Initial Clinical Experience with Siemens Symbia SPECT-CT

Frank P DiFilippo, PhD
and
Manuel D. Cerqueira, MD

Cleveland Clinic Foundation, Cleveland, OH USA
Overview

Part One: (F. DiFilippo, PhD)
- Instrumentation / Technical experience

Part Two: (M. Cerqueira, MD)
- Clinical experience
Siemens Symbia SPECT-CT
Symbia scanner design
Siemens configuration

Configuration options

- Symbia “SPECT-Only”
- Symbia T
- Symbia T2
- Symbia T6

CT: Siemens Emotion series (air-cooled)
CT detector arrays

Symbia T6

3mm  2mm  2x1  8 x 0.5 mm  2x1  2mm  3mm

Symbia T2

Variable Collimation (1.0 – 10 mm)

2 x 5 mm

Symbia T

Slice width matched to SPECT data

2 x 5 mm

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CT design

- Patient port diameter: 70 cm
- CT reconstructed field of view: 50 cm
- CT rotation speed:
  - T2: 0.8 sec, 1.0 sec, 1.5 sec
  - T6: 0.6 sec, 0.8 sec, 1.0 sec, 1.5 sec
- Tube current range:
  - T, T2: 30 – 240 mA
  - T6: 20 – 345 mA
- Tube voltage settings:
  - T2, T6: 80 kV, 110 kV, 130 kV
Gamma camera design

- “HD4” digital detectors (e.cam)
- 59 photomultiplier tubes
- Rectangular FOV: 53.3 cm x 38.7 cm
- NaI(Tl) crystal / Intrinsic Spatial Resolution
  - 3/8” (9.5mm): ≤ 3.8mm CFOV, ≤ 3.9mm UFOV
  - 5/8” (15.9mm): ≤ 4.5mm CFOV, ≤ 4.6mm UFOV
- Collimators:
  - LEUHR, LEHR, LEAP, LEHS, MELP, HE, UHE
System design

- **Table**
  - Maximum weight: 204 kg (450 lbs)
  - Maximum SPECT-CT overlap: 184 cm (5 “spins”)
  - Material: Carbon fiber (CT compatible)
  - Rear catcher (maximum deflection < 2mm)

- **Gamma camera motions**
  - Gantry Rotation, Radial motion, Tangential motion, Angular Pivot, Caudal Tilt

- **Collimator carts**
  - Four collimators per cart
  - Cart docks sideways (with table in place)
Symbia collimator exchange
Symbia at Cleveland Clinic
Symbia at Cleveland Clinic
Symbia at Cleveland Clinic

Installation notes:

- **Scanner Room**
  - Cleveland Clinic room size: 11.5’ × 24’
  - “Minimum” room size: 12’3” × 20’8” (3.7m × 6.3m), or 15’2” × 19’ (4.6m × 5.8m) if angled

- **Control Room**
  - Depth: 6’ (1.9m)

- **CT**: Air-Cooled (no chiller)

- **CT Shielding**
Workstations

Acquisition & SPECT Processing:
- One “ICS” e.soft / Syngo workstation (WinXP)
- Shared between SPECT and CT
  - Start with e.soft workflow for SPECT acquisition
  - Automatically launches CT acquisition
  - After CT, returns to e.soft workflow for SPECT reconstruction and post-processing

CT Reconstruction:
- One “IRS” workstation (WinXP)
Quality assurance

CT Daily Quality Assurance – phantom

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Quality assurance

- **Gamma camera QA**
  - Daily: Peaking and Low-count flood
  - Monthly: Routine calibrations
    - Tuning, High-count Intrinsic Flood, CORs

- **SPECT/CT Co-Registration**
  - Calibration performed after mechanical servicing
  - Mulit-point source phantom (mixture of Tc-99m solution and iodinated contrast)
Quality assurance

SPECT/CT Co-Registration

Measurements:

No weight on table:
- 2mm offset

60kg (132lbs) lead bricks:
- 4mm offset
Reconstruction / processing

Typical processing workflow

- Initial SPECT reconstruction (without Att Corr)
- Image fusion (verify or adjust CT registration)
- Attenuation map generation
- Scatter estimation
- SPECT reconstruction
  - With Attenuation Correction
  - With Scatter Correction
  - With Collimator Response Correction (“Flash 3D”)
Cardiac SPECT/CT misregistration

Correct registration (shallow breathing)

Simulate breathing artifact:

Offset CT (10mm axial, 10mm trans)

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SPECT/CT protocols

Attenuation Correction

- **Cardiac**
  - Elimination of artifacts (breast attenuation, diaphragmatic attenuation)

- **Brain**
  - Improved accuracy over calculation-based methods
  - Software-based fusion possible

- **Oncology**
  - Improved lesion conspicuity
SPECT/CT protocols

Anatomic Localization

- Oncology
  - Parathyroid, octreotide, MIBG, prostascint, gallium, etc.

- General nuclear medicine
  - Lymphoscintigraphy, CSF leak, shunt patency, etc.

“One-stop shop” exams

- Diagnostic CT (with or without contrast)
- Calcium scoring
“Software Fusion”
Auto-registration of:

- SPECT image (Siemens Symbia)
- Coronary CTA (Siemens CT Sensation 64)