1) The Technological Transition of X-ray Computed Tomography

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BACKGROUND : The historical review about X-ray CT scanner is shown as follows ;
(1) in 1917 : J.Radon(Austria) reported,
"Theory of image reconstruction by projection data"
(2) 1949 : S. Takahashi(Japan) developed,
"Axial tranverse tomography" so called "TAKAHASHI-TOMOGRAPHY"
(3) 1961 : W.H. Oldendolf tried,
"Reconstruction of axial-transverse images for phantom-structure by R.I. source"
(4) 1963 : A.C. Cormack(U.S.A) reported,
"Theoretical-analysis for the image reconstruction by X-ray"
(5) 1972 : G.N.Housfield & J.Ambrose(U.K) reported,
"First clinical report of X-C.T. examination in Atkinson Morley's Hosp."
(6) 1973 : Product debut of "E.M.I Scanner" at R.S.N.A Show in chicago
"First generation(Translate-Rotate Type) brain scanner"
(7) 1979 : Housfield & Cormack received "Award of Nobel-Prize"
(8) 1985 : TOSHIBA Corp. developed,
"Fourth generation("Nutate-Rotate Type) X-C.T. scanner with "Slip ring" mechanism.
(9) 1986 : TOSHIBA Corp. patent registration of "Helical-scanning" C.T. in U.S.A
(10) 1998 : Debut of "Multi-slice Type" C.T. scanner at R.S.N.A Show

GENERATIONS : X-ray C.T. scanners are categorized by scanning system as follows,
(1) First generation(71) : "Translate-Rotate(T-R) Type" C.T. scanner,
Translate scanning by pair of X-ray detector & pencil like(narrow) X-ray beam every 1°
of the beam **rotation**(0° ~180°), For brain exam only.
(2) Second generation(73) : "T-R Type"
Translate scanning by narrow fan(3° ~10°) beam every 3° or 10° of **beam rotation**
(0° ~180°), For brain & body exam
(3) Third generation (75) : "Rotate-Rotate(R-R) Type"
X-ray detector array & fan(~40°) beam X-ray rotate(0° ~360°)
For whole body examination.
(4) Fourth generation
Fan beam X-ray rotates(0° ~360°) against the stationary detector array(85) :

"Nutate - Rotate(N-R) type"

Fan beam X-ray rotates(0° ~360°) around the nutating detector array.

"Slip ring" mechanism for high voltage power supply to X-ray tube.

(5) Fifth generation(76~85) : High Speed Electron Beam Scanning Type

Electron Beam Scans over 4 Tungsten semi-ring belts(0° ~210°).

2 detectors make up to 8 slices in 50ms scanning.

For cardiac or pediatric examination(max. 17 scan/s)

(6) Helical scanning X-ray C.T.(89) : Single detector array type introduced

"Sub-second scanning age"

(7) DICOM-3 interface & 3-D display for I.V.R application(94)

Global trend for "Digtal Imaging & Communications on Medicine"

(8) Multi-row Detectors(Multi-slice) Type(98~99)

Facing to "Half-second scanning age" (See, V.T.R presentation)

COMPETITIVE MANUFACTURERS

Many medical imaging companies entered in C.T. market and faded out in the past, The aspect of severe struggling for existence as a C.T. manufacturer was implied in "Figure3" shown below, which indicated competitors in the embryonic and growing period of C.T. scanner market in mid '80s.

Applox 20 companies penetrated in the early period and current survivals are around only 7 or so.

Not so many manufacturers could afford for significant resources of sustaining technological innovations in next C.T. generation.

FUNDAMENTAL REQUIREMENTS

Essential requirements for C.T. scanner are always as follows :

(1) Informative image quality with minimized dosage

(2) Better cost performance

(3) Ease of operation

(4) Higher throughput

(5) Compactness for space saving

(6) Reasonable service contract offering

(7) Minimized down-time(Electronic remote maintemance & parts supply)

(8) Environmental considerations(for E.M.C. etc.)

KEY COMPONENTS

Integrity of advanced key components is important for reliable C.T. assembly in helical scanning age.

(1) High power X-ray tube assembly with easy access for replacement

(2) Precise upper beam collimating & lower beam trimming mechanism

(3) Stable and uniform X-ray detector array

(4) Rigid gantry for high speed helical scanning operation

(5) Powerful and compact "flat peak" type high voltage generator

(6) High speed A/D converter and short time image reconstruction computer unit

(7) DICOM interface

(8) Flexible 3-D display("Fly through" capability)

EXPECTATIONS FOR FUTURE

"What are more important items to be investigated for C.T. system from noe on ?

Clinical competitions among other major imaging modalities such as M.R.I, Nuclear Medicine, Conventional / Direct Digital X-ray and Ultrasound system should request to add possble more advantages or intrinsic values to C.T. system for future.

So far, present priority to be done could be as follows ;

(1) Minimize irradiation dosage

(2) More speedy operation

(3) Seeking for possible system integration with other imaging modality

2) 담도 결석 진단에 있어서 전산화 단층촬영의 유용성에 관한 비교 분석

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목 적 : 방사선학적 검사법에 따른 부위별 담도 결석의 진단능력을 비교하여 담도 결석 진단에 전산화단층촬영의 임상적 유용성을 알아보고자 하였다.

대상 및 방법 : 1998년 4월부터 1999년 3월까지 담도 결석으로 본원에 내원하여 전산화단층촬영(CT)과 초음파검사(U/S) 및 내시경적 역행성 담도조영술(ERCP)을 모두 시행한 환자 78명을 대상으로 하였으며, 담도결석을 간내담석과 간외담석, 그리고 담낭결석으로 구분하여 각 검사별로 진단능력을 비교 분석하였다. 통계적 분석기법은 빈도분석과 교차분석을 이용하였고, 95% 신뢰도를 설정하여 유의성을 검증하였다.

결 과

1. 조사대상자의 일반적인 특성으로 평균 연령은 58.8세였고, 성별은 남자 44명, 여자 34명이다.
2. 담도결석의 진단능력은 CT가 75.6%였고, U/S가 83.3%였으며, ERCP가 98.7%로 조사되었다.
3. 결석의 부위별 진단능력에 있어 간내담석은 CT가 39.3%, 간외담석은 ERCP가 60.4%, 담낭결석은 U/S가 37.6%로 각각 가장 높게 나타나, 통계적으로 매우 유의한 차이를 보였다($P<0.01$).
4. 간내담석을 보유한 15예 중 CT가 73.5%로 가장 높은 진단능력을 보였고, ERCP와 U/S가 각각 60.0%와 53.3%의 순으로 나타났다.

결 론 : 부위별 담도 결석의 진단능력에 있어 간외담석과 담낭결석은 ERCP와 U/S가 높게 나타난 반면, 간내담석의 경우는 CT가 가장 높은 것으로 분석되어, 간내담석의 진단시 CT의 적용이 매우 유용하며 필수적이라 사료된다.