Angiogenesis betrays breast cancer to near-infrared photoacoustic imaging

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Cancer angiogenesis and optical contrast
- Angiogenesis results in enhanced blood content at tumor site
- Hemoglobin provides absorption contrast for detection using light

Photoacoustic imaging
- Light pulses converted to acoustic pulses at absorbing sites in tissue
- Acoustic pulses detected using ultrasound detectors
- Arrival time of pulses localizes position of absorber

The Twente Photoacoustic Mammoscope
- Developed at the University of Twente¹
- Uses 1064 nm, 5 ns pulsed light for excitation
- Detection with a 90 mm diameter, 1 MHz, unfocused ultrasound detector array
- Resolution 3.5 mm; imaging depth 35+ mm¹

Case 1: 50 year old with infiltrating ductal carcinoma²
- High intensity regions in photoacoustic images
- These regions correspond to higher optical absorption due to hemoglobin
- Photoacoustic ‘hot spots’ attributed to heterogeneous distribution of vascularization associated with cancer
- Extent of cluster in photoacoustic image; comparable with cancer size derived histopathologically

Case 2: 57 year old with infiltrating ductal carcinoma²

Current clinical study:

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<th>BIRADS 5</th>
<th>BIRADS 4</th>
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Phase 1 & 2:
- Nr. of subjects: 60 (BIRADS 4,5)
- Months: 1-16
- Goals:
  - Improve measurement methods
  - Find photoacoustic malignancy markers
  - Guide developments towards PAM II

Phase 3:
- Nr. of subjects: 20 (BIRADS 1,2)
- Months: 14-18
- Goal:
  - Evaluate absence of malignancy markers
  - Guide developments towards PAM II

Future Plans (PAM II):
- Full view breast imaging
- No breast compression
- Shorter measurement duration
- Multiple wavelengths