Exchange visit to the Nihon Kohden Ogino Memorial Laboratory in Tokyo, Japan, July 2019



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Science & Technology Facilities Council









NIVERSITY OF FICESTER

NIHON KOHDEN



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NHS Trust

Nihon Kohden, Japan

Nihon Kohden is one of the world's foremost developers and manufacturers of medical physiological measurement systems.

Nihon Kohden's philosophy is to "contribute to the world by fighting disease and improving healthcare with advanced technology".



Nihon Kohden's strategic priorities for the coming years is to further support the creation and evaluation of emerging neuromonitoring and physiological monitoring technology for hospital acute care. Such work regularly translates into new healthcare products.

Acquired brain injury (ABI) statistics (Headway)



Could measurement of brain tissue pulsation be used to detect and monitor injury?

The pulsing brain...



Pulsations seen through the fontanelle in small babies.

Transcranial Tissue Doppler (TCTD) ultrasound concept



The aim of our Nihon Kohden collaboration is to develop a medical neuromonitoring device (Brain TV) for monitoring brain tissue pulsations using ultrasound.





Patient case study – Intracerebral haemmorrhage



High frequency oscillations observed



TCTD waveform from the right forehead obtained from a 48 year old male patient with an acute right basal ganglia haemorrhage (NIHSS = 4), 24 hours after symptom onset. A typical healthy waveform from a 48 year old male is shown for comparison (black line).

Brain TV project timeline

- 2014: Proof of Concept (Nihon Kohden, £50k)
- **2016:** Laboratory tests (Institute of Physics and Engineering in Medicine (IPEM), £10k)
- **2017:** Healthy volunteer reference data (Science and Technologies Facilities Council, STFC, £10k)
- 2018: Software for AI feature extraction and headset design (MRC funding via the University of Leicester Drug Discovery and Diagnostics (LD³) programme, £30k (plus prototype from Nihon Kohden).
- 2019: IAX Industry-Academia exchange award to visit Nihon Kohden's development laboratory in Tokyo, Japan (Leicester Precision Medicine Institute)

Our visit to Japan was important for gaining Nihon Kohden's support for further clinical research to be led by the University of Leicester.













Nihon Kohden Brain Tissue Velocimetry (Brain TV) pulsation measurement system – clinical research











Proposed Midlands Multicentre Study

Measurements from patients with a range of conditions will help to explore potential clinical applications of Brain TV.

- Ischaemic stroke
- Haemorrhagic stroke
- Head trauma
- Brain tumour
- Hydrocephalus shunt
- Chiari I Malformation

- Raised Intracranial Pressure
- Migraine
- Encephalitis
- Concussion
- Meningitis
- Hypoxic brain injury



University Hospitals Birmingham NHS Foundation Trust



Nottingham University Hospitals









Nihon Kohden visit

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Norihito Konno, Mitsuhiro Oura, Jonathan Ince, Meshal Alharbu, Emma Chung, Andrea Lecchini-Visintini, Poppy Turner, Iwao Takahashi (front left), and Naoki Kobayashi (front right).

As a result of the IAX exchange Nihon Kohden committed to providing:

- Further Brain TV prototype data acquisition systems in 2020 for multicentre use (to be located at Leicester, Birmingham and Nottingham hospitals)
- Continued 'In kind support' from our Nihon Kohden Engineer (Mitsuhiro Oura) and commitment to development of a further 'multi-probe' prototype.
- Equipment loan and clinical consumables: ECG consumables, capnography sensors for NK equipment, plus support with the development of disposable probe holders and accessories (led by Leicester).
- Financial support to cover NHS and MHRA costs (for recruitment, patient monitoring, MRI scans, and regulatory approvals).

Nihon Kohden's support will significantly strengthen our applications for external research funding to the NIHR, MRC, British Heart Foundation (BHF), and Engineering and Physical Sciences Research Council (EPSRC)

Thank you!



Emma Chung (PI)

Mitsuhiro Oura (Nihon Kohden)

Poppy Turner (PhD student)

Jonathan Ince (Medical MSc student)

Andrea Lecchini-Visintini (Co-I)

Meshal AlHarbi (PhD student)

Soccer concussion studies

Alan Shearer: Dementia, Football & Me

Leicester City Football Club (feasibility study)







Movement of brain tissue in response to head motion

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Right head tilt

Right head tilt, hold, and return

First direct measurements of brain motion during impact!