

DEPARTMENT OF CLINICAL PHYSIOLOGY AND NUCLEAR MEDICINE & PET AND CYCLOTRON UNIT



Annual Report 2007

Rigshospitalet · University of Copenhagen



Rigshospitalet



DET SUNDHEDSVIDENSKABELIGE FAKULTET
KØBENHAVNS UNIVERSITET

Rigshospitalet, University of Copenhagen

Rigshospitalet, University of Copenhagen, was founded in 1757. At present it has 1.500 beds, 17.000 employees and a budget of approximately ½ billion Euros. The research production is more than 1.000 publications per year, including approximately 50 higher academic degrees (PhD and doctoral of medical science).

From the 1st January 2007 Rigshospitalet is part of Region Hovedstaden.

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Preface



The year 2007 was a particularly exciting one for the Department of Clinical Physiology and Nuclear Medicine and the PET and Cyclotron Unit, with very high levels of activity. In 2007, for the first time we had more than 25.000 patient investigations in one year. There were many notable highlights throughout the year, including the publication of more than 70 peer-reviewed papers. The financial balance was positive, as it has been for the previous seven years, and we even managed a relaxing outing with a visit to Tivoli after the annual research day in June.

In December Professor Andreas Kjær and Professor Liselotte Højgaard and the Danish biotech company TopoTarget were granted 24.8 mio. d.kr from The Danish National Advanced Technology Foundation for an advanced molecular imaging platform for in vivo assessment of new cancer treatment.

The radiochemistry labs in PET were rebuilt in the second half of 2007 and were due to be completed in February 2008. It has been a tough period for the PET and Cyclotron Unit – moving into Finsen II and undergoing reconstruction while at the same time having to maintain its level of productivity. EANM, The European Association of Nuclear Medicine, held its annual meeting in Copenhagen in October. It was heartening to note that 21 presentations at the conference came from our department. The Danish Society for Clinical Physiology and Nuclear Medicine celebrated its 25th anniversary, marking the occasion with a new book “Present Status and Future Development”, with six of the 27 chapters being written by members of our department.

As in previous years we welcomed many visiting guests and researchers, and many of our own members of the department were invited speakers and teachers at symposia, workshops and conferences in Denmark and abroad.

Doctor Ian Law, MD, PhD, defended his Doctor of Medical Science thesis in August and was appointed Consultant at the Department. We also welcomed Dr. Peter Oturai as new consultant at the Division of Clinical Physiology and Nuclear Medicine and Dr. Peter von der Recke and Dr. Elena Markova at the Radiology division of the PET and Cyclotron Unit.

EMRC, the European Medical Research Councils, which is chaired by Liselotte Højgaard, published a White Paper “Present Status and Future Strategy for Medical Research in Europe”. The document was discussed with Dr. Elias Zerhouni, Director at NIH, in September and with Research Commissioner Janez Potocnik at the European Commission in December, who both supported the vision of strengthening medical research in Europe. We hope that our department at Rigshospitalet can play a full part towards reaching that goal.

On the administrative front, 2007 was the first year when Rigshospitalet became part of “Region Hovedstaden”, the Capital Region for all the hospitals in the greater Copenhagen area. It has been a time of change and has entailed new administrative and collaborative work. Hopefully it will lead to a strengthening of patient treatment, research and education that will benefit everyone in the region, as well as Rigshospitalet and our department. We welcome the fact that in the autumn our governing politicians endorsed a policy supporting medical

research in the Capital Region. This is a positive step towards securing and strengthening medical research in our region for the future.

We would like to offer a warm and sincere thank you to all staff members and external collaborators for their great efforts in 2007. Everyone from both the Clinic of Clinical Physiology and Nuclear Medicine and the PET and Cyclotron Unit has made an important contribution to patient studies, isotope production, research and development and education and collaboration. All these efforts result in better care for our patients and greater progress in research and development.

Finally to one of the great highlights of the year. Our own Professor Andreas Kjær was presented with the ‘Best Researcher in 2007’ award for “The Speciality of Clinical Physiology and Nuclear Medicine in the Nordic Countries.”

Warm congratulations from the Department!

Liselotte Højgaard & Linda M. Kragh





Mission and Objectives

The mission of Rigshospitalet is to be the leading hospital in Denmark for patients in need of highly specialized treatment:

General objectives:

- To be in the lead within highly specialized diagnostics treatment and nursing
- To carry out research and development at an advanced international level
- To educate staff in the health services on an highly specialized level
- To contribute with professional advice and exchange of knowledge and expertise with the surrounding world
- To be characterized by openness and human respect

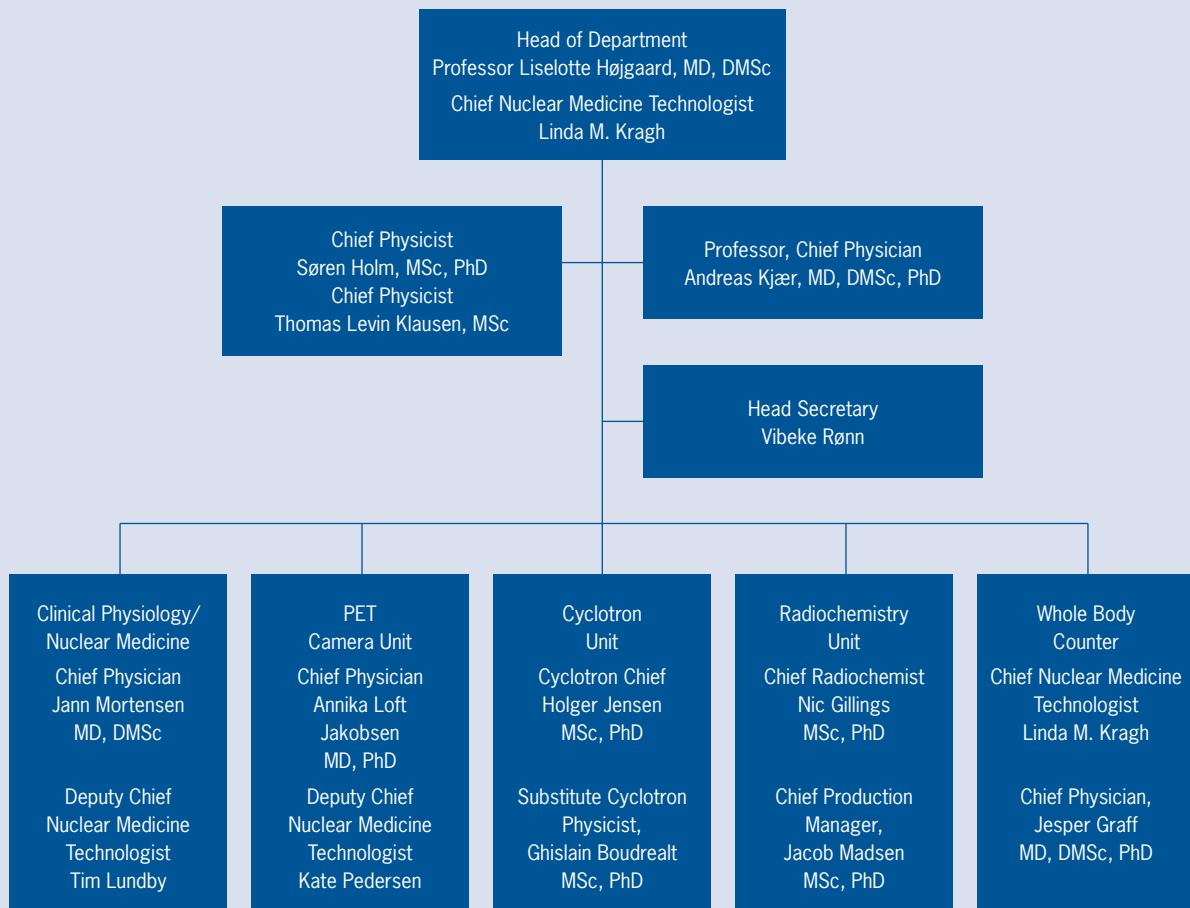
The objectives of The Department of Clinical physiology & Nuclear Medicine and PET & Cy-clotron Unit are:

- To carry out clinical patient investigations in clinical physiology and nuclear medicine, including PET – at the most advanced international level and dedicated to patients in need of highly specialized treatment.
- To conduct research and development in nuclear medicine, including PET and clinical physiology at a high international level
- To develop and test new radioactive isotopes and to produce radioactive isotopes and medicinal products for clinical purposes and research
- To participate in education and the spreading of knowledge in a national and international setting within the expert fields of the clinic
- To develop diagnostic strategies for clinical patient investigations in collaboration with clinicians in accordance with the principles of evidence-based medicine
- To be an attractive and positive place of work with emphasis on teamwork, competence and a positive atmosphere

The staff has participated in a number of congresses, symposias, meetings and workshops with invited lectures, oral presentations, abstracts and posters. We have a comprehensive programme for all staff members at the department, and frequent visits from Danish and international research groups.

In 2007 more than 200 groups and individuals visited the department.

Organisation and Staff



Department of Clinical Physiology and Nuclear Medicine & PET and Cyclotron Unit is part of the Diagnostic Center, headed by Mogens Sandbjerg Hansen, Director, MD, DMSc and Karin Nørregaard, Vicedirector.



Physicians

Berthelsen, Anne Kiil, MD, Chief Physician, Borgwardt, Lise, MD, PhD, Senior Registrar, Dejanovic, Danijela, Registrar, Doetsch, Anne-Marie, MD, Senior Registrar, Dümcke, Christine, MD, Registrar, Graff, Jesper, MD, DMSc, PhD, Chief Physician, Jakobsen, Annika Loft, MD, PhD, Chief Physician, Hesse, Birger, MD, DMSc, Chief Physician, Hovind, Peter, MD, DMSc., Registrar, Højgaard, Liselotte, MD, DMSc, Head of Department, Professor, Høyer, Alice Outzen, MD, Consultant Kjær, Andreas, MD, DMSc, PhD, MBA, Chief Physician, Professor, Krakauer, Martin, MD, Registrar, Kupers, Ron, MD, Associate Professor, Law, Ian, MD, PhD, Chief Physician, Lyttkens, Kerstin, MD, Chief Physician, Markova, Elena, MD, Chief Physician, Mehlsen, Anne-Birgitte, MD, Staff Registrar, Mortensen, Jann, MD, DMSc, Chief Physician, Oturai, Peter, MD, DMSc, Chief Physician, Pfeifer, Andreas, MD, Registrar, Recke, Per von der, MD, Chief Physician

Physicists, Chemists

Andersen, Peter Andreas, MSc, PhD, Physicist, Boudreal, Gislain, MSc, PhD, Substitute, Cyclotron Physicist, Brandt-Larsen, Malene, PhD, Chemist, Gillings, Nicolas, MSc, PhD, Chief Radio Chemist, Golrokhian, Diana, Physicist, Hansen, Charlotte Lund, MSc, Chemist, PhD student, Holm, Søren, MSc, PhD, Chief Physicist, Jensen, Holger J., MSc, PhD, Cyclotron Chief Physicist, Jørgensen, Jesper, MSc, Physicist, Madsen, Jacob, MSc, PhD, Chief Production, Manager, Chemist, Nægren, Kjell, MSc, Research Radiochemist, Szabolcs, Lehel, MSc, PhD, Chemist

Engineers, Technicians, Computer Scientists

Andersen, Flemming, MSc, PhD, Computer Scientist, Christensen, Jan Damgaard, Cyclotron Technician, Drennan, David, Cyclotron Technician, Dähnhardt, Andreas, Computer Assistant, Weihrauch, Per, Cyclotron Technician

Nuclear Medicine Technologists, Radiographers and Nurses

Abrahamsson, Elisabeth, Radiographer, Al-Karbalaie, Zainab, NM Technologist, Andersson, Åsa Katarina, NM Technologist, Banerup, Björn Tony, NM Technologist, Christensen, June, NM Technologist, Christensen, Pia, NM Technologist, Cortsen, Annette, NM Technologist, Dall, Bente, NM Technologist, Dondera, Brita, NM Technologist, Elkington, Sakeena, NM Technologist, Federspiel, Marianne, NM Technologist, Frederiksen, Mette Borggreen, NM Technologist, Gudmundsson, Sven, NM Technologist, Hansen, Lasse, NM Technologist, Heiberg, Therese, NM Technologist, Hillebrandt, Henriette, NM Technologist, Hovgaard, Beinta, NM Technologist, Høybye, Lene, NM Technologist, Jensen, Martin Ravn, NM Technologist, Jørgensen, Hanne, NM Technologist, Jørgensen, Mette Møller, NM Technologist, Kernchen, Ulla, Staff Nurse, Knudsen, Camilla Sloth, NM Technologist, Korfitsen, Julie, NM Technologist, Kragh, Linda M., Chief NM Technologist, Larsen, Lis, Deputy Chief NM Technologist (until Oct 2007), Linnet, Solveig, NM Technologist, Lundby, Tim, Deputy Chief NM Technologist, Myschetzky, Rebecca, NM Technologist, Nielsen, Majbritt Lykke, NM Technologist, Nielsen, Merete Søndersø, NM Technologist, Nilausen, Mia, NM Technologist Pedersen, Birgitte, NM Technologist, Pedersen, Kate, Deputy Chief NM Technologist, Pejtersen, Maria H., NM Technologist, Ramadani, Lutjeta, NM Technologist, Stahr, Karin, NM Technologist, Svalling, Susanne, NM Technologist, Sørensen, Anne, NM Technologist, Sørensen, Beira, NM Technologist, Sørensen, Louise Sørup, NM Technologist, Ulrich, Eva, NM Technologist, Wikke, Tina, NM Technologist

Secretaries

Christensen, Eva, Medical Secretary, Damborg, Anne-Marie, Quality Co-ordinator, Forstrøm, Ulla, Assistant Secretary, Marquardsen, Joan, Medical Secretary, Myltoft, Mette, Medical Secretary, Petersen, Tina Wikmann, Secretary, Runge, Gitte, Medical Secretary, Rydahl, Maybritt, Medical Secretary, Rønn, Vibeke, Head Secretary, Semitoje, Gudrun, Medical Secretary

PhD students

Beck, Martin, Cand.scient., PhD Student, Binderup, Tina, MSc, Human Biologist, PhD Student Chakera, Anette H., MD, PhD Student Eckardt, Rozy, MD, PhD Student, Erritzøe, David, MD, PhD Student, NRU Researcher, Ettrup, Andersen, Human Biologist, PhD Student, NRU Researcher, Frøkjær, Vibe, MD, PhD Student, NRU Researcher, Græbe, Martin, MD, PhD Student, Gutte, Henrik, MD, Research Fellow, PhD Student, Haahr, Mette, MD, PhD Student, NRU Researcher, Hansen, Charlotte Lund, MSc, Chemist, PhD Student, Hansen, Martin, Cand.scient., PhD Student, Jensen, Torben Hougaard, Cand.scient, PhD Student, Jørgensen, Emilie Arnth, MSc, Human Biologist, PhD Student, Kalbitzer, Jan, MD, PhD Student, NRU Researcher, Kornum, Birgitte, MSc, Human Biologist, PhD Student, NRU Researcher, Kristoffersen, Ulrik Sloth, MD, Research Fellow, PhD Student, Loring-Andersen, Julie, MD, Research Fellow, PhD Student, Marner Lisbeth, MD, PhD Student, NRU Researcher, Marthin, June, MD, PhD Student, Nielsen, Kristina, MD, PhD Student, Ormstrup, Tina, MD, PhD Student, Pedersen, Dorthe Skovgaard, MD, PhD Student, Pedersen, Minna W., MSc, Research Fellow, PhD Student, Pfeifer, Andreas, MD, Research Fellow, PhD Student, Tägill, Kristina, MD, PhD Student

Students, Assistants

Boota, Sobia Aniki Aslam, Assistant, Christiansen, Maria, Assistant, Dalbjerg, Christian, Student, Fonsleet, Jesper, Student, Gudmundsson, Marie, Assistant, Jørgensen, Jesper, Student, Kamstrup, Andreas, Student, Naert, Arne, Student, Nielsen, Carsten Haagen, Student, Nielsen, Lea Allingham, Student, Pappense, Meike, Student, Pinholt, Rasmus, Student, Toft-Petersen, Rasmus, Student

Highlights of the year 2007

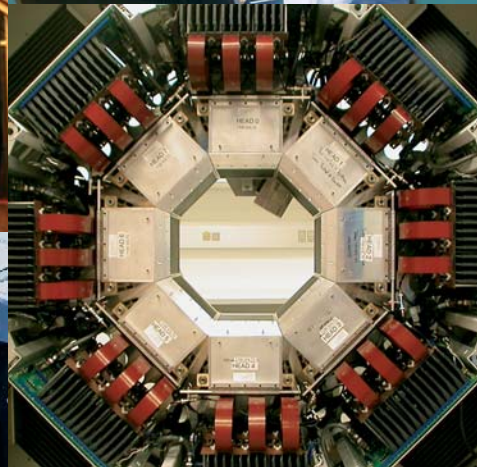
The absolute highlight of the year occurred on the 21st June, when the John and Birthe Meyer Foundation informed us that they had granted us 20.5 mio d.kr for an HRRT PET brain scanner. For this we are immensely grateful.

During the year we 'head-hunted' physicist Merence Sibomani from CTI/SIEMENS in the US to run the HRRT PET scanner, thanks to funding from "Savværksejer Jeppe Juhl og Hustru Juhls Mindelegat" and Merence has started working here in Copenhagen.

In December we opened the fifth PET/CT scanner and the new Finsen II building, where we will continue our close collaboration with the Department of Radiotherapy, who opened their four new accelerators for radiation therapy. It was a great honour that our Minister of Health Jacob Axel Nielsen opened the new wing.

It was a special honour to welcome Professor Dr. Gustav von Schulthess from the famous PET centre at the University of Zürich for his Doctor of Honours graduation at the University of Copenhagen in November.

It was also a special year for Righospitalet, as it was the 250th anniversary of the hospital, which was founded as "Kongelig Frederiks Hospital" on 30th March 1757. On the same day 250 years later the anniversary was celebrated in the presence of Her Majesty Queen Margrethe II and the Royal Prince Consort. It was a privilege for us that our friends and benefactors Birthe Meyer, Henrik Meyer and Søren Drost-Nissen of the John and Birthe Meyer Foundation were present at this fine occasion. During the jubilee year the hospital hosted four scientific symposia and held a celebratory party which was enjoyed by more than 3.500 staff members from the hospital.



Nuclear Medicine



The majority of our patient examinations in the Department of Clinical Physiology and Nuclear Medicine are related to the diagnosis and monitoring of cancer. For this purpose we have six gamma cameras for routine clinical imaging and research studies, including two hybrid SPECT/CT cameras (a 16-slice Precedence scanner and a one-slice Hawkeye scanner), two dual-head gamma cameras and two single-head cameras. In addition, we have two Jaeger body plethysmographs for lung function testing, one of which was installed in 2007. In our animal facilities we have SPECT and PET, as well as micro PET/CT and micro SPECT.

In 2007 there was a large increase in the number of hybrid SPECT/CT scans especially for imaging of neuroendocrine tumours, pulmonary embolism and sentinel nodes.

The somatostatin receptor ligand ^{111}In Octreotide imaging is the most important endocrine nuclear medicine imaging modality and is being increasingly used for evaluating and monitoring radionuclide therapy

in patients with inoperable tumours. At present we compare the diagnostic value of Octreotide imaging with MIBG imaging and FDG-PET.

State-of-the-art 3-D physiological and anatomical hybrid imaging using both perfusion and $^{81\text{m}}\text{Kr}$ ventilation SPECT together with pulmonary CT angiography has been applied for the diagnosis of pulmonary embolism. Other frequent indications for lung physiology measurements in children and adults are control after chemotherapy and transplantation or preoperative evaluation. There has been an increase in radio aerosol mucociliary clearance examinations for the diagnosis of primary ciliary dyskinesia. In collaboration with the pharmaceutical company Novo Nordisk A/S radio aerosols have been applied to assess the deposition and clearance of radiolabelled insulin after inhalation.

The sentinel node technique is increasingly used, leading to optimized surgery of breast cancer, melanoma, oral cancer and other types of cancer.

Radioisotope leakage monitoring procedu-

res are used during isolated limb perfusion with melphalan and tumor necrosis factor alpha for recurrent melanoma and soft-tissue sarcoma.

Research studies in nuclear cardiology include myocardial perfusion imaging and ^{111}In -labelling of stem cells in the evaluation of the effect and homing of stem cells in severe coronary disease. The department has been closely involved in the production of comprehensive European nuclear cardiology guidelines.

Jann Mortensen & Peter Oturai



Pediatric Nuclear Medicine



Each year we perform 1.200 paediatric nuclear medicine investigations mainly for the large paediatric clinics at the hospital. We aim to carry out these investigations at the highest level of excellence and at the same time make the experience a positive one for both the child and the parents. The clinic is a member of the Paediatric Nuclear Medicine Network and the International Telemedicine Network for Second Opinion and Exchange of Ideas.

The clinic has focused on children PET scans since 1999 and has now performed close to 900 such scans. Since the introduction of PET/CT in 2001 and the acquisition of our second PET/CT scanner in 2003, most of the whole body studies have been performed as PET/CT, but only in high-resolution when relevant.

Our Paediatric Focus Group is growing as we get more people involved in developing a systematic approach to information, procedures and scanner performance in order to continuously improve the quality of pa-

ediatric examinations. In late 2007 our focus group started planning a 2008 Paediatric Symposium at Rigshospitalet. The symposium aims to strengthen the relationship between paediatric patients and the entire hospital to increase the quality of diagnostic treatment and generally to improve the experience of the child while he or she remains in hospital. The concept of such a symposium and the ideas that lie behind it have been very well received.

With the new regional plans of our hospital system in Denmark the numbers of paediatric patients coming to Rigshospitalet will increase. We have been actively preparing for this increase in demand and many interesting plans and ideas are now being evaluated to develop the optimal solution for the children at Rigshospitalet.

In June we had a dedicated paediatric educational day with a very interesting talk from our invited speaker, Dr. Lorenzo Biasioni, Head of the Paediatric Task Committee at EANM.

We ourselves are giving an increasing number of talks and presentations internationally. L. Borgwardt was an invited speaker at the SNM 2007, Washington D.C., and delivered a presentation on 'Multimodality Imaging of Paediatric Brain Tumours'. Our Nuclear Medicine Technologists from the Paediatric Focus Group, M. Federspiel and E. Abrahamsson, attended the CME, EANM 2007, Copenhagen, where they gave a successful talk on how to perform children PET scans.

There is a constant need to carry out research in paediatric nuclear medicine, including PET. To help advance medical science in this area we conduct research protocols in children with PET or PET/CT in lymphomas, sarcomas, epilepsy, Mb. Fabry and brain tumours; octreo-scans to monitor Langerhans histiocytosis; and MIBG SPECT/CT of children with neuroblastomas.

Lise Borgwardt

Cyclotron Unit



The PET and Cyclotron Unit has a Scanditronix 32 MeV cyclotron from 1990 and a CTI 11 MeV cyclotron from 2005. In 2007 we made 586 and 277 successful productions in the Scanditronix and CTI cyclotrons, respectively. This corresponds to an increase of 6% relative to 2006. In 2007 we had only two cancelled productions. Despite the very high success rate of 99.8%, we have had several target- and RF-problems in 2007 for the Scanditronix and CTI cyclotrons respectively.

In order to strengthen our research programme on ^{11}C -labelled radiopharmaceuticals we invested in a new ^{11}C target for the CTI cyclotron in 2006. This target has performed successful in 2007, but the specific activities obtainable are not sufficient for some of our radiopharmaceuticals.

Consequently in 2007, together with the company SCANSYS and Peter Larsen, we started development of a new ^{11}C -methan target for the Scanditronix cyclotron.

The Danish "InnovAcc" project, which is focused on the development of accelerator equipment for particle therapy, started a collaboration with the Cyclotron Unit in 2007 on the development of a new type of beam profile detector. The project is supported by the Danish National Advanced Technology Foundation and is a collaboration between the Institute for Storage Ring Facilities (ISA), University of Aarhus, and the Engineering College of Aarhus (IHA), and the companies Danfysik A/S and B. Rustfrit Stål A/S.

Holger J. Jensen

Radiochemistry



Routine Production

In 2007 production of [¹⁸F]FDG increased steadily with one or two syntheses each day. Towards the end of the year we reached our limit for one daily synthesis and are now working on stability studies in order to increase the batch size. In 2007 there were 270 batches of FDG released with an average batch size of 69 GBq at end of synthesis, giving a 23% increase compared to 2006. We now also regularly supply FDG to Næstved Hospital.

Production of krypton generators continued according to the well-established delivery schedule on Mondays, Wednesdays and Fridays. With Næstved Hospital also as a regular customer we produced 869 generators in 2006, which is an increase of 25% from 2006.

Research Production

Production of labelled neuroreceptor ligands for use in research projects by the Neurobiology Research Unit at Rigshospitalet continued in 2007 (see Table 1). [¹¹C]Flumazenil is now approved for human use by The Danish Medicines Agency and approval of [¹¹C]PIB. As in previous years we continued to produce [¹³N]ammonia for cardiac blood flow measurements and [¹⁵O]water for cerebral blood flow measurements. As a consequence of modifications of the production facilities in order to comply with current GMP requirements, [¹³N]ammonia production was suspended in September 2007 and was not due to commence again until March 2007 after the new labs have been validated and accepted.

Oncology Research and Development

Charlotte Lund Hansen continued her PhD project on development of labelled peptides for imaging the epidermal growth factor tyrosine kinase receptor (EGFR) and will submit

her thesis in spring 2008. This project is conducted in collaboration with the Department of Radiation Biology at Rigshospitalet and the Department of Natural Sciences, University of Copenhagen.

Production of the promising hypoxia tracer [⁶⁴Cu]ATSM is now set up. Approximately 10 productions were performed in 2007 for animal studies at the Cluster for Molecular Imaging, Panum Institute. The Hevesy Laboratory at Risø supplies copper-64.

Synthesis of the cell proliferation tracer [¹⁸F]fluorothymidine ([¹⁸F]FLT) has been set up and animal experiments using this tracer were due to commence in early 2008. A number of new PET tracers are currently under development for measurement of processes such as apoptosis and angiogenesis.

Neurobiology Research and Development

Collaboration with the Neurobiology Research Unit, Rigshospitalet and the Department of Medicinal Chemistry at the Danish University of Pharmaceutical Sciences under CIMBI (Centre for Integrated Brain Imaging) continued in 2006. The main focus is on the development of serotonin agonist ligands for PET. A post-doc synthetic organic chemist is employed at Danish University of Pharmaceutical Sciences and a PhD student started in December 2007. Several candi-

date radioligands have been tested in animal experiments (ex vivo and in vivo) and this work will continue in the coming years.

Pain Research and Development

The synthesis of [¹¹C]Carfenamil, an opioid receptor ligand, and [¹¹C]FLB457, a very potent dopamine D2 receptor ligand, has been established and permission for use in humans will be sought in 2008. These tracers will be used by Senior Researcher Ron Kupers together with Professor Henrik Kehlet from the Section for Surgical Pathophysiology at Rigshospitalet. The research will focus on furthering the understanding of chronic post-operative pain processes.

[Tyr^{A14-123}]insulin

In close collaboration with Novo Nordisk A/S, a clinical trial investigating the deposition of human insulin after inhalation into the lungs was performed in 2007. For this purpose human insulin was labelled with iodine-123. Human insulin is a protein containing four tyrosine residues, which all to some extent were labelled with iodine-123 under the reaction conditions. The main product, [Tyr^{A14-123}]insulin, was isolated and formulated in solution to be used in a pulmonary delivery system.

Radiopharmaceutical	Batches released for human use		
	2005	2006	2007
[¹⁸ F]Altanserin	40	42	36
[¹¹ C]DASB	17	47	49
[¹¹ C]SB207145	-	3	20
[¹¹ C]Flumazenil	-	-	1
[¹³ N]Ammonia	75	97	67
[¹⁵ O]Water	195	176	62

Table 1: Summary of research productions performed (2005–2007)

PET and PET/CT Scanners



By the end of 2007, the installed equipment base of the PET and Cyclotron Unit comprised two stand-alone PET scanners and three combined PET/CT scanners in the hospital itself, and at the Cluster for Molecular Imaging at the Faculty of Health Sciences, University of Copenhagen we have one stand-alone PET scanner and facilities for carrying out SPECT/CT, micro SPECT, micro PET and micro CT.

The oldest PET scanner in use for patients is a GE Advance, installed in 1993 as the first of its kind in Europe. During 2007 it still performed most of the brain scans, including the receptor ligand research. The ammonia heart perfusion studies were also made here, but only few whole-body PET scans. In the future most, if not all, brain scans are scheduled to be moved to our new, dedicated brain scanner, the HRRT (High Resolution Research Tomograph). Originally intended – as the name indicates – mainly for research, the HRRT is now evolving into a clinically useful instrument, although the user interface still lacks some of the features of the typical commercial instruments. Designed in cooperation by several research groups in Europe and USA, and built by CTI in Knoxville, Tennessee, owned by Siemens, the HRRT project has a nearly 10-year history that finally resulted in the building of a series of 18 instruments. Thanks to a most appreciated grant from the John and Birthe Meyer Foundation in 2007, we managed to acquire an HRRT and to secure Rigshospitalet a place in the exclusive HRRT research network. The fast implementation of the scanner would not have been possible without the skills and efforts of computer scientist Merence Sibomana, who has been working with the HRRT project in Knoxville, and joined us as a consultant during 2007.

Technically, the HRRT has a record high

number of detector crystal elements (119.808) and a high sensitivity compared to other scanners. The enormous amount of data these detectors create has been a major challenge ever since the scanner was designed, but the continuous improvement in computer performance has now reached a level where image reconstruction can be performed within reasonable time. The images provide a resolution of 2–3 mm in the full field of view with standard reconstruction methods. By means of improved reconstruction software this is expected to be further reduced, placing a strong demand on the stability of the patient's position during the scan, and/or the ability to correct for any motion of the patient. A Master's/Phd project has been launched to help find a solution to this issue.

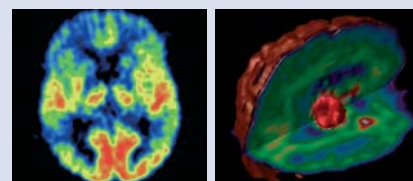
The majority of studies in the department are FDG whole-body scans, and these are normally performed with the use of combined PET and CT. Our first PET/CT scanner was a GE Discovery LS, where the PET is almost identical to the Advance PET scanner. The Discovery LS was installed in the autumn of 2001 as the second PET/CT in Europe. In the combined PET/CT examination, the CT scan is used both as a full diagnostic quality CT (including contrast media) and for attenuation correction of the PET images. Our second PET/CT, installed in 2005, is a Siemens Biograph with 16-slice CT. It is run in a unique and well-functioning collaboration with the Department of Radiotherapy, and it is extensively used for therapy planning. One major advantage of this new generation of scanners is that the patient opening has been widened to 70 cm (compared with 60 cm previously). This is particularly important for patients that are being prepared for therapy, because it ensures that there is enough room for the necessary "fixation" devices that are used to guarantee that

the position of the patient is known and can be transferred to the linear accelerators with great precision.

To meet the still increasing demand for whole-body scans, a third PET/CT scanner was installed in November 2007 in the new extension of the Finsen building. This scanner is a further developed member of the Siemens Biograph family. It has a CT scanner with 40 slices, and the PET axial field of view is extended (in round figures) from 15 to 20 cm. This apparently minor change increases the overall sensitivity by 78% that can be used to obtain a combination of lower doses, faster scans and improved images.

In the Cluster for Molecular Imaging, we maintain the old GE 4096 PET scanner (suitable for larger animals), and research scanners for PET and CT of small animals (installed in 2006). The PET is a Focus 120 with resolution well below 2 mm, and the CT is a microCAT II, with an ultimate 15 μm resolution.

Søren Holm



PET/CT scanning is improving Radiotherapy

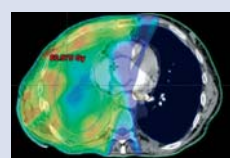
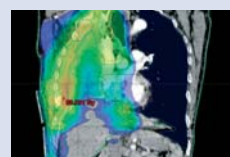


Positron emission tomography (PET) and its usefulness in oncology are well established. With the introduction of combined PET/CT scanners, a new world has opened with exciting possibilities.

We perform the CT scans of PET/CT as high-quality diagnostic scans using oral and intravenous contrast media. When reading the scans, we describe the PET and the CT scans separately before reading the fused images and giving a final, combined conclusion taking both examinations into account. This provides the clinician with a more precise PET result, a better CT result, and also a more useful conclusion. The CT result improves in quality because the PET data can help detect small tumours that can easily be overlooked even by a trained radiologist's eye. The information that can be gained from a combined PET/CT scan is, therefore, superior to either scan result alone. Furthermore, the patient is spared from an extra CT examination at the Department of Radiology as well as an additional dose of radiation.

We cooperate closely with the Department of Radiotherapy on the use of PET/CT for treatment planning of cancer and we carry out more than 500 PET/CT scans for radiotherapy every year. The advantages are numerous: the anatomical localisation and the metabolic activity of the tumour are defined, and the characteristics of the tissue can then be taken into account when choosing the best radiation technique and energy of the dose. Furthermore only one scan is necessary. Two of our PET/CT scanners are able to perform PET/CT scans for radiotherapy planning. The Nuclear Medicine Technologist delineates the viable tumours depicted by PET on the fused PET/CT images after interpreting the data with the radiologist. These defined regions are then exported to the radiation dose planning system together with the CT scan, and the information is incorporated in the treatment planning. Research in this field is necessary, and we have conducted trials with nasopharyngeal and cervical cancers and malignant lymphoma with encouraging results. PET/CT for radiotherapy planning is now used routinely for patients with cervical, head and neck, lung, oesophageal, cardiac and anal cancers as well as for malignant lymphoma and mesothelioma. Working with PET/CT every day, we are convinced of the usefulness of PET/CT in clinical work as well as in clinical research. However, the introduction of any kind of new modality requires clinical trials to verify the usefulness of the method and the current literature on the use of PET/CT for oncology supports this view.

Annika Loft Jakobsen & Anne Kiil Berthelsen



Patient Investigations

CNS and peripheral nervous system

Regional cerebral bloodflow, rest, 0-15-H2O	9
Regional cerebral bloodflow, physiological, 0-15-H2O	130
Regional cerebral metabolism, F-18 FDG	121
Regional cerebral metabolism, F-18 Altanserin	54
Regional cerebral receptor, stat., C-11-DASB	46
Regional cerebral receptor, stat., F-11-SB	22
Regional cerebral receptor, dyn., C-11FMZ	1
Total	383

Respiratory organs

Lung function test, whole body plethysmography	886
Lung function test, whole body plethysmography w/reversibility	71
Lung function test, spirometry, WLHLB +WL1LB	1.211
Lung function test, spirometry w/reversibility	79
Lung function test, spirometry, physiological provocation	1
Lung function test, diffusionscapacity (CO)	2.058
Lung perfusion scintigraphy, Tc-99m-MAA	236
Lung perfusion scintigraphy, regional, Tc-99m-MAA	74
Lung perfusion scintigraphy, Spect, Tc-99m-DTPA	31
Lung ventilation scintigraphy, Spect, Kr-81-gas	31
Lung ventilation scintigraphy, Kr-81m	249
Lung ventilation scintigraphy, regional, Kr-81m	125
Mucociliary clearance, Tc-99m-venticolloid	47
Total	5.099

Heart and cardiovascular system

Isotope cardiography, first pass, Tc-99m, HSA	105
Isotope cardiography, LVEF, Tc-99m-HSA	1.284
Isotope cardiography, LVEF + vol., Tc-99m-HSA	44
Myocardial perfusion scintigr., Tc-99m-MIBI, pharmacol. stress, adeno.	2
Myocardial perfusion scintigr., gated, Tc-99m-MIBI, pharmacol. stress, dipy.	18
Myocardial perfusion scintigr., gated, Tc-99m-MIBI, pharmacol. stress, dobut.	6
Myocardial perfusion scintigr., gated, Tc-99m-MIBI, pharmacol. stress, adeno.	175
Myocardial perfusion scintigr., gated, Tc-99m-MIBI, physiological stress	35
Myocardial perfusion scintigr., gated, Tc-99m-MIBI, NTG	215
Myocardial perfusion scintigr., gated, Tc-99m, MIBI	8
PET Myocardial perfusion, N-13-NH3	27
PET Myocardial perfusion, N-NH3, pharmacol. stress, dipy.	26
PET myocardial perfusion, N-13-NH3, cold press, phys. stress	18
PET myocardial metabolism, F-18 FDG	2
Exercise electrocardiography	34
Total	1.999

Peripheral vessels

Isolated limb perfusion leakage monitoring, chemotherapy	21
Total	21

Gastrin intestinal tract, including liver, biliary tract and pancreas

Salivary gland scintigraphy, Tc-99m	5
Bleeding scintigraphy (abdomen), Tc-99m-erythrocyt	7
Bleeding scintigraphy (abdomen), Tc-99m-human serumalb.	1
Biliary tract scintigraphy, Tc-99m-Mebrofenin	18
Meckels diverticulum scintigraphy, Tc-99m	3
Schillings test I	4
Total	38

Kidneys and urinary tract

Glomerular filtration, Cr-51-EDTA, several samples	175
Glomerular filtration, Cr-51-EDTA, one sample	3.735
Renal scintigraphy, Tc-99m-DMSA	22
Renography, Tc-99m-MAG3, diurese	12
Renography, Tc-99m-MAG3, ph	1.756
Renography, Tc-99m-MAG3, graft	13
Renography, Tc-99m-MAG3, ACE-inhibitor	112
Renography, Tc-99m-DTPA	102
Renography, Tc-99m-DTPA, diurese	3
Total	5.930

Bone and joint

Bone scintigraphy, Tc-99m-HDP, regional, static	160
Bone scintigraphy, Tc-99m-HDP, whole body, static	813
Bone scintigraphy, Tc-99m-HDP, SPECT	6
Total	979

Endocrine organs

Thyreoid scintigraphy, Tc-99m	427
Thyreoid scintigraphy, I-123 jodid	1
Parathyreoid scintigraphy, Tc-99m-MIBI, SPECT + CT	74
Tumorscintigraphy, I-123 jodid	14
Wholebody scintigraphy, diagnostic I-123-jodid	5
Adrenal marrow scintigraphy, I-123-MIBG	73
Whole body scintigraphy after I-131-therapy	141
Total	735

Blood and lymph system

Erythrocyt volume, Tc-99m-ery	12
Plasma volume, I-125, S-albumin	12
Lymph scintigraphy, extremities, Tc-99m-HAS	3
Lymph scintigraphy, extremities, Tc-99m-nanocolloid, stases	2
Sentinal node, tumor drainage, Tc-99m-nanocolloid	60
Sentinal node scintigr., tumor drainage, mamma c., Tc-99m-nanocolloid	13
Sentinal node scintigr., tumor drainage, malign. mel., Tc-99m-nanocolloid	141
Sentinal node scintigr., tumor drainage, penile c., Tc-99m-nanocolloid	8
Sentinal node scintigr., tumor drainage, vulva c., Tc-99m-nanocolloid	11

Finance

Peritumoral injection of Tc-99m-nanocolloid	497
Spleen scintigraphy, w/Tc-99m-erythrocyte, heated	3
Total	762

In vitro analysis

Plasma thyreoglobulin	922
Total	922

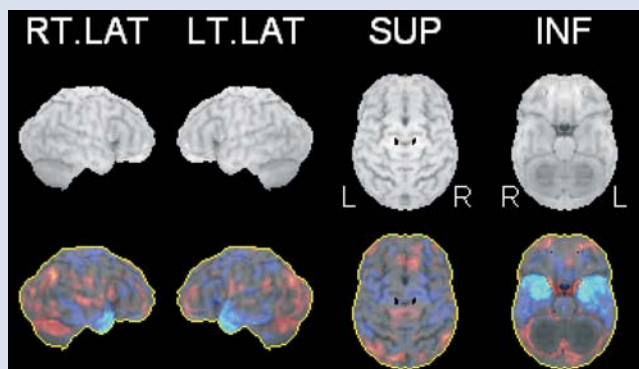
Other diagnostic procedures

Aprotinin scintigraphy, Tc-99m	24
Tumorscintigraphy, I-123-jodid	14
Tumor scintigraphy, In-111-Octreotide	205
PET tumor scanning, F-18 FDG	2.612
PET infection scanning, F-18 FDG	63
PET tumor scintigraphy, F-18-Cholin	3
White blood cell scintigraphy, In-111	115
Labelling white blood cells, In-111	10
Image fusion (PET, SPECT, MRI, CT or planar), PET and KF-section	2.600
Diagnostic CT, PET	2.032
Diagnostic CT, KF	31
CT-therapy scanning	491
Total	8.200

Radiotherapy

Treatment with I-131, benign thyreoid	62
Investigation without specification	7
Investigation without specification, I-123-j scintigraphy	10
Isotope treatment with Zevalin 90-Ytrium	8
Supplementary/repeated imaging, PET and KF-section	556
Total	643

Total number of patient investigations: 25.711



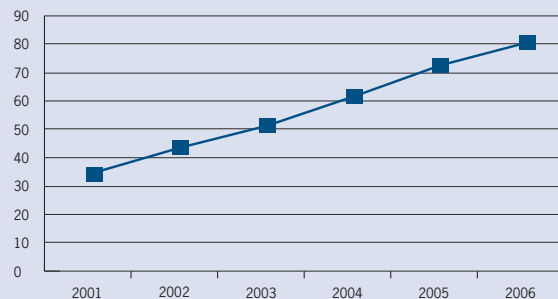
BALANCE 2006

Expenditure

Running costs	DKK 10.3 million
Staff	DKK 31.6 million
In total	DKK 41.9 million

Receipts	DKK 15.7 million
Net sum	DKK 26.2 million

TURNOVER DURING THE LAST SIX YEARS



Research



The department has a vibrant and active research programme and works in collaboration with several national and international partners. Our research focuses on the development of new tracers for PET and nuclear medicine, on clinical evaluation of new diagnostic methods, and on the use of methods from clinical physiology and nuclear medicine to study pathophysiology. At present, special attention is given to translational research in the area of molecular imaging and we conduct extensive research based on the principles behind molecular imaging.

Current areas of major research are detailed below.

Development of new tracers

A series of projects aimed at development of new, specific tracers for non-invasive tissue characterization to be used for the diagnosis of different cancer types as well as for planning and monitoring of therapy are currently underway. These projects, most of which are translational in nature, are carried out in collaboration with other departments and laboratories, since they are dependent on expertise in molecular biology, chemistry, radiochemistry, cancer biology and imaging. In collaboration with a pharmaceutical company, a new method for diagnosing bleeding has been patented and is currently being evaluated. In collaboration with another pharmaceutical company, a molecular imaging platform for testing anti-cancer drugs is being developed.

Clinical PET and PET/CT

A series of prospective protocols are being used to evaluate the diagnostic and prognostic value of PET and PET/CT in different forms of cancer in children and

adults. The use of PET/CT for the planning of radiation therapy (IMRT) and the use of respiratory gating are also being evaluated.

Labelling of stem cells

In cooperation with stem cell researchers from cardiology, we have successfully labelled human stem cells and been able to track the cells in vivo with nuclear medicine techniques. Experiments in patients are planned for the near future.

Paediatric nuclear medicine investigations

The department conducts many paediatric investigations. Several research protocols with the use of PET and SPECT are carried out in cooperation with clinical departments, particularly oncology.

Neuro PET

In cooperation with the Neurobiology Research Unit and Centre for Integrated Molecular Brain Imaging, a series of neuro receptor ligands have been developed and used for re-search in neurobiology. The focus has mainly been on the serotonergic system.

Nuclear cardiology and neuro-endocrinology

With the use of PET, coronary flow regulation is studied in connection with gene therapy and pharmacological interventions in a variety of disease states. With the use of SPECT/CT the development of ischaemic heart diseases is studied in selected groups of patients. A study using SPECT/CT in patients with suspected lung embolism is currently underway to study the impact on right ventricular cardiac function as assessed with gated multi-slice CT.

Lung studies

Research is being conducted into mucociliary clearance and assessment of the use of hyperpolarized helium MRI. The latter is being evaluated together with lung function tests, lung scintigraphy and CT. The added value of combined use of SPECT/CT for diagnosing acute lung embolism is currently being studied. Animal experiments investigating deposit characteristics and lung-transplanted patients are other examples of current lung research.

Radionuclide treatment

Localized radiation therapy using specific ligands binding to certain cancer forms is currently being implemented. The department takes part in research within this area by testing new ligands and producing relevant isotopes. Cancers that are currently being targeted include certain types of lymphoma and ovarian cancer. Treatment will in part be based on imaging using new tracers for molecular profiling.

Whole body Counting

Together with external partners, whole body counting is used for exact measurements of body composition in a series of studies. In addition we are investigating absorption of certain minerals from the gastrointestinal tract.

Andreas Kjær

Cluster for Molecular Imaging

The move towards individualized, tailored therapy has led to an increasing need for diagnosing disease at the cellular and molecular level. Most of the molecular biology methods used today need tissue sampling for in vitro analysis. In contrast, molecular imaging diagnostics at the cellular and molecular level is performed non-invasively in the living, intact organism. With PET it is possible to label a whole new group of biomolecules with radioactive isotopes to be used for visualization of, for example, metabolism, receptors and gene expression. Especially within cancer biology – but not limited to this – these techniques are expected to lead to a breakthrough in the diagnosis and treatment of disease. Of the different methods for molecular imaging only those techniques based on nuclear medicine are of a true translational nature; in other words methods developed in animal models may directly be transferred to and used in humans. Tailored therapy requires a thorough characterization of tissue, for example tumour and metastases. Ideally this characterization could be achieved non-invasively using PET.

Our current molecular imaging research programme is aimed at using molecular biology and imaging techniques in both animals and humans to develop, evaluate

and deploy non-invasive molecular imaging for human tissue characterization. This would enable the planning of individualized, tailored therapy.

Development of new molecular imaging tracers for PET is a complex process that involves many steps, from the definition of the target to the final use of the tracer in patients.

Main steps involved in tracer development and use

- Selection of key processes involved in the pathophysiology of the disease
- Definition of relevant molecular targets of the key processes
- Design of specific ligands
- Radioactive labeling of ligands
- Test of imaging ligands in animal models
- Use of imaging data for therapy planning (e.g. IMRT or radionuclide therapy) and monitoring of response
- Use for diagnosing, therapy planning and monitoring in patients

Through the formation of the Cluster for Molecular Imaging at the Faculty of Health Sciences, University of Copenhagen (headed by Professor Andreas Kjær) it has been possible to establish a core facility at

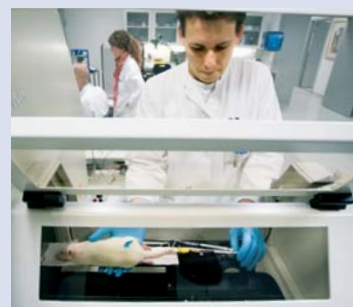
the Panum Institute for molecular imaging in animals with PET, SPECT and CT. This has improved our translational capacity since we are now able to test new tracers in animal models prior to clinical use. Furthermore, we are the molecular imaging partner of the European Advanced Translational Research Infrastructure in Medicine (EATRIS) under the European Union's 7th Framework Programme.

Currently the main focus of the translational research is non-invasive tissue characterization in cancer and cardiovascular diseases models to study pathophysiology and to develop the diagnostic tools for selection, planning and monitoring of tailored therapy.

Some tissue characteristics currently targeted for imaging

- Hypoxia
- Angiogenesis
- Apoptosis
- Cell proliferation
- Glycolytic activity
- Receptor expression

Andreas Kjær



Publications 2007



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As in previous annual reports we have chosen only to list scientific papers, and not the many abstracts and proceedings etc. from the department.



Center for Integrated Molecular Brain Imaging University of Copenhagen, Rigshospitalet

In cooperation with the Neurobiology Research Unit, Professor Gitte Moos Knudsen and Professor Olaf B. Paulsen, a series of neuroreceptor ligands are developed and used for research in neurobiology. The focus has mainly been on the serotonergic system. In 2005 Gitte Moos Knudsen received a grant from the Lundbeck Foundation and established CIMBI; "Center for Integrated Molecular Brain Imaging", where we are proud to collaborate on the PET studies.



MSc in Medicine and Technology

In cooperation with the Technical University of Denmark (DTU) and the University of Copenhagen (KU), the department represented by Professor Liselotte Højgaard has been involved in planning the new MSc programme in Medicine and Technology, which was implemented on 1 September 2003 as a five-year bioengineering degree at Bachelor and Master's level. The first Masters will graduate in 2008.

Since the launch of the programme in 2003 more than 200 students have applied for the 60 available places each year. You can read more about the course at www.medicin-ing.dk

Today's healthcare sector is facing complex problems at the crossroads between medicine and technology that can only be solved by teams of doctors, engineers, physicists, nuclear medicine technologists, nurses, radiographers, computer scientists and chemists. The Medicine and Technology programme equips the student with broad health-related knowledge together with classical technical engineering expertise. Medicine and Technology engineers will be able to occupy positions in hospitals, research institutions and the medical industry in general.

Grants and Awards

Professor Liselotte Højgaard received on behalf of the Department and Rigshospitalet a grant from The John and Birthe Meyer Foundation 20.5 mio Dkr for an HRRT dedicated brain PET scanner.

Professor Liselotte Højgaard received on behalf of the Department and Rigshospitalet a grant for a computer scientist from "Savværksejer Jeppe Juhl og Hustru Ovita Juhls Mindelegat".

Henrik Gutte, MD, PhD student, received a grant from The Danish Heart Foundation.

Dorthe Skovgaard, MD, PhD student, received a Young Investigator Award for her presentation at the Joint Molecular Imaging Conference, Providence, RI, September 2007.

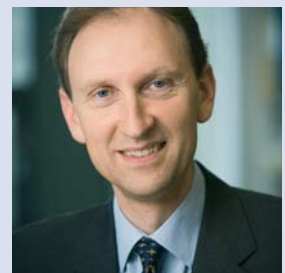
Mette Munk Jensen, MSc Human Biology, received a Young Investigator Award for her presentation at the Joint Molecular Imaging Conference, Providence, RI, September 2007.

Charlotte Lund Hansen, MSc Chemistry, PhD student received a travel grant from The Faculty of Health Sciences for studies at Orsay, France.

Professor Andreas Kjær and Professor Liselotte Højgaard received 24.8 mio. Dkr from The Danish National Advanced Technology Foundation, in collaboration with the Danish Biotech Company TopoTarget.



Professor Liselotte Højgaard thanked Queen Margrethe II for "Ridderkorset" – The Danish Royal order of Dannebrog.



Professor Andreas Kjær received the 2007 great scientific Prize of the SSCPNM, the Scandinavian Society of Clinical Physiology and Nuclear Medicine.



Education



The Department of Clinical Physiology and Nuclear Medicine and the PET and Cyclotron Unit participates in pre-graduate medical education in the Faculty of Health Sciences at the University of Copenhagen within the following fields: human biology, clinical physiology and nuclear medicine, theoretical physiology, biomedical engineering. The department participates in the OSVAL programmes for medical students and the education of nuclear medicine technologists. The department is involved in the specialist postgraduate education of doctors in clinical physiology and nuclear medicine. The oncology, cardiology, lung, and endocrinology pathophysiology courses dedicated for specialist education are all held at our department and arranged by chief physicians in the department. At present 26 PhD students are engaged in research in the department.

The department's educational activities are comprehensive and include all staff members. The Nuclear Medicine Technologists participate in our dedicated CT courses, which include 80 lectures and tutorials. This allows our staff to operate combined PET/CT and SPECT/CT scanners and take responsibility for the CT aspect of the sy-

stem – something that we believe is unique. The competence in CT that our staff has achieved is fully recognised by the Danish National Agency for Radiation Protection.

The department host extensive training programmes for staff members from other nuclear medicine and radiological departments in Denmark and the Nordic countries through study visits to our facilities of physicians and nuclear medicine technologists for periods ranging from weeks up to six months. Chief Physician Peter Oturai is responsible for postgraduate education in the department.

Clinical ass.proff. Jann Mortensen is responsible for pregraduate education of medical students.

Throughout the year the department has held more than 20 scientific and other lectures for all staff members. Examples of these are given in the table below.

Scientific lectures

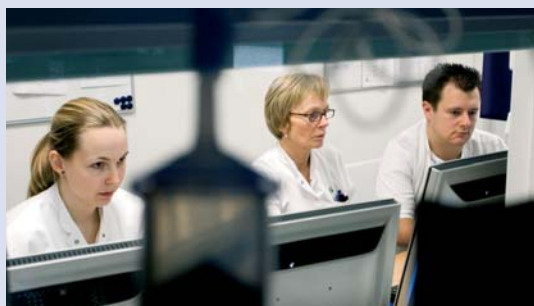
- Parathyreoidea in the clinic
- Stem cell project
- Prostate cancer
- Brain PET – methods and use

- Children and gallstone atresia
- PET/CT and children
- Octreotid and MIBG scintigraphy
- Cancer disease and children
- PET and Mamma cancer
- Renovascular hypertension
- SPECT/CT of lung emboli
- SPECT for epilepsy – surgical explanation
- Aprotinin scintigraphy – amyloidose
- Salivary gland scintigraphy
- Chemotherapy from nature to “rational design”
- PIB Pittsburgh Compound B – Brain tracer
- PET tracers – new and old

Other lectures

- Emergency plan
- Deviant incidents
- Introduction to Medical Library
- Electronic security
- My Boston experience
- EANM contributions
- Communication
- Notification to the Ethics Committee
- PET expansion – Finsen II

Peter Oturai & Jann Mortensen



Nuclear Medicine Technologists



The Department has 38 Nuclear Medicine Technologists, a Staff Nurse, a Radiographer, a Chief Nuclear Medicine Technologist and two Deputy Chief Nuclear Medicine Technologists. The Nuclear Medicine Technologists do the daily radiopharmacy production and run the daily clinical patient investigations in both nuclear medicine and PET, and they also participate in research and development projects. They have co-responsibility for several projects and are involved in data management, quality assurance and patient and animal studies. The results of the research are disseminated through oral presentations and posters at both Danish and international meetings and symposia for technologists. We collaborate with CVU Øresund on research, training and development.

The department's Nuclear Medicine Technologist group presented four posters at the 2007 European Association of Nuclear Medicine Congress in Copenhagen. In addition, during the technologists' education session of the meeting Hanne Jørgensen gave a presentation on 'How to Prepare Patients for Radiotherapy', and Marianne Federspiel and Elisabeth Abrahamsen delivered a talk at the doctors' education ses-

sion on 'Children in a PET Centre'. Many of our Nuclear Medicine Technologists take part in Computer Tomography Education (CTE) and one passed the CTE examination.

Our Nuclear Medicine Technologists are frequently asked to deliver courses and lectures either in Denmark, Scandinavia or at the PET/CT course in Vienna. In 2007 five Nuclear Medicine Technologists participated in our own dedicated CT course, officially recognised by the Danish National Agency for Radiation Protection.

Our Nuclear Medicine Technologists are a very dynamic, competent and responsible group with an important role for the continuous development of the clinic. They have all been involved in the rebuilding of the department, something that has proved challenging to carry out alongside the department's day-to-day work. Our priority is the welfare of our patients and if we have a waiting list all the technologists, our nurse and radiographer work overtime in the evening and at weekends – and they do so with a smile.

Linda M. Kragh



Equipment

Equipment	Product	Purchase year
Gamma cameras	GE Millenium MG	1998
	GE Millenium VG, Hawkeye, lowdose CT	2001
	Philips ADAC Thyurus	2001
	Philips ADAC Skylight	2002
	Mie-Scintaron	2004
	Mediso Nucline X-Ring/R	2004
SPECT/CT camera	Philips, Precedence 16-slice	2006
PET scanners	GE Advance	1993
	HRRT Siemens/CTI	2007
PET/CT scanners	GE Discovery LS	2001
	Siemens Biograph Sensation 16 (hirez)	2005
	Siemens Biograph TruV 40-slice CT	2007
Lung function	Jaeger Masterscreen w/bodybox	2005
	Jaeger PFT pro w/bodybox	2007
Whole body counter	WBC w/Nal counting chamber	1977
	WBC w/plast counting chamber	1978
Cyclotron	Scanditronix 32 Mev	1990
	RDS Eclipse cylotron, CTI	2005
NMR	Varian spectrometer 400 MHz	1993
Cluster for Molecular Imaging	SPECT Provivo, ADAC mobile	1990
	PET scanner GE 4096	1991
	SPECT Mediso Nucline X-Ring/R	2004
	Siemens Micro-PET Focus 120	2006
	Micro-CT Siemens Micro-CAT	2006
	Phosper Imager Perkin Elmer cyclotrone	2007

The John & Birthe Meyer Foundation has donated the equipment in the PET and Cyclotron Unit.

The Joint Commission International, an international American accreditation board, performed a successful accreditation in the spring of 2002 of all the H:S hospitals including Rigshospitalet. In January 2005 the 2nd accreditation took place, also with success. The next review will be in January 2008.

We have worked on standards and politics, standard operation procedures, our quality handbook, patient informations and documentation. It has been an extensive task, and it has contributed to a positive improvement of the quality for the department.



Other Activities

Anne Kiil Berthelsen, Chief Physician is member of "British Institute of Radiology" and member of the Danish Lymphoma Group (DLG).

Lise Borgwardt, Senior Registrar is a member of the management committee for "Pediatric Solid Tumors" at University of Copenhagen, Rigshospitalet. External member of the guideline group for Pediatric PET under EANM and Chair of the "Pediatric Focus Group" at the Department of Clinical Physiology and Nuclear Medicine & the PET and Cyclotron Unit.

Christina Dümcke, Senior Registrar is a member of the course committee at the Danish Society of Clinical Physiology and Nuclear Medicine.

Nic Gillings, Chief Radio Chemist is a member of the management committee of the EU COST Action B12 programme: "Radiotracers for in vivo assessment of biological function".

Jesper Graff, Chief Physician is chair for kursusudvalget in the "Danish Society of Clinical Physiology & Nuclear Medicine" until October 2007 and representative in "Vurderings- og Ansættelsesudvalget" in Clinical Physiology & Nuclear Medicine under the Danish Society of Clinical Physiology and Nuclear Medicine. Member of the Steering Committee of "DMCG Livertumors".

Birger Hesse, Chief Physician is a member of the "European Council of Nuclear Cardiology" (ECNC) and Chair of The Medical Research Library at Rigshospitalet. Member of the "Cardiovascular Committee, EANM" and Head of "Corelab for myocardialscintigraphy". Editorial board in Eur J Nucl Med, Curr Med Imag Rev, Eur Ass Nucl Med Cardiovascular Com and Eur Council Nucl Cardiol Board. Member of the Local Organizing Committee for EANM 07 and the Scientific Cardiovascular Committee of EANM 07. Member of the Advisory Committee of International Conference on Nuclear Cardiology 2009.

Søren Holm, Chief Physicist is President of the Danish Society for Medical pPhysics (DSMF), member of the Educational Board of DSMF and a delegate for the DSMF at the "European Federation of Organizations in Medical Physics" (EFOMP). Member of "Sundhedsfagligt Råd i Klinisk fysiologi og nuklearmedicin" in the Capital Region, the Specialty Advisory Committee (SFR) in Clinical Physiology & Nuclear Medicine. External lecturer at Copenhagen University.

Professor Liselotte Højgaard, Head of Department, is Chair of the Standing Committee of the European Medical Research Councils (EMRC), at the European Science Foundation, Strasbourg and member of the Science Advisory Board, the European Science foundation. Member of the "Danish Council for Research

Policy". Member of the Steering Group for Biological and Medical Sciences, the "European Strategy Forum on Research Infrastructures" (ESFRI Medical) and chair of the ESFRI Expert Group on Clinical and Translational Medical Research. Chair of the Council for "Medical Museion" (Museum of the History of Medicine in Copenhagen). She represents the University of Copenhagen and Rigshospitalet in the programme, MSc in Medicine and Technology in cooperation with The Technical University of Denmark (DTU). Member of ATV "The Danish Academy of Technical Sciences".

Annika Loft Jakobsen, Chief Physician is a member of the "European Organisation for Research and Treatment of Cancer" (EORTC), the Functional Imaging Group and "The British Institute of Radiology". Member of the EANM, AMI, BIR and Oncoradiological Society and chair of the Diagnostic Imaging Group under Danish Lymphoma Group (DLG) and member of the guideline group for Pharyngeal/Laryngeal Cancer.

Professor, Andreas Kjær, Chief Physician is the Danish delegate in the "Scandinavian Society of Clinical Physiology & Nuclear Medicine" (SSCPNM). Chairman of the board of "Selskabet for Teoretisk og Anvendt Terapi" (the Society for Theoretical & Applied Therapy). Member of "Forskningsrådets formandskab" (The Research Council) at Rigshospitalet, member of "Sundhedsfagligt Råd i Klinisk fysiologi og nuklearmedicin" in the Capital Region, the Specialty Advisory Committee (SFR) in Clinical Physiology & Nuclear Medicine and member of the Scientific Committee of the Danish Cancer Society. He is leader of the project "Molecular Imaging for Testing of New Drugs" funded by the Danish National Advanced Technology Foundation. Steering Committee member and partner of EATRIS (the European Advances Translational Research Infrastructure in Medicine) under the EU 7FP. Responsible for the course in heart pathophysiology for nuclear medicine physicians. Head of Cluster for Molecular Imaging at the Faculty of Health Sciences, University of Copenhagen.

Linda M. Kragh, Chief Nuclear Medicine Technologist, is a member of "Sundhedsfagligt Råd i Klinisk fysiologi og nuklearmedicin" in the Capital Region, the Specialty Advisory Committee (SFR) in Clinical Physiology and Nuclear Medicine", member of "Uddannelsesrådet for Bioanalytikeruddannelsen i Storkøbenhavn" in the Capital Region (the speciality council for the education of laboratory technologists) and member of the "Danish Society for Clinical Physiology and Nuclear Medicine".

Ian Law, Chief Physician is a Member of the Board of the Medical Society and Member of the Referencegroup MTV regarding dementia

under the National Health Service. Member of the Research Council at University of Copenhagen, Rigshospitalet. He is responsible for the "Brain imaging" and "Oncology" specialist course for nuclear medicine physicians and member of the guideline group for Sarcoma.

Anne-Birgitte Mehlsen, Senior Registrar is a member of the Committee for "Yngre Nuklearmedicineres Klub".

Jann Mortensen, Clinical Associate Professor, Chief physician is a member of the board of "Dansk Endokrinologisk Selskab" (Danish Society of Endocrinology) and the steering committee of "Dansk Lungecancer Gruppe" (Danish Lung Cancer Group). Member of the Steering Committee of "DMCG of Lung Cancer" and Member of the regional Steering Committee of "DMCG of breast cancer". Member of the subcommittees for "Dansk Diagnostisk Lungecancer Gruppe" (Danish Diagnostic Lung Cancer Group) and "Lungecancer Screeningsgruppen" (Screening of Lung Cancer Group). Member of the supplementary training committee of the Danish Society of Clinical Physiology and Nuclear Medicine and substitute for the board of the Danish Society of Clinical Physiology and Nuclear Medicine. He is responsible for the specialist course in "Clinical Respiratory Physiology" for nuclear medicine physicians and respiratory physicians. Section editor of The Clinical Respiratory Journal.

Peter Oturai, Chief Physician, responsible for the postgraduate education. He is member of the board and Vice President of the "Danish Society for Clinical Physiology and Nuclear Medicine (DSKFNM)". Representative for DSKFNM in the "Danish Medical Society" (Dansk Medicinsk Selskab). Danish delegate, representing DSKFNM, in the "European Association of Nuclear Medicine", in the "European Union of Medical Specialists" (UEMS), and in the "World Federation of Nuclear Medicine and Biology". Member of the "UEMS/European Board of Nuclear Medicine - Accreditation of Nuclear Medicine Training Centres Committee". Webmaster for DSKFNM internet homepage. Part-time lecturer in Human Physiology at DTU.

Kate Pedersen, Nuclear Medicine Technologist is a member of the Technologist Committee under EANM and a member of "Udvalget for Ledende og Afdelingsbioanalytikere i Region Hovedstaden under Dbio".

Peter von der Recke, Chief Physician is member of the "Danish Oncoradiological Society" (DRS), the "British Institute of Radiology" and member of the Danish Lymphoma Group (DLG).

European Medical Research Councils

The European Medical Research Councils (EMRC) is the membership organization of all the European medical research councils – for the EU member states, and for all the other European countries also.

Set up in 1971, the EMRC evolved into Standing Committee of the ESF in 1975. It covers broad range of disciplines and the Committee's objectives range from promoting interactions between the biological, biomedical and clinical research communities to developing European scientific strategies and stimulating collaboration in emerging and interdisciplinary research areas.

In pursuing these objectives, the EMRC seeks to ensure that its strategy takes into account the variety of sources of funding available across Europe.

The chair of the Committee for the European Medical Research Councils is Professor Liselotte Højgaard from the Rigshospitalet, University of Copenhagen, Denmark.

This Standing Committee is composed of delegates with a high scientific profile nominated by their ESF Member Organisations involved in biomedical sciences, together with observers from the European Commission, Standing Committee for Life, Earth and Environmental Sciences (LESC): Canada, WHO-Europe, Israel, New Zealand and USA.

The EMRC Core Group includes members from Belgium, France, Germany, Hungary, Italy, Spain, Sweden and the United Kingdom.

In 2007 EMRC published the White Paper, Present Status and Future Strategy for Medical Research in Europe. The White Paper has been quoted in Deutsches Ärzte-Blatt and in the British Medical Journal



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