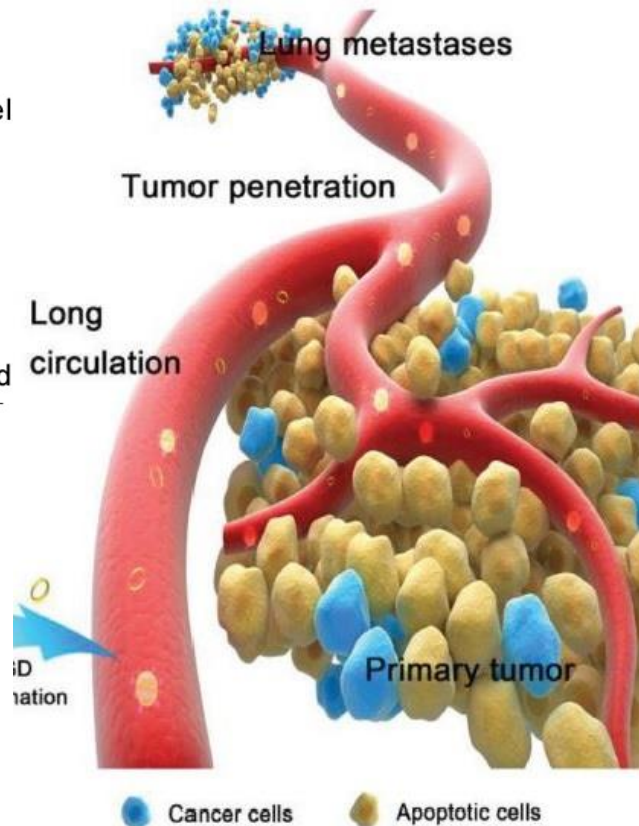
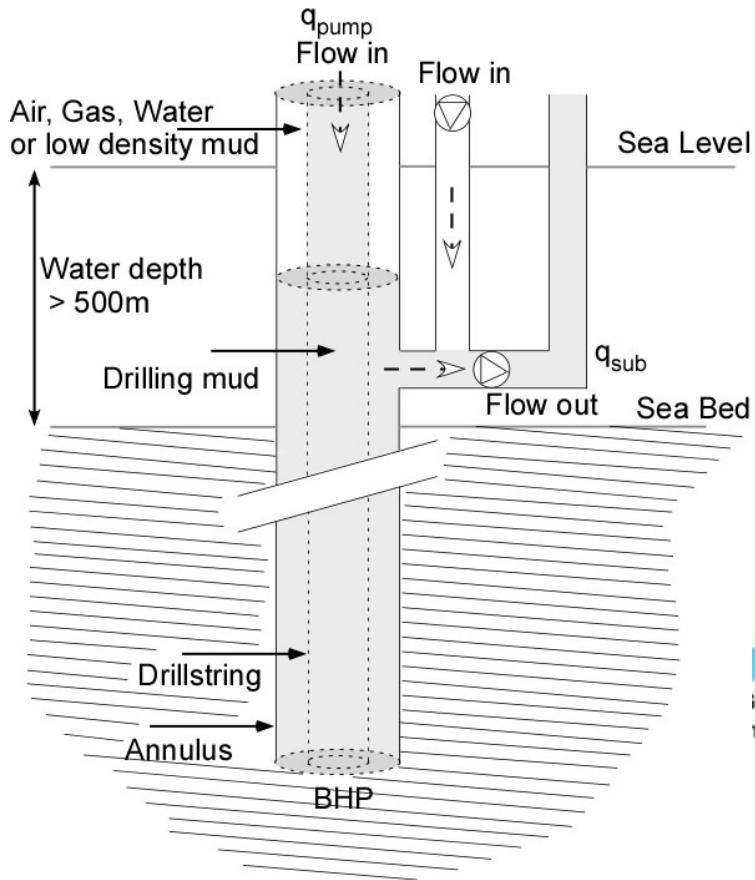
$$\rho \left(\underbrace{\frac{\partial \mathbf{v}}{\partial t}}_{\text{Unsteady acceleration}} + \underbrace{(\mathbf{v} \cdot \nabla) \mathbf{v}}_{\text{Convective acceleration}} \right) = \underbrace{-\nabla p}_{\text{Pressure gradient}} + \underbrace{\mu \nabla^2 \mathbf{v}}_{\text{Viscosity}} + \underbrace{\mathbf{f}}_{\text{Other forces}}$$

Challenge: What is the role of physical forces in spreading of cancer?

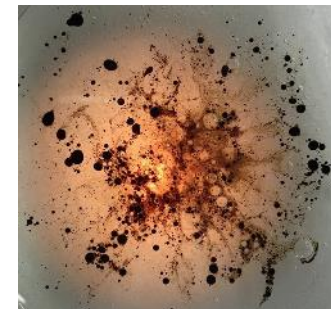


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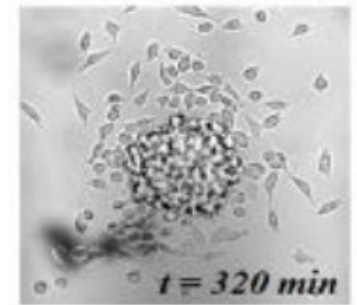
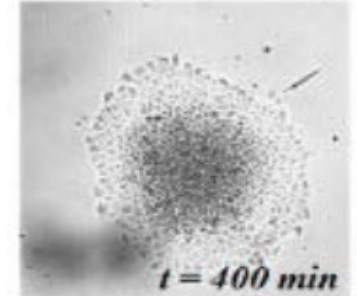
Flow, pressure, displacement of particles
– many similarities



Oil in viscous water



Cancer cell cluster growth

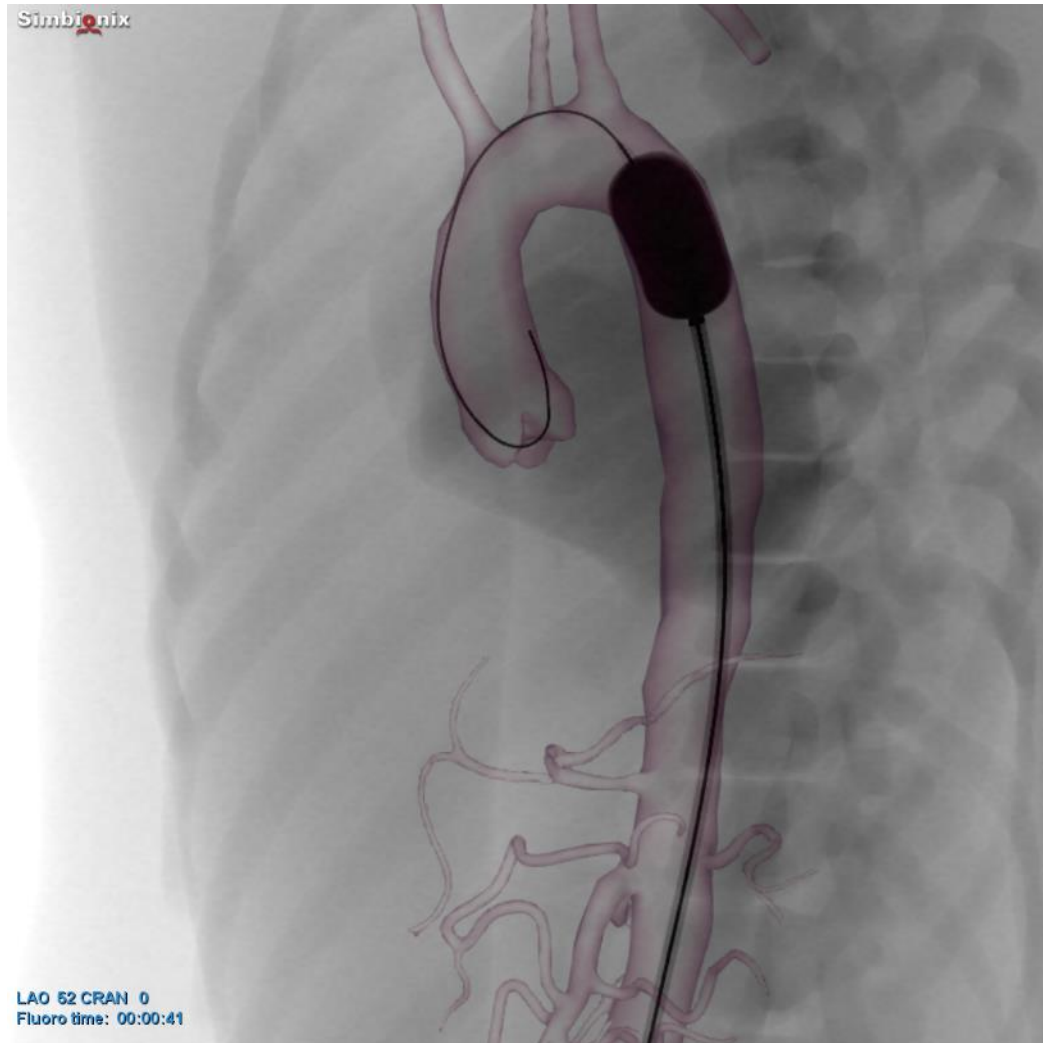


Cell images: Douezana et. Al., 2011.

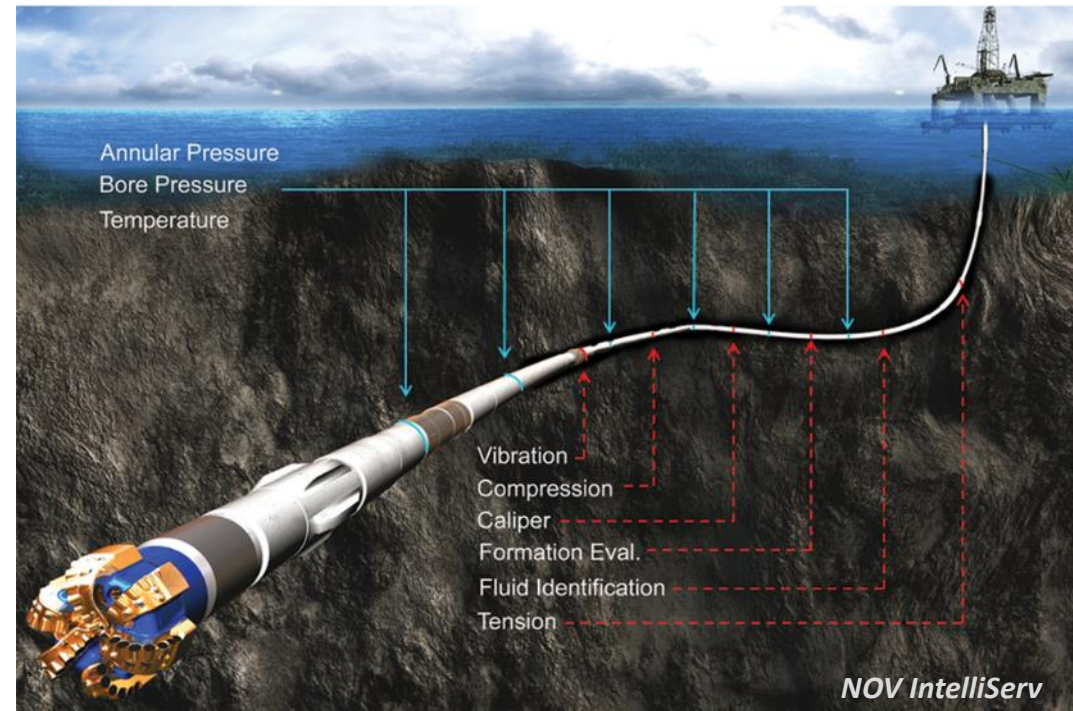
Inspiration: Along string measurements and Resuscitative Endovascular Balloon Occlusion of Aorta (REBOA)



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- REBOA is a technique that stops internal bleeding by inflating a balloon inside the aorta
- Can the catheter be equipped with sensors that register different vital parameters such as blood pressure and oxygen content?



EXCITUS field suction unit



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- For cardiac arrests, **every second counts**
- Seconds are lost by **poor airway management**
- Poor airway management is caused by **inadequate suction devices**;
 - Not there (too big/heavy for first responder bag)
 - Not effective (manually operated)
 - Not used (clumsy operation, time consuming to build vacuum, etc.)

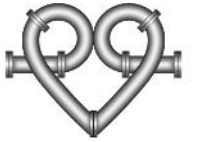


- Features:
 - Always ready, immediate vacuum
 - One hand operation, full finger tip control with precise vacuum control
 - Designed for rough transportation and operation (in any spatial orientation; does not need to stand)
 - Single use pump and canister to eliminate (field) cleaning hassle
 - Battery operated



From “Ullrigg” to “Ullrik”

Arterial blood flow simulator



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Photo: Pål Christensen, Stavanger Aftenblad.

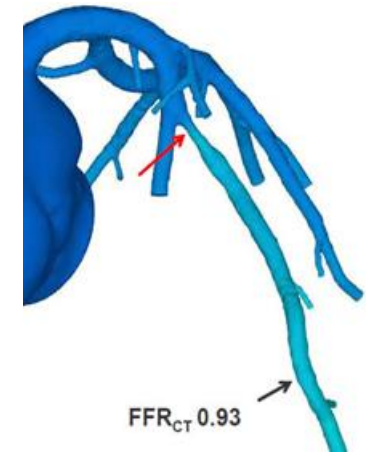
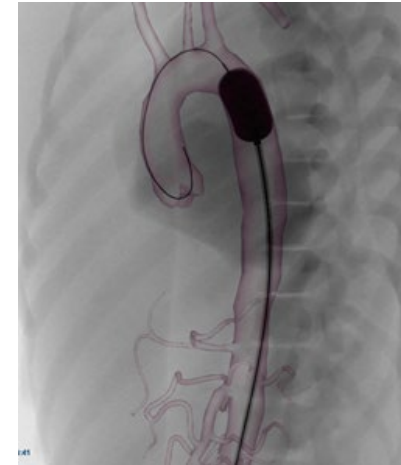
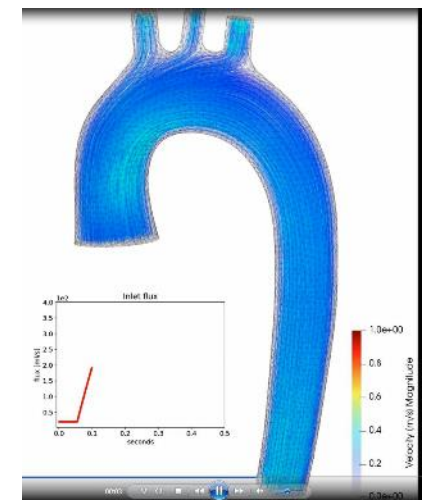
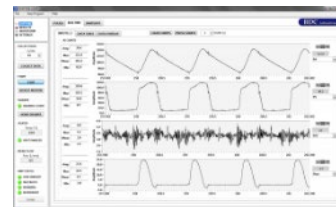


Photo: Pål Christensen, Stavanger Aftenblad.

Pump: PD-1100 from BDC labs

- Frequency: 2 to 240 bpm
- Stroke Volume: 0 – 300 ml
- Flow rate: 0-10 L/min



Thank you for your attention!

www.pumpsandpipes.no