**Introduction**

- People who are exposed to ionizing radiation are categorized into environmentally, occupationally, medically radiation-exposed groups.
- A wide range of complications is reported in these groups.
- Particularly the risk of circulation diseases were observed even in people who were exposed to a low dose of radiation such as cancer patients[1].
- The effect of radiation in vessels can be acute or chronic, however, it leads to serious injuries imposed on endothelial cells in the basement of vessels.
- Vessel injuries caused cardiovascular disease that endangers the patient's life.
- A study showed that among the 3,234,256 cancer patients, 38% died from cancer and 11% died from cardiovascular diseases including heart disease, stroke, and damage to blood vessels[2].
- The kidney and heart are two inter-related organs and vascular injuries in the kidney can result in cardiovascular diseases that endanger the life of radiation-exposed groups[3].

**Question:** Does radiation induce vascular injuries in the kidney? If so, what are the statistics?

**Goal**

- Developing a method to extract the 3D vessel network and quantitatively assess the effect of radiation on kidneys’ vessels

**References**

[3] L Torborg, Mayo Clinic Q and A, 2019

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**Methods**

- **3D fluoresce cryo-imager**
  - Images the surface NADH fluorescence of the tissue (organ), cuts the tissue with micron thickness and images the NADH surface fluorescence again.
  - Repeats these step sequentially

**Results**

**Figure 1**: Schematic view of 3D fluorescence cryo-imager

**Figure 2**: Vessel segmentation of NADH slices of a kidney

**Experimental Protocol**

<table>
<thead>
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<th>12.5 Grey irradiation</th>
<th>0 Grey irradiation</th>
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<tr>
<td>Day 0</td>
<td>n = 14</td>
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<tr>
<td>Day 60</td>
<td>n = 12</td>
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<tr>
<td>Day 90</td>
<td>n = 7</td>
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- **Figure 3**: Experiment overview
  - 14 rats received 12.5 Grey irradiation, and 12 rats did not receive radiation (0 Grey irradiation)
  - The kidneys of half or rats in each group was harvested 60 days post-radiation and the other half were harvested 90 days post-radiation.

- **Figure 4**: Statics of total vessels volume
  - Total vessel volume in irradiated kidneys of day-90 post-radiation (p<0.05) is significantly lower than non-irradiated kidneys of day-90 post-radiation

**Conclusion**

- This novel research introduces a non-expensive method to extracted the 3D vessel structure of organs.
- Radiation adversely affects the vessels in kidney.
- Radiation-induced vessel injuries causes impaired blood perfusion in kidneys leading to cardiovascular diseases.
- Clinicians may seek to control cardiovascular diseases more aggressively in people who are exposed to radiation, particularly cancer survivors.
- The long-term goal of this research is to study multiple vascular diseases and use the outcome of it to promote strategies for controlling cardiovascular diseases.