WEBINAR

Imaging Equipment: CT
Technology, usage, and service

WEDNESDAY NOVEMBER 16
3 PM UNIVERSAL TIME (UTC) 10 AM NEW YORK TIME (ET)

REGISTER FOR FREE
CT Introduction

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Computed Tomography (CT)

• A CT scan is a diagnostic imaging exam that uses X-Ray technology to produce images of the inside of the body.

• A CT scan can show detailed images of any part of the body, including the bones, muscles, organs and blood vessels.

• CT scans can also be used for fluid or tissue biopsies, or as part of preparation for surgery or treatment.

• CT scans are frequently done with and without contrast agent to improve the radiologist’s ability to find any abnormalities.
CT Major Sub-systems

- Power Distribution Box (aka A1 Main Disconnect)
- PDU
- Table
- Console
- Gantry
Computed Tomography (CT)

Two major evolutionary leaps occurred in the early '90s:

- Slip-ring Technology → Helical Scan
  Permits continuous rotation of tube and detector while maintaining electrical contact with the stationary frame.

- Multiple-row detector (Multi-slice)
CT Scan Modes

1. Scout Scan: Cradle moves, X-Ray Tube is stationary
   The scout scan is used to identify the region of interest and select the scan area.
CT Scan Modes

1. Scout Scan: Cradle moves, X-Ray Tube is stationary
2. Axial: Cradle is stationary, Gantry rotates
CT Scan Modes

1. Scout Scan: Cradle moves, Gantry is stationary
2. Axial: Cradle is stationary, Gantry rotates
3. Helical: Cradle moves, and Gantry rotates
Views
During a rotation, the X-Ray beam passes through the patient at different angles each new position of the beam detector relative to the patient anatomy is called a view or projection. Those views are used to create a CT image.
CT numbers (or HU) calculated for each pixel correspond to different tissue types.

- Low-density tissues are in the negative value range and appear gray to black.
- High-density tissues are in the positive value range and appear gray to white.

Examples:

<table>
<thead>
<tr>
<th>Material</th>
<th>CT Numbers</th>
<th>Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air</td>
<td>-1000</td>
<td>Low - Black</td>
</tr>
<tr>
<td>Lung</td>
<td>-700</td>
<td></td>
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<tr>
<td>Fat</td>
<td>-84</td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>Muscle</td>
<td>+40</td>
<td></td>
</tr>
<tr>
<td>Bone</td>
<td>+700 to 3000</td>
<td>High – White</td>
</tr>
</tbody>
</table>
3 Hazards

Radiation
The amount of radiation used during a CT scan is considered minimal; therefore, the risk for radiation exposure is low.
Pregnant women should notify their physician. Radiation exposure during pregnancy may lead to birth defects.

Axial
If a part in the rotating frame is replaced, the service engineer should apply the proper torque specified in the service manual.

Crush
The system has a Tilt sensor to prevent crushing the patient when tilting the gantry remotely from the operator console.
ASiR – Adaptive Statistical Iterative Recon

No Dose Reduction & No ASiR
mA 258 and SD 4.48

50% Dose Reduction & No ASiR
mA 151 and SD 5.27

50% Dose Reduction & 50% ASiR
mA 151 and SD 3.43
kV and mA analogy

- Higher kV \(\rightarrow\) more penetration  
  \((\text{Force applied})\)

  Higher mA \(\rightarrow\) Thin slice  
  \((\text{Sharpness})\)

CT Issues

- As x-rays passes through the body, it can be scattered or absorbed.
SAFETY CONTROL FOR COMPUTED TOMOGRAPHY AT HEALTHCARE FACILITIES IN JAPAN

Keiko Fukuta*1, Tetsuya Otsuka*2

*1 Osaka University Hospital
*2 Mito Brain Heart Center
Agenda

• Computed Tomography (CT scanner) in Japan
• The Government Policies and related strategies
• Healthcare facilities implementations
Agenda

• Computed Tomography (CT scanner) in Japan

• The Government Policies and related strategies

• Healthcare facilities implementations
International comparison of the number of CT scanners and exams, 2015 (or nearest year)

CT scanners, 2015 (or nearest year)

- Japan
- United States
- Iceland
- Denmark
- Korea
- Latvia
- Switzerland
- Latvia
- Greece
- Germany
- Italy
- Austria
- OECD34
- Belgium
- Portugal
- Finland
- Lithuania
- Sweden
- Spain
- Slovak Republic
- New Zealand
- Ireland
- Luxembourg
- Poland
- Estonia
- France
- Czech Republic
- Brazil
- Canada
- Chile
- Turkey
- Netherlands
- Slovenia
- Russian Federation
- Israel
- Hungary
- United Kingdom
- Mexico

OECD34: 25.7

Per million population

CT exams, 2015 (or nearest year)

- United States
- Luxembourg
- Belgium
- France
- Iceland
- Greece
- Korea
- Turkey
- Latvia
- Portugal
- Denmark
- Slovak Republic
- Germany
- OECD29
- Austria
- Israel
- Australia
- Hungary
- Spain
- Czech Republic
- Switzerland
- Poland
- Chile
- Netherlands
- United Kingdom
- Slovenia
- Finland

OECD29: 143.1

Per 1,000 population

1. Exams outside hospital not included.
2. Exams on public patients not included.
3. Exams privately-funded not included.

Comparison of the installed number of CT scanner (Hospitals vs Clinics)

The number of the single slice

- Hospital: 1,810 (40%)
- Clinic: 2,762 (60%)

The number of facilities

- Hospital: 5,036 (69%)
- Clinic: 5,001 (31%)

The number of the multi slices

- Hospital: 6,627 (57%)
- Clinic: 2,286 (43%)

Sourced from the Aggregation of medical facility survey, 2011
• Computed Tomography (CT scanner) in Japan

• The Government Policies and related strategies

• Healthcare facilities implementations
Medical Care Act

Maintenance and inspection of medical equipment is the **duty of the medical institution** and must be carried out appropriately by itself.

Medical Institution must
1. Place a medical device safety manager
2. Train for the safe use of medical devices for employees
3. Plan and implement regular maintenance appropriately
4. Collect safety information related to medical devices and share it to users
Requires planning regular maintenance and implement

<Mandatorily Medical Devices>

① Artificial heart-lung machine and auxiliary circulation device
② Ventilator
③ Blood purification device
④ Defibrillator (excluding automatic external defibrillator (AED))
⑤ Closed Incubator
⑥ Computer Tomography* 1
⑦ High-energy radiation generator for medical use (linear accelerator, etc.)
⑧ Medical particle beam irradiation device
⑨ Medical radiation irradiation device (Gamma knife, etc.)
⑩ Magnetic resonance imaging device (MRI device) *1

* 1 Maintenance Only

A Check List for daily inspection
（Pre-use and Post-use）
Safety management system for medical radiation is the **duty of the medical institution** and must be carried out appropriately by itself.

Medical Institution must

1. Place a medical radiology equipment safety manager
2. Formulate guidelines for the safe use of medical radiation
3. Train for the safe use of medical radiology for employees
4. Measures to manage and record the radiation exposure doses of those undergoing radiological treatment and to improve other measures for the safe use of medical radiation
   - Exposure doses measure
   - Exposure doses recording
   - Exposure dose measure and recording for other radiological medical equipment
   - Collect safety information related to medical radiology and share it to users
Exposure doses measure and recording

<Mandatory Medical Radiology Equipment>

① Mobile Digital Cardiology X-ray fluoroscope
② Mobile Analog Cardiology X-ray fluoroscope
③ Fixed-type Digital Cardiology X-ray fluoroscope
④ Fixed-type Analog Cardiology X-ray fluoroscope
⑤ Cardiovascular X-ray diagnostic device combine Computed Tomography
⑥ Computer Tomography
⑦ Positron Computer Tomography device combine Computed Tomography
⑧ SPECT device combine Computed Tomography
⑨ Radioisotopes for positron tomography examination
⑩ Medical radioisotopes

* 1 Maintenance Only
Guidelines for Safety Management System for Medical Radiation

Published by Japan Radiological Society
Revised November 2019
Agenda

• Computed Tomography (CT scanner) in Japan

• The Government Policies and related strategies

• Healthcare facilities implementations
Medical equipment handled by occupation

• **Clinical Engineers (CE)**
  
  Life supporting machine
  
  E.g.) Ventilator, Hemo-dialysis Machine, hyperbaric oxygen equipment, heart/lung machine etc.

• **Medical Radiation Technologists (MRT)**
  
  Radiological equipment and MRI
  
  E.g.) X-Ray machine, **CT scanner**, Angiography, MRI, RI, Heavy Particle Ion Generator etc.

• **Medical technologists/ Laboratory Technologists (LT)**
  
  Laboratory machine
  
  E.g.) EKG, Urine test instruments, Biochemical automatic analyzer, Ultrasound etc.
The definition of MRT in Medical Law

A person who has received a national license from the Minister of Health, Labor and Welfare and is in the business of irradiating the human body with radiation (Including photography. Excludes irradiation equipment inserted into the human body) under the direction of a medical doctors or dentists.

Source from Article 2 of Chapter 1 of the Radiological Technologist Act

globalcea.org
## Inspection type and Implementors

### Type of inspection
- Dairy inspection
- Periodical inspection

### Implementors
Users
- e.g.) Physician, Nurse, MRT

### Manufacturers

<table>
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**User Training**

Require to properly use medical radiation equipment

- **When**: At the time of purchase
  - As need
- **Whom**: MRT
- **Details**: Usage & troubleshooting
- **Methods**: Manufacture staff teach to MRT face-to-face

- **When**: At the time of purchase
  - As need
- **Whom**: Staff working in a medical radiation environment.
  - e.g. Physicians, Nurses, CEs
- **Details**: Usage & troubleshooting
- **Methods**: Video viewing and a mini-test after video viewing
Radiation doses measure and recording

• When: As you work
• Who: Users of equipment.
  e.g.) Physicians, Nurses, MRT, CEs
• Place to measure: Body on the clothes
  Body under the clothes
  Finger
  Neck
  On the glasses
Radiation Safety Management Committee

Executive Board

annual report

Radiation Safety
Management Committee

- Selected members
- Created of guidelines for the safe use of medical radiation
- Reported on the activities of the year, as a post-event report
- Hold an annual meeting
  * A temporary meeting will be held in the event of an emergency notice or serious accident.
CT scanner was installed a lot of hospitals and clinics in Japan

- MRT under the Radiation safety manager manages CT scanner at hospitals
- Physicians and nurses need to manage it at many clinics due to no MRT

In small clinics, maintenance and measurements of CT scanner are not implemented properly due to luck of human resource, finance and recognition.
• Japan has a higher installation rate of CT scanner than other countries.

• The Japanese government requires safety control of medical devices, especially medical radiation including CT scanner.

• Health facilities follow the government requirement such as training, maintenance, radiation dose measure and record for patients and operators.

• Radiation Safety manager was appointed and establish the radiation safety management committee under the executive bord.

• Although CT scanner is well managed by MRT based on the safety radiation manager in hospitals, it need to improve in small clinics.
References

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