Asian School of Nuclear Medicine
Korea Campus
Asian School of Nuclear Medicine
Seoul Campus

Seoul National University Hospital
Introduction/History

Introduction of the Seoul National University Hospital

Seoul National University Hospital (SNUH) having a history dating back to 1885 has now over 1,700 hospital beds and 533 doctors are taking care of 2,000 inpatients and 8,000 outpatients every day. Public recognition of excellence in medical practice has been the best in Korea for the consecutive seven years now. Recently, global outreach of SNUH attracted many foreign patients and recently took the charge of managing Sheikh Khalifa Specialist Hospital in United Arab Emirates.

Introduction of the Department of Nuclear Medicine

Nuclear Medicine started in 1960 in SNUH. Nuclear medicine practice increased and diversified exponentially during the Nineties, and at the turn of this Millennium, Department became renowned to support almost every needs of the clinicians in the fields of cancer, heart and brain diseases. Multi-head SPECT and PET helped the growth of clinical practice since their first introduction in 1993 and 1994. Many best nuclear medicine physicians in the biggest Private General Hospitals such as Samsung and Asan Medical Center are this Department’s alumni. During 2002 to 2006, Professor Myung Chul Lee had led World Federation of Nuclear Medicine and Biology (WFNMB) as the President. Department was also designated as the world first and only International Atomic Energy Agency (IAEA) Collaborating Center for Nuclear Medicine and Molecular Imaging in 2004 throughout 2014. Following this success, a new program supporting international fellows began in 2010 with the name of Koh Chang-Soon Fellow. This name remembers the mentorship of the late Honorary Professor Koh Chang-Soon. Professor Edmund E Kim of MD Anderson Cancer Center joined the Department in 2008 as Invited Professor.

Education Courses and Training

The residents and fellows are under an Organized Training Program meant to make them global leaders in nuclear medicine and related sciences. The vision of the training reached to make the best physician/scientist. Program consist of Joint-hospital conferences, minisymposia and structured courses every day in the morning and trainees are also obliged to enroll graduate courses held by the Department of Medical College and the Department of Molecular Medicine and Biopharmaceutical Sciences of Graduate School of Convergence Science and Technology. These programs aim at training researchers for translational research, combining clinical needs and related basic sciences and technologies. During four years of residency training and further training of clinical and research fellowship, the trainee become Board-persons in Nuclear Medicine accredited by Ministry of Health and PhD in Medical Sciences.

Department also established since decades ago, the MS and PhD training courses for radiochemistry/pharmacy, nuclear medicine physics, molecular imaging and tumor biology, neurosciences and related disciplines. Fifty MS/PhD students are under training and they are also
required to attend the Departmental morning courses and graduate courses altogether with medical doctors seeking PhD. These students recently work together with MD students in almost every research projects and PhD experiments.

**Clinical Practice Scope**

In 2014, 14,747 cases of PET/CT studies mostly torso or brain studies were performed. 1,023 patients were imaged with PET/MRI. This means 1,023 torso PET/MRI and 1,023 regional PET/MRI studies. 3,123 cases of myocardial and brain SPECT studies and 27,706 cases of Gamma Camera Imaging were also performed. In vitro studies of RIA/IRMA was done reaching 849,086 cases. 1,408 patients were treated at Outpatient Clinic or as Inpatients with radionuclides mainly radioiodine.

![Graph showing the number of in vivo and in vitro imaging studies from 2010 to 2014.](image)

**Research and Faculties**

**Research**

We are pursuing many research projects based both on the scientific interests and on the clinical needs. Clinical trials with or without clinician collaborators are running using PET/CT, SPECT/CT and PET/MRI. And basic and translational researches are performed by chemistry/pharmacy team whose recent interest is to enhance therapy using Lu-177 or Y-90 associated with inert nanoparticle or albumin platform. Physics team is on the way to develop animal PET/MRI or human dedicated PET system. The characteristics of the research is everyday joint laboratory meeting between several sub-disciplines of research including educational conferences and symposia.

**Faculties**

Dong Soo Lee is the brain imaging and nanomedicine expert, who published a Nature paper (first author) and a Lancet paper (co-author) and now associate editor of Nanomedicine; NBM and editor-in-chief of Nuclear Medicine and Molecular Imaging. He has pursued many collaborative
researches with the best scientists and engineers within the Department, within Seoul National University and nationally. Jae Min Jeong is a world-renowned radiochemist and pharmacist whose remote achievement was with Re-188 radiopharmaceuticals and whose recent achievement is all-purpose simplistic encapsulation method of nanoparticles (JNM 2012). Jae Sung Lee is a rising star in nuclear medicine physics and reported the first animal PET/MRI imaging with his SiPM PET in 3T MRI (JNM 2012). Keon Wook Kang and Yun-Sang Lee recently established albumin nanoplatform which enables simple multiplex labeling and very plausible human application.

**Instruments and Facilities**

One PET/MRI scanner (Biograph mMR (3T); Siemens); Three PET/CT (Biograph True Point, Biograph MCT 40, Biograph MCT 64; Siemens); Two SPECT/CT (Discovery NM/CT 670; GE); Ten Gamma cameras (E-cam; Siemens, Cardio MD and others); Two Cyclotrons (PETtrace 10; GE installed in 2011, IBA installed in 2008).

**Training Summary**

The average training time taken to complete Koh Chang-Soon Fellowship is one year (12 months)

- Graduate School of Molecular Medicine and Biopharmaceutical Science

http://mmb.snu.ac.kr/Aboutus/Introduction.asp
• Graduate Scholarship for Foreign Students (GSFS)

http://www.useoul.edu/apply/graduate/scholarships/before-application

• Koh Chang-Soon Fellowship Program

Asian School of Nuclear Medicine
Hwasun Campus

Chonnam National University
Hwasun Hospital
Introduction/History

Introduction to the Hospital

The Chonnam National University Hospital which was founded in 1910 is a tertiary medical center of the South-West region of Korea. It recently opens a new comprehensive cancer center with state-of-the-art technologies in 2014, which was named as the Chonnam National University Hwasun Hospital (CNUHH). International education/training of nuclear medicine is mainly done at the new hospital. CNUHH was accredited by the Joint Commission International (JCI) in 2010 and 2013 consecutively. It was designated as the Asia Training Center of PET/cyclotron for GE Healthcare in 2009.

Introduction to the Department

Department of Nuclear medicine of CNUHH has whole scale technologies including RI therapy unit, PET/CT, SPECT/CT, cyclotron, animal PET/SPECT/CT, optical imaging system, photoacoustic imaging system, operational photo-imaging and gamma-probe systems, in vitro laboratories as well as animal facilities. Main clinical practice is F-18 FDG PET/CT for oncology, C-11 methionine and C-11 acetate PET/CT for oncology, N-13 ammonia PET/CT for coronary artery disease, and Tc-99m HDP bone scintigraphy. I-131 therapy for thyroid diseases at the therapy unit is also one of our major clinical practice.

Equipment

Two PET/CTs, one SPECT/CT, one SPECT, one Cyclotron system, four Hot-cells, six Modules, one animal PET/CT/SPECT, one RALS system
Clinical Practice Scope

- Diagnosis in Oncology (\(^{18}\text{F-FDG-PET}, {}^{11}\text{C-methionine PET, }^{11}\text{C-acetate PET, bone-scan, etc}\))
- Diagnosis in Cardiology (\(^{13}\text{NH}_3\text{ PET, perfusion SPECT, etc}\))
- Diagnosis in Neurology (Brain perfusion SPECT, \(^{18}\text{F-FP-CIT, etc}\))
- \(^{131}\text{I therapy for thyroid disease}\)
- \(^{131}\text{I-MIBG therapy for neuroendocrine tumor}\)

Research and Development

- Evaluation of preclinical animal study for anti-cancer and immune-development product
- The development of basic bacterial technology for bacteriobot
- Development of tumor specific drug delivery system based on engineering of tumor-targeting bacteria
- Development of Tissue-Specific Bio-probe Technology Using Microbe
- Radiation-induced signal conversion technology for targeted cancer theranostics
• Development of targeted cancer therapy and RF-based theranostic monitoring technology
• Development of intelligent biosystem for incurable cancerous disease
• Development of Tissue-Specific Bio-probe Technology Using Microbe
• Novel myocardial imaging radiotracer development
• Production of routine clinical radiochemical tracers
• Development of novel radioisotope labeled small molecules for oncology
• Designing new radiolabeling techniques and methodologies
• Development of novel optical imaging probes for molecular imaging
• Application of radio labeled synthetic peptide and protein in molecular imaging
• In vivo studies and evaluation using imaging instruments.

**Education Courses/Training Expertise**

**PhD course**

<table>
<thead>
<tr>
<th>Steps</th>
<th>Main Topic</th>
<th>Practice/Training</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1</td>
<td>Overview</td>
<td>basic (molecular biology), technique, methods</td>
</tr>
<tr>
<td>2-1</td>
<td>In vitro (1)</td>
<td>cell and bacteria culture</td>
</tr>
<tr>
<td>2-2</td>
<td>In vitro (2)</td>
<td>gene transfection and expression</td>
</tr>
<tr>
<td>2-3</td>
<td>In vitro (2)</td>
<td>data analysis (e.g., FACS, confocal microscope, etc)</td>
</tr>
<tr>
<td>3-1</td>
<td>In vivo (1)</td>
<td>animal handling (e.g., IV injection, tumor volume</td>
</tr>
<tr>
<td></td>
<td></td>
<td>measurement, etc</td>
</tr>
<tr>
<td>3-2</td>
<td>In vivo (2)</td>
<td>animal model establishment (heterotopic or orthotopic)</td>
</tr>
<tr>
<td>3-3</td>
<td>In vivo (3)</td>
<td>imaging procedure with optical imaging devices (e.g., IVIS, photoacoustic scanner, mini-FLARE)</td>
</tr>
<tr>
<td>3-4</td>
<td>In vivo (4)</td>
<td>imaging procedure with micro PET/SPECT/CT</td>
</tr>
<tr>
<td>3-5</td>
<td>In vivo (5)</td>
<td>imaging analysis with software</td>
</tr>
</tbody>
</table>

**Nuclear Medicine Physician Course**

<table>
<thead>
<tr>
<th>Steps</th>
<th>Main Topic</th>
<th>Practice/Training</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1-1 Overview (1) radionuclides, generator, cyclotron
1-2 Overview (2) instruments (PET, SPECT), image processing
1-3 Overview (3) radioimmunoassay, quality control

2-1 Oncology (1) $^{18}$F-FDG PET/CT: basic, procedure, interpretation
2-2 Oncology (2) $^{18}$F-FDG PET/CT: reporting with clinical indications
2-3 Oncology (3) non-FDG PET/CT: $^{11}$C-methionine, $^{11}$C-acetate

3-1 Cardiology (1) perfusion SPECT: procedure, interpretation
3-2 Cardiology (2) $^{13}$N-NH$_3$, $^{18}$F-FDG PET-CT: procedure, interpretation

4 Neurology Brain perfusion SPECT, $^{18}$F-FP-CIT: procedure, interpretation

5 Therapy $^{131}$I therapy (thyroid disease), $^{131}$I-MIBG therapy (neuroendocrine tumor)

• **Nuclear Medicine Technologist Course**

<table>
<thead>
<tr>
<th>Steps</th>
<th>Main Topic</th>
<th>Practice/Training</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1</td>
<td>Overview (1)</td>
<td>radiation safety, radiation monitoring</td>
</tr>
<tr>
<td>1-2</td>
<td>Overview (2)</td>
<td>dosimetry, regulation</td>
</tr>
<tr>
<td>2-1</td>
<td>Scanner (1)</td>
<td>operating procedure, maintenance</td>
</tr>
<tr>
<td>2-2</td>
<td>Scanner (2)</td>
<td>data reconstruction, data management</td>
</tr>
<tr>
<td>2-3</td>
<td>Scanner (3)</td>
<td>imaging procedures according to clinical settings</td>
</tr>
<tr>
<td>2-4</td>
<td>Scanner (4)</td>
<td>manual in emergency or accidents</td>
</tr>
<tr>
<td>3-1</td>
<td>Radioimmunoassay (1)</td>
<td>operating procedure, reporting</td>
</tr>
<tr>
<td>3-2</td>
<td>Radioimmunoassay (2)</td>
<td>quality control</td>
</tr>
</tbody>
</table>
• **Radiopharmaceutical Chemist Course**

<table>
<thead>
<tr>
<th>Steps</th>
<th>Main Topic</th>
<th>Practice/Training</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Overview</td>
<td>radiopharmaceuticals in nuclear medicine</td>
</tr>
<tr>
<td>2</td>
<td>Cyclotron</td>
<td>production of radioisotope</td>
</tr>
<tr>
<td>3-1</td>
<td>Radiochemistry</td>
<td>labeling methods of radioisotope</td>
</tr>
<tr>
<td>3-2</td>
<td>Radiosynthesis</td>
<td>$^{18}$F-FDG, $^{11}$C-methionine, $^{11}$C-acetate, $^{13}$N-NH$_3$</td>
</tr>
<tr>
<td>4</td>
<td>Purification</td>
<td>methods, maintenance, etc</td>
</tr>
<tr>
<td>5-1</td>
<td>Quality control</td>
<td>guideline in handling of radiopharmaceuticals</td>
</tr>
<tr>
<td>5-2</td>
<td>Safety test</td>
<td>education, non-bacterial procedure, endotoxin, impurity</td>
</tr>
<tr>
<td>6</td>
<td>Reporting system</td>
<td>standard procedure</td>
</tr>
</tbody>
</table>

**Staffs**

- **Clinical**
  
  Henry Hee-Seung Bom, MD, PhD, FANMB, Jung-Joon Min, MD, PhD,
  Seong Young Kwon, MD, FANMB, Sang-Geon Cho, MD, Hee Jeong Park, MD,
  Guem Cheol Jeong, MD, Ki Sung Park, MD

- **NM Technology**
  
  Myeong Jun Kim (Chief), Jung Jin Roh, Sang Min Han, Yong Seok Lee,
  Gyeong Won Kim, Hyun Oh Oh, Chan Yong Kim, You Ri Kim

- **Radiopharmaceutical chemist**
  
  Dong-Yeon Kim, PhD

- **Nuclear Physics/Cyclotron**
  
  Hwa Yeon Jang, Sang Min Sin, Yo Ram Han

- **Nursing**
  
  Hyoun Ju Jung, Sun Ah Go, Ju Young Jo

- **Typist**
  
  Su Bin Jeon
Laboratory
Seung-Hwan Park, PhD, Hong Vu Nguyen, PhD, Hyeon-Sik Kim, PhD,
JinHai Zheng, MS, Mi Sun Yun, MS, Xuan Thuy Phan, MS,
Thi Quynh Mai Duong, MS, Yeon Jin Chu, A Young Pyo,
Yoon Soon Moon, Young Jae Kim
Asian School of Nuclear Medicine
Daegu Campus

Kyungpook National University Hospital
Introduction/History

Introduction of the Hospital

Kyungpook National University Hospital (KNUH in following) was opened to the public in 100 years ago when the western medical science arrive in Korea. With numerous clinical research and diagnoses, we have led the way in developing the medical field overall and remained as one of the best medical institute for the community.

Introduction of the Department

Clinical nuclear medicine was introduced in KNUH in 1961 and the Department of Nuclear Medicine in the Kyungpook National University School of Medicine in 1964. The major research topics in the clinical medical science cover the clinical application of PET/CT to the oncologic diseases and the advancement of diagnostic and therapeutic nuclear thyroidology including high-dose radioiodine treatment. The major basic research interests are expanding to the fields of molecular imaging, gene therapy strategies and high-throughput screening system for new drug discovery.

Our department has novel techniques for the studies of cell trafficking using nuclear/optical probes or reporter genes, patented theranostic strategies using reporter genes, and molecular imaging methodologies for cell differentiation or dedifferentiation. We have medical cyclotrons producing positron-emitting radioisotopes, several automatic modules synthesizing radiopharmaceuticals, HPLC for analyzing and purifying, and microPET/CT for cutting-edge molecular imaging. Also, biological research facility for gene handling, cell, bacteria and yeast cultures, and in vivo animal imaging instruments are fully equipped.

Equipment

- Clinical department: four PET/CTs, two SPECT/CTs, six SPECTs, and Hot-lab with cyclotron operated by GMP standard
- Preclinical department: small animal PET/CT, IVIS Lumina III

Clinical Practice Scope

- Diagnosis in Oncology (F-18 FDG PET/CT, C-11 methionine PET/CT, I-131 SPECT/CT, Bone scan,
Lymphoscintigraphy, etc)

- Diagnosis in Neurology (Brain perfusion SPECT, F-18 FDG PET/CT, F-18 FP-CIT PET/CT, etc)
- Diagnosis in Cardiology (Myocardial perfusion SPECT, Pyrophosphate scan, Gated blood pool scan, etc)
- Diagnosis in Endocrinology (MIBG scan, Parathyroid scan, Technetium scan, etc)
- I-131 therapy for benign and malignant thyroid diseases

Research and Development

- Basic technical practice from in vitro work to in vivo arena mainly focused on molecular imaging
- Tracking the migration of immune cells / stem cells with multimodal imaging strategies
- Developing reporter gene imaging technology for assessing apoptosis
- Developing reporter gene imaging technology for screening of chemical libraries
- Developing cell therapy tool through molecular imaging technology

Education Courses/Training Expertise

- Nuclear Medicine Physician Course

<table>
<thead>
<tr>
<th>NM Physician Course</th>
<th>Main Topic</th>
<th>Practice/Training</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Overview of NM, MI</td>
<td>guideline of NM practice, concept of MI</td>
</tr>
<tr>
<td>2</td>
<td>Radionuclides</td>
<td>radiation safety, generator, cyclotron</td>
</tr>
<tr>
<td>3</td>
<td>Instrument</td>
<td>gamma camera, SPECT, PET, imaging procedure</td>
</tr>
<tr>
<td>4</td>
<td>Radioimmunoassay</td>
<td>RIA, IRMA, gamma counter</td>
</tr>
<tr>
<td>5</td>
<td>FDG PET/CT Oncology</td>
<td>procedure, interpretation, reporting</td>
</tr>
<tr>
<td>6</td>
<td>FDG PET/CT Oncology</td>
<td>clinical research</td>
</tr>
<tr>
<td>7</td>
<td>FDG PET/CT Non-oncology</td>
<td>inflammation, FUO, autoimmune disease</td>
</tr>
<tr>
<td>8</td>
<td>Nuclear Endocrinology</td>
<td>thyroid, parathyroid, MIBG, octreotide</td>
</tr>
<tr>
<td>9</td>
<td>Nuclear Neurology</td>
<td>SPECT/PET, tumor imaging, DAT imaging, amyloid imaging</td>
</tr>
</tbody>
</table>
10 Nuclear Cardiology  
  first-pass study, GBPS, SPECT, FDG PET

11 SPECT/CT  
  bone SPECT/CT, I-131 SPECT/CT, dosimetry

12 Radionuclides Therapy  
  thyroid cancer, metastatic bone disease, adi immunotherapy

- **Molecular Imaging Researcher Course**

<table>
<thead>
<tr>
<th>NM Scientist Course</th>
<th>Main Topic</th>
<th>Practice/Training</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Overview of multimodal MI</td>
<td>Method of molecular imaging</td>
</tr>
<tr>
<td>2</td>
<td>In vitro technique-1</td>
<td>How to culture the mammalian cells</td>
</tr>
<tr>
<td>3</td>
<td>In vitro technique-2</td>
<td>How to isolate the primary immune and stem cells</td>
</tr>
<tr>
<td>4</td>
<td>In vitro technique-3</td>
<td>How to produce virus expressing multimodal reporter genes</td>
</tr>
<tr>
<td>5</td>
<td>In vitro technique-4</td>
<td>Introduction of reporter gene/cell tracking probe to cells</td>
</tr>
<tr>
<td>6</td>
<td>In vivo-1</td>
<td>Animal handling methods</td>
</tr>
<tr>
<td>7</td>
<td>In vivo-2</td>
<td>How to establish animal model (tumor, inflammation, etc)</td>
</tr>
<tr>
<td>8</td>
<td>In vivo-3</td>
<td>How to track immune and stem cells (PET/CT, IVIS)</td>
</tr>
<tr>
<td>9</td>
<td>In vivo-4</td>
<td>How to track immune and stem cells (PET/CT, IVIS)</td>
</tr>
<tr>
<td>10</td>
<td>In vivo-5</td>
<td>Imaging analysis (Pmod, VIVID, Living imaging software)</td>
</tr>
</tbody>
</table>

**Education Courses/Training Expertise**

- **Regular PhD, post PhD, MD courses**
  - Four to five years for PhD course
  - Two years for PhD course
  - One year for MD course

- **One month course for PhD, post PhD and MD**

**Staff**

**Internal Lecturer**
• Clinic
  Jaetae Lee (Regional principal of ASNM in Korea)
  Byeong-Cheol Ahn (Chairman)  Sang-Woo Lee  Shin Young Jeong
  Do-Hoon Kim  Choon-Young Kim  Seung Hyun Son
  Ji-hoon Jung

• Basic Research
  Young Hyun Jeon  Thoudam Debraj Singh  Ho Won Lee
  Kalimuthu Senthilkumar  Li Xiujuan  Gangadaran Prakash
  Ji-min Oh  Su Bi Ahn  Seul-Gi Oh
  Sang Bong Lee

External Lecturer
  Kyung Ah Chun  Yeungnam University Hospital
  Ji Hyoung Seo  Daegu Fatima Hospital
  Sungmin Kang  Daegu Catholic University
  Hong Je Lee  Dongnam Institute of Radiological and Medical Sciences
  Bong-II Song  Keimyung University
  Hae Won Kim  Keimyung University
  Jong-Ryool Oh  Raphael Hospital