
Great Ormond Street Hospital for Children, Paediatric Nuclear Medicine in the UK

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The history of paediatric nuclear medicine in the United Kingdom is closely related to Great Ormond Street Hospital (GOSH) for Children. The hospital was founded in 1852 and is one of the most famous children's hospitals in the world, a centre of excellence which gathers expertise and equipment to treat complex paediatric clinical conditions.

Paediatric nuclear medicine at GOSH is inseparably linked to Professor Isky Gordon (Fig. 9.1), who was a consultant radiologist with special interest in nuclear medicine at GOSH between 1976 and 2006 and the clinical lead of the nuclear medicine unit within the radiology department.

The first Gamma Camera was installed at GOSH in 1977. This was a Nuclear Enterprises camera with a hard copy real time output. It took a further 4 years before a dedicated computer, Informatek, was purchased. The pediatricians found the



Fig. 9.1 Prof. Isky Gordon

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functional information on patho-physiology from nuclear medicine examinations useful, although there was a significant period of training for both radiologists and paediatricians. Quite quickly renal nuclear medicine examinations began replacing conventional radiology, something that the older paediatricians did not readily accept. Soon nuclear medicine examinations were being used in most areas of the body. The nuclear medicine expanded at GOSH so that by 1995, there were three gamma cameras, including one mobile unit. Exciting research came from close working with different groups of paediatricians both at GOSH and at Institute of Child Health (UCL ICH).

Within the European Association of Nuclear Medicine (EANM), as it is known today, Dr Amy Piepsz from Brussels and Isky Gordon from London met in Barcelona in 1978 and decided that a special group interested in paediatric nuclear medicine should be created. Over the next few years, with a few ‘political’ skirmishes the task group in paediatrics was formed in the EANM, with contributions also from several other colleagues among whom Klaus Hahn from Munich, Rune Sixt from Gothenburg, and Isabel Roca from Barcelona. GOSH played a leading role in the task group, the group produced two atlases of bone scintigraphy in children, created guidelines for virtually every paediatric nuclear medicine examination and generated research that resulted in published papers.

The Henri Becquerel fellowship was established at GOSH. The fellowship was aimed at nuclear medicine physicians from the developing world who had at least 4 years experience in nuclear medicine to come to GOSH for 6 months. The cost was fully funded by the nuclear medicine section of the department of radiology. Thirteen Henri Becquerel fellowships were awarded to nuclear medicine physicians from 12 countries.

Professor Gordon has been an international figure and brought the paediatric nuclear medicine activity of GOSH to the world stage. Under his leadership the nuclear medicine unit of GOSH have set the standards of quality of paediatric nuclear medicine examinations in the UK and abroad. The unit developed its own philosophy and practice in preparing the child and family for the examination and became also a reference point to train radiographers and technicians. The child is not a small adult and paediatric nuclear medicine is like a suit made to measure for each child: among other innovations, the unit designed and adopted a novel system of image acquisition, with a custom made cut out gamma camera acquisition table, still in use today in a new version (Fig. 9.2): the table has a hole in the middle of the same size of the gamma camera head, so that the child lies directly on the collimator, thus significantly improving the resolution of the images.

Gordon did ground breaking work in the use of nuclear medicine techniques in nephro-urology. He developed the concept that slow drainage in dynamic renography in the context of an ante-natally diagnosed hydronephrosis, does not necessarily mean obstruction. Together with his physicist Peter Anderson he set up a new cutting edge way to process the renogram: the clearance image, a purely functional image that reflects renal parenchymal function per pixel (very much loved by the surgeons, who used to call it “the poor man’s DMSA”), the pelvic excretion



Fig. 9.2 Custom made cut out gamma camera acquisition table

efficiency (PEE), an index to evaluate drainage taking renal function into account, the post-micturition view normalized to the dynamic renography, which takes into account gravity in the evaluation of drainage. Gordon developed the indirect radio-nuclide cystography (IRC) as a way to make the best possible use of the information available at the end of the renogram to evaluate the possible presence of vesico-ureteric reflux and to gain some insights on bladder function. He disseminated around the world all his findings in countless invited lectures at national and international conferences, and crystalized his practice in the European and British Guidelines on paediatric renography, of which he was a main contributor.

The Nuclear Medicine Unit at GOSH pioneered radionuclide studies on intractable epilepsy. The technique for paediatric ictal and interictal cerebral perfusion studies in children with epilepsy in the UK was set up at GOSH. Over the years, several other paediatric nuclear medicine centres in the UK established links with GOSH to get advice. GOSH was also to take a leading role in the molecular imaging assessment of children with neuroblastoma. The SIOPEN High Risk Neuroblastoma Study Group received a significant contribution from the nuclear medicine unit at GOSH with the MIBG studies. The quality of the GOSH MIBG studies was acknowledged to be outstanding in Europe, their number per annum among the highest. Professor Gordon authored the first Guidelines of the European Association of Nuclear Medicine (EANM) on MIBG scintigraphy in children in 2002.



Fig. 9.3 Bone densitometry scanner

In the year 2000 a bone densitometry scanner was purchased (Fig. 9.3), as well as a third gamma camera, as part of the expansion of the Nuclear Medicine Unit. With the help of the now Professor Mary Fewtrell, a paediatrician of the Nutrition Unit in the Institute of Child Health, a correction for the height and weight of the child was introduced, thus enabling a proper evaluation of the bone density results in children.

In 2008 the Nuclear Medicine Unit moved to a different part of the hospital, in a new purpose built more spacious department. A new Siemens Symbia T2 SPECT CT gamma camera was installed (Fig. 9.4). In the following year, child friendly low dose CT acquisition protocols were developed, with the help of senior CT radiographers. With these protocols, the CT component of the examination is SPECT guided and limited to the area of clinical interest, and administers a very low radiation dose, often below 0.5 mSv. Gradually a new area of expansion of the clinical service was opening up, with a significantly increase in referrals for bone scans with SPECT CT in children and adolescents with back pain and extremity pain, in requests for DMSA with SPECT CT in children with renal stones, and of MIBG scans with SPECT CT in neuroblastoma patients.

By the end of 2015, more than 400 SPECT CT examinations have been performed in children and adolescents, and preliminary results on the effectiveness of SPECT CT in paediatrics in different pathologies have been presented at national and international conferences. This is an expanding activity of the department, linked to the recent upgrade of the Hermes workstations that allows accurate co-registration of tomographic nuclear medicine images with CT and/or MRI performed separately.

In the last 3 years there has been a significant increase of the activity of the nuclear medicine unit in the field of gastrointestinal motility studies, thus meeting a long standing request from the Gastroenterology Department. The unit has made



Fig. 9.4 Siemens Symbia T2 SPECT CT gamma camera

available studies for the evaluation of colonic and small bowel transit in children with severe constipation, thus helping significantly clinical management.

Visitors to the department have continued to come from different parts of the world, especially the Indian subcontinent, and are allowing the establishment of professional links with those countries.

In recent years, the nuclear medicine unit has been involved in a project funded by the International Atomic Energy Agency (IAEA), geared to publishing a book on everyday practice of paediatric nuclear medicine. This publication will disseminate, especially in developing countries, part of the vast practical experience accumulated at GOSH over many years.

In conclusion, the paediatric nuclear medicine unit at GOSH has been and still is a reference point of paediatric nuclear medicine practice in the UK and abroad. Ground breaking work has been done and novel work is in progress for the better management of many children affected by a broad spectrum of pathologies.

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Lorenzo Biassoni I graduated in Medicine from the University of Rome “La Sapienza” and I undertook a specialty residency programme in Oncology at the University of Genoa. During this time I was fascinated by the developing use of nuclear medicine in Oncology, also stimulated by the example of my father, who was a general physician and university professor with special interest in thyroid diseases and in nuclear medicine. As a result, I decided to pursue a career in Nuclear Medicine. I enrolled in the specialist training programme in Nuclear Medicine at the University of Genoa. Subsequently I undertook the Master Degree programme in Nuclear Medicine at the University of London, while based at St Bartholomew’s Hospital under Professor Keith Britton. I continued my training in Nuclear Medicine in London at Guy’s Hospital under Professor Michael Maisey. After a number of locum jobs in different London hospitals, in 1999 I was appointed consultant in nuclear medicine at Barking, Havering and Redbridge NHS Trust, where I worked as a single handed consultant for almost 3 years. I subsequently joined Great Ormond Street Hospital for Children in 2002 (where I had worked before) and I had the chance to work closely with Professor Isky Gordon for almost 5 years. In 2006, following Professor Gordon’s retirement from the NHS, I succeeded him as Clinical Lead of the Nuclear Medicine Unit at GOSH. I also work for Barts Health NHS Trust 1 day a week, gaining experience in PET CT imaging. During my time at GOSH I have been involved in the Paediatric Committee of the EANM, which I chaired between 2004 and 2007. I also joined the Nuclear Medicine Committee of the British Institute of Radiology (BIR), where I served for 7 years. In 2007 I joined ARSAC as a paediatric nuclear medicine expert, and I served on that Committee for 8 years. In 2008 I was elected Fellow of the Royal College of Physicians. I am on the editorial board of the *European Journal of Nuclear Medicine and Molecular Imaging*, of *Molecular Imaging & Radiometabolic Therapy*, and of the *Journal of Cancer and Allied Specialties*, and the Associate Editor for Nuclear Medicine of the *BJR Case Reports*. I am a reviewer for several other scientific journals. I am passionate about teaching and I have organized many regional, national and international teaching events on paediatric nuclear medicine. I have been invited to give many lectures at national and international conferences. Currently my main goal is to expand the range of the examinations on offer at the Nuclear Medicine Department at GOSH. My research interests include nuclear medicine in paediatric oncology and nephro-urology, and SPECT CT in paediatrics. I have authored 35 papers in peer-reviewed journals and 8 chapters of textbooks.