Comprehensive Division
NUCLEAR MEDICINE
INTEGRATED ACTIVITY DEPARTMENT of IMAGING DIAGNOSTICS
Director: prof.ssa Maria Assunta Cova

NUCLEAR MEDICINE Comprehensive Division
Director: Dr. Franca Dore
Phone: 040 – 399 2573; Fax: 040 – 399 2572
e-mail: franca.dore@aots.sanita.fvg.it

Technical Coordinator: Barbara Pelos
Phone: 040 – 399 2017; Fax: 040 – 399 2572
e-mail: barbara.pelos@aots.sanita.fvg.it

<table>
<thead>
<tr>
<th>USEFUL NUMBERS</th>
<th>TELEPHONE</th>
<th>FAX</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>SECRETARIAT</td>
<td>040 - 399 2428</td>
<td>040 - 399 2572</td>
<td>Ground Floor</td>
</tr>
<tr>
<td></td>
<td>040 - 399 2416</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEDICAL DIRECTORS</td>
<td>040 - 399 2132</td>
<td>040 - 399 2572</td>
<td>1st Floor</td>
</tr>
<tr>
<td></td>
<td>040 - 399 2117</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LABORATORY</td>
<td>040 - 399 2548</td>
<td>040 - 399 2572</td>
<td>1st Floor</td>
</tr>
<tr>
<td></td>
<td>040 - 399 2853</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RADIATION MEDICINE</td>
<td>040 - 399 2127</td>
<td>040 - 399 2572</td>
<td>Underground Floor</td>
</tr>
<tr>
<td>TECHNOLOGISTS’ ROOM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>REPORTING ROOM</td>
<td>040 - 399 2130</td>
<td>040 - 399 2572</td>
<td>Underground Floor</td>
</tr>
<tr>
<td>ADMISSION</td>
<td>040 - 399 2129</td>
<td>040 - 399 2572</td>
<td>Underground Floor</td>
</tr>
<tr>
<td>OPERATIVE ROOM</td>
<td>040 – 399 2128</td>
<td>040 – 399 2572</td>
<td>Underground Floor</td>
</tr>
</tbody>
</table>

Via Pietà 19 – 34121 Trieste
medicina-nucleare@aots.sanita.fvg.it; www.aots.sanita.fvg.it
Dear Patient, we know that the word “nuclear” conveys the meaning of something terrible, and the need to perform a diagnostic test in a centre of Nuclear Medicine can raise fears. To help you cope calmly, this brochure is going to provide you with some preliminary information, pending our meeting at the time of the test.

Nuclear Medicine in Trieste started in October 1959 thanks to prof. Sergio Lin, as a Service associated with the Oncology Division. In April 1962 prof. Lin was entrusted with the role of Chief Physician of the Autonomous Service of Nuclear Medicine.

At present, Nuclear Medicine is a Comprehensive Division of Trieste University Hospital.

The Division is located in via della Pietà 19 (Tumour Centre):

- **Ground Floor**: Secretariat, Coordinator’s Office
- **First Floor**: DEXA (CBM) tests, Laboratory, Director’s Office, Physicians’ Office.
- **Underground Floor**: Diagnostics Rooms for scintigraphic tests.

On the Underground and First Floor there is a change dispenser and some food and drink vending machines; on the Ground Floor there is a public phone.
**What is Nuclear Medicine?**

Nuclear Medicine is the branch of medicine that uses artificial radionuclides in diagnosis, therapy and biomedical research.

In a suitable chemical form or conjugated with molecules or cells acting as carriers, radionuclides are administered into the body as solutions, suspensions, aerosols or in other forms, and either work as functional tracers, thus making it possible to carry out “in vivo” diagnostic studies, or concentrate on pathological tissues, allowing their detection or – sometimes – their therapeutic irradiation.

Nuclear Medicine is first of all an irreplaceable diagnostic service, that is available to general and specialist medicine and which can provide reliable solutions to several diagnostic problems. For this to come true, the nuclear physician should be familiar with the modern medical-surgical issues and entertain a constant dialogue with the physicians dealing with them.

Unlike radiologic images, formed through the attenuation of the x-ray beam by the tissues located between the x-ray producing equipment and the detecting system, medical-nuclear images are obtained detecting the radiations emitted by the radiological drugs distributed around the body.

According to the various nuclear medicine methods, patients are administered a radiological drug, suitably chosen so that it concentrates in the organ studied or it works as a tracer of a specific biological function.

Scintigraphic images represent the spatial or the spatial-temporal distribution of the radiological drug. The information obtained can often be represented as numerical parameters, making it possible to obtain semi-quantitative or quantitative data. The images derived are the morphological expression of a vital function.
What is it for?

DIAGNOSTIC applications include:

- Fully “in vitro” laboratory applications (e.g. RIA dosage)
- "in vivo" and "in vitro" applications, studying diseases by counting radioactivity in body fluids after administering suitable radiological drugs to the patients under examination (e.g. measurement of the haematic and plasmatic volume, calculation of the erythrocyte mass, vitamin B12 Absorption Test)
- "in vivo" applications of morpho-functional imaging, commonly known as scintigaphies, with a very wide field of application because, by using the suitable radiological drug, several physiological functions and their alterations (if any) can be studied.

Instruments to be used in “in vivo” Nuclear Medicine:

2 gamma-cameras (one of which is a SPECT/TC gamma camera) connected with data processors.

Both pieces of equipment can acquire rapid sequence planar, static or dynamic images and carry out SPECT surveys; the SPECT/TC gamma camera can provide SPECT/TC anatomic-functional image fusion;

1 DEXA Densitometer to carry out Computerized Bone Mineralometry, both on the whole body and on specific skeleton segments (lumbar rachis, femur and wrist).

Two intraoperative Gamma Probes for radioguided surgery: sentinel lymph node to detect breast cancer, melanoma and parathyroid adenomas.
List of Diagnostic Tests Performed:

Cardiac Apparatus
- Equilibrium angiocardioscintigraphy
- Stress myocardial SPECT or SPECT with pharmacological test
- Rest myocardial perfusion SPECT

Osteoarticular Apparatus
- Total body bone scintigraphy
- Polyphasic segmentary bone scintigraphy
- Bone marrow scintigraphy
- Bone mineralometry: whole–body, segmentary (lumbar rachis, femur, wrist), vertebral morphometric analysis.

Gastroenteric Apparatus
- Gastroesophageal and duodenogastric reflux
- Liver scintigraphy
- Liver SPECT
- Sequential hepatobiliary scintigraphy
- Splenic scintigraphy
- Salivary gland scintigraphy
- Scintigraphy to reveal hepatic angioma lesions
- Scintigraphy to detect gastroenterorrhagia
- Diagnosis of Meckel's diverticulum

Urinary Apparatus
- Static renal scintigraphy
- Sequential renal scintigraphy
- Sequential renal scintigraphy with pharmacological test (ACE inhibitor)
- Sequential renal scintigraphy with pharmacological test (diuretic)
- Direct cystoscintigraphy
- Indirect cystoscintigraphy

Respiratory Apparatus
- Perfusion lung scintigraphy
- Ventilatory lung scintigraphy
- Lung SPECT
Endocrine System
- Thyroidal captation curve of 131 I-Na
- Thyroid scintigraphy
- Parathyroid gland scintigraphy
- Total Body scintigraphy with 131 I-Na
- Adrenocortical scintigraphy
- Adrenomedullary scintigraphy

Central Nervous System
- Cerebral perfusion SPECT
- Cerebral SPECT with $^{123}$I-DATSCAN
- Cerebral SPECT with $^{123}$I-IBZM

Oncology
- Total Body scintigraphy with 67 Gallium citrate
- Total Body scintigraphy with receptor tracers (Octreoscan)
- Total Body scintigraphy with 123 –MIBG and 131-MIBG
- Scintimammography

Studies on Acute and Chronic Flogosis
- Total Body scintigraphy with 67 Gallium citrate
- Total Body scintigraphy with marked autologous leukocytes
- Total Body scintigraphy with marked autologous granulocytes.

Other Diagnostic Tests:
- Lymphoscintigraphy to diagnose lymphedemas.
- Tracking the sentinel lymph node in breast cancer
- Tracking the sentinel lymph node in melanoma

“In vitro” activities:

Radioimmunometry and Radiopharmacy Laboratory
- Plasma Renin Activity.

Cell Marking, such as:
- Overall leukocyte population
- Granulocyte marking
PET
Positron Emission Tomography (PET) is an instrumental diagnostic technique aimed at revealing, by means of images (qualitative assessment) and numerical parameters (quantitative assessment), the distribution of radiotracers marked with positron-emitting radionuclides, which are generally administered to patients by intravenous injection.

Over the last few years, and in particular between 2001 and 2002, a new technology, known as PET/CT or PET/CAT, has proved successful. The new equipment combines two technologies, PET and CT (computerized tomography) so that the PET “functional” information can be combined with the CT “morphological” information. The two images are joined together and the clinical results are extremely effective.

Thanks to PET technology, organs and biological structures can be studied by means of specific radiotracers that allow a local assessment of glucidic, lipid and protein metabolism, as well as of the receptor perfusion, distribution and density of several sites. At the same time, radiotracers can ascertain and localize focal diseases of different nature (tumours, flogosis, etc). Moreover, the local determination of biochemical processes provides more
thorough assessments on the tissue response to any therapeutic treatment.

For instance, it is by now clinically recognized that PET can detect metastasis in any organ, irrespective of the size, with the consequent staging of neoplasia and the definition of the patient’s treatment programme, thus preventing him/her from undergoing invasive procedures (surgery, biopsy, etc) and saving the National Health Service's money.

The great potential of PET in the “in vivo” assessment of biochemical processes lies also in the wide choice of tracers that can be marked with positron-emitting radionuclides, such as Fluorine-18, Carbon-11, Nitrogen-13 and Oxygen-15.

The opportunity to study, without resorting to invasive procedures, the biochemical and biological processes that form the basis of the functions (and the diseases) of organs and apparati, as well as the availability of information that sometimes can be obtained only by means of interventional procedures, have led to the gradual introduction of PET technology in the clinical practice, with significant applications in Neurology, Cardiology and especially Oncology.

At present there are three main fields of application:

1. Neoplastic diseases: differential diagnosis and characterization of those lesions that have not been determined by preliminary diagnostic investigations, staging, assessment of neoplasia extension, follow-up, differential diagnosis between neoplastic recurrence and post-surgical or post-radiotherapy fibrosis, assessment of the therapeutic response, etc.

2. Neurological disorders: Alzheimer’s disease, Parkinson’s disease, focal drug-resistant epilepsy, cerebrovascular diseases, etc.

3. Cardiologic diseases: coronary diseases, ischemic heart disease, clinical decision-making for patients with left ventricular dysfunction, myocardial vitality, etc.
Next to the activity of clinical diagnostics, PET can be used in the various fields of research – clinical activity, pharmacology, radiology, physics and information technology (early diagnosis of relapse, assessment of response to the new non-cytotoxic neoplastic agents, functional mapping in neurosurgery, etc).

TELEPHONES

For security reasons mobile phones must be turned off: they can interfere with medical electrical instruments.

WARD STAFF

Apart from 1 Director, the staff includes:

- 3 Medical Directors, white uniform
- 1 Biologist, white uniform
- 1 Technical Coordinator, sky-blue uniform with white collar
- 1 Secretary
- 7 Radiology Technicians, sky-blue uniform
- 1 Registered Nurse, green uniform
- 1 Licensed Practical Nurse, yellow uniform
- Healthcare Assistants, light blue uniform.
- Cleaning on the ground floor and first floor (physicians’ rooms) is done by a private firm; its staff wear white trousers and a jacket with thin white and cyclamen stripes.
- Cleaning on the first floor (CBM room-laboratory) and on the underground floor is done by the Healthcare Assistants.
DO YOU REQUIRE ANY OTHER INFORMATION?

For booking you can reach the Secretary on the ground floor from 11.00 a.m. noon to 13.00 pm on Tuesday and Thursday.

If you wish to get in touch with a physician on the phone, please call after 12.00 noon, not to interrupt tests.

The Director of the ward is available to provide further information and to receive proposals on potential improvements, communications or any complaint; please call 040 – 399 2573.

To book CBM and Thyroid Scintigraphies, please go to the Single Booking Centre (CUP) with your General Practioner’s referral; the CUP desks are located at Maggiore Hospital, at Cattinara Hospital and in the various Districts of the Local Health Authority.

For any other services, please contact the Secretary: on Tuesday and Thursday from 12.00 p.m to 14.00 p.m.

In case of real emergency certified by the General Practitioner, the tests required will be carried out within 24 hours. Book your appointment by getting in touch with the ward; phone the Secretary (040 – 399 2416)

HOW, WHERE and WHY.

All scintigraphies and tomoscintigraphies aim at studying the in-vivo distribution of radiological drugs, i.e. compounds with different biological behaviour marked with gamma-emitting isotopes or radionuclides.

Radiological drugs are usually administered by intravenous injection and behave as tracers inside the body under examination.

The administration of the tracer takes place by intravenous injection, by mouth (capsules) or by aerosol.
To carry out the test, a gamma camera is used; this kind of equipment is controlled by safety devices, therefore it poses no risk to the patient.

The test can last from a few minutes to one hour.

Some tests start with the injection, others require an interval of a few minutes or a few hours (or even some days) between the injection and the scintigraphy; for this reason, according to the test required you will have to wait as much as necessary or come back several times.

In order to reduce exposure to ionizing radiations (this point concerns patients, hospital staff and people coming to the hospital to book an appointment, to receive information or to collect reports), a person undergoing scintigraphy must follow a special route in the ward of Nuclear Medicine:

The patient enters a “cold” waiting room where forms and papers are filled in and cleared, then he/she is admitted to an outpatient unit for the preliminary diagnostic assessment, and only if he/she has to undergo scintigraphy, he/she will proceed to the “hot” area where the test will take place; this area is provided with its own waiting room and toilets, and a direct exit to the corridor on the floor; at the end of the test, the patient will leave from this door.

The tests with radioactive isotopes are important because they reveal the functioning of an organ; these isotopes do not differ from
the ordinary body components. Our thyroid gland does not distinguish between radioactive iodine and stable iodine, just as the bone does not distinguish radioactive from stable phosphonates.

Following their “traces” in the body, one can detect the early signs of a disease, when this has not yet altered the organs’ structure, but the “function” of the organ is starting to change.

Therefore, the pathological changes of our body become visible before their clinical appearance.

We feel it is our duty to carry out these tests only on patients who really need them, when the valuable information gained through scintigraphy cannot be acquired with other techniques.

On the day of the test, patients are recommended to carry their medical records (previous lab tests, clinical records, etc.) so that the indication to test the patient can be properly assessed. Under special circumstances, our physicians may decide to refer patients back to their General Practitioners, recommending further tests instead of the scintigraphy required (article 3 Decree Law 187/00).

Some tests require special precautions (fasting, suspension of medication, etc.); patients are invited to carefully read the specific instructions for each test required. Such instructions are given to the patients at the time of booking.
FURTHER INFORMATION

Even though the risks connected with the small radiation dose which is administered are very low, we deem it necessary to provide detailed information; first of all, the equipment used for the scintigraphy test does not emit radiations, but merely receives them from the patient’s organs, the real source of radiations. The equipment measures such radiations and then maps their function: therefore, the longer duration of a test in comparison with another does not imply a greater exposure to radiation.

Secondly, the radioactivity introduced in the body is gradually reduced both through the radioactive decay and its disposal through urine, feces etc…

Our hospital staff take every precaution in order for exposure to radiations to be as low as possible (in keeping with the test requirements), and justified by the benefits of an early and accurate diagnosis that would be impossible with other techniques.

Ionizing radiations are (and have always been) present in the environment because of the natural radioactivity of some substances.

Human exposure to overall background radiation varies according to the area (geological features, altitude, etc). Such exposure is measured in Sievert (Sv) and on average it corresponds to a dose equivalent amounting to 2 mSv/year. The sources of medical radiations provide 12% of the overall background radiation, whereas the natural background radiations are responsible for 87%. Of the artificial radioactivity produced by the human being, 90% is attributable to all radiological procedures, 4% to nuclear medicine procedures and the remaining 6% to other activities (extractive industry, nuclear fallout, nuclear plants wastes and other various activities).

In general, exposure to radiations deriving from nuclear medicine tests is more than acceptable nowadays, if one thinks, for example, that a renal scintigraphy is equivalent to 8 weeks of exposure to
the natural background, or that a thyroid scintigraphy with 99mTc is equivalent to 6 months of exposure.

Special caution must be adopted with women of fertile age because, when a radiological drug is administered, the woman may be pregnant without being aware of it, with the consequent useless irradiation of the conceived child.

The doses administered in nuclear medicine with diagnostic purposes are largely below the threshold which can produce effects on the embryo; anyway nuclear physicians have the duty of preventing any useless irradiation, also in order to protect the woman’s psychological condition during pregnancy, should she fear the possibility of having caused damage to the child.

Therefore the test must be carried out preferably during the first 10 days of the menstrual cycle.

Prudentially, in case of menstrual delay, the patient must be dealt with as if she were pregnant, unless there is clear evidence to rule it out.

In case of “delay” in a woman with irregular menstrual cycle a preliminary pregnancy test can be recommended.

In case of pregnancy, the test can be carried out only in case of emergency, or if the General Practitioner deems it necessary (Decree Law 187/00, Art.3).
Consultation between the nuclear physician and the referring physician is advisable, in order to decide whether the risk of doing without the necessary diagnosis is higher than the risk deriving from low foetal irradiation.

If the test cannot be postponed, women shall interrupt breast-feeding long enough to reduce breast milk radioactivity to negligible levels. The time depends on the type of tracer administered to the patient, who will be informed about it at the time of the test.

**Breast-feeding must be definitively stopped after scintigraphy employing Iodine 131 and Gallium 67.**

**MOREOVER...**

During your stay in our ward, you will be told where to wait for the test and the toilets you are supposed to use; since radioactive tracers are quickly expelled from our body, this simple precaution prevents other people from being exposed to radiations.

At the end of the test, the risk of radiation for the patients' relatives is thus negligible, because almost all radiological drugs used lose their radioactivity quickly (after a few hours) and they are employed sporadically.

The doses absorbed by the patient at different intervals, immediately after being administered and after 2 hours, are reassuring also for those tests that involve quite a high activity, such as bone scintigraphy and angiocardiocscintigraphy (at a distance of 30 cm: 0.01 mSv/hr immediately; from 0.005 to 0.007 mSv/hr after 2 hours).

Yet, close and protracted contact should be avoided in the first few hours after the test, especially with regard to children and pregnant women.
The most important factor for dose reduction is distance, because ionizing radiations lose energy when passing through matter, and the reduction in dose intensity is proportional to the square of the distance from the source – in this case the patient.

Risks for the exposed staff

The Nuclear Medicine staff are required to limit the risk of exposure to activities closely connected with handling radiological drugs, the technical performance of the test and the medical and nursing assistance, if necessary. The staff shall reduce, as much as possible, useless exposure deriving from a protracted and close contact with patients who have already been administered their dose.

Patients are kindly required to ask for any explanations before the administration of the radiological drug, at the time of booking the appointment or when collecting the medical report.

Patients should not take offence at the staff carrying out very quickly the procedures that follow the injection of the radiological drug.

Drawn up in cooperation with the Communication Office and the Public Relations Office
Phone: 040 – 399 6301 ; 040 – 399 6300; fax 040 399 6298
e-mail: comunicazione@aots-sanita.fvg.it
Strada di Fiume 447 – 34 149 Trieste

Revision 02 – july 2013