:
:

^{99m}Tc- MIBI   1

.   .   .   .   2.   2.   3

3.   4.   4.

:   (EBT) ^{99m}Tc-
MIBI   .

:   (n = 6),   (n = 5),
(   )   (n = 11),   22   . EBT
16   -
.   4
18   . ^{99m}Tc- MIBI 20 mCi
SPECT   16   ,
,   EBT
.

:   0.71(0.14
ml/g/min,   1.16(0.24 ml/g/min
1:1.68(0.38   .   352 ^{99m}Tc- MIBI   28   EBT
0.54(0.19 ml/g/min,   324   0.79(0.22 ml/g/min
($p < 0.05$).

: EBT ^{99m}Tc- MIBI
.

,
.

.

(1).
Xenon- 133
(1),
(thermodilution),   (coronary sinus
indicator dilution),   (inert gas washout
method),   (labeled particles
administration into the coronary arteries)

(2).
Single
photon emission computed tomography (SPECT)
,

Positron emission tomography
(PET)
(3, 4).
MRI
,
(5- 7),
T 1   (spin labelling)
(deoxy- hemoglobin)   T2*
(8),   .
MRI

.   Electron
beam tomography (EBT)   MRI

CT

(9),

EBT

,

Technetium- 99ᵐ- methoxyisobutylisonitrile (MIBI)

.

(n = 6),
(n = 5),
(n = 11) 3 22 .
6 (: = 3:3,
= 28.5) .

5 (: = 4:1, 55.3
) , 4 ,
1
. 6
EBT (Imatron C- 150, Imatron Inc., San
Francisco, CA, U.S.A.)
.

EBT
7 ,
EBT 4 , 11 (: = 4:7,
51.3) .
1 EBT ⁹⁹ᵐTc- MIBI
1 .
8 20 gauge
(Magnasin ,) 10 ml ,

. 8 30 ⁹⁹ᵐTc- MIBI
7- 8 mCi (Cardiolite , Dupont, MA, U.S.A.)
, 10 EBT
4 Iopamidol, (Iopamiro 370, Bracco,
Milano, Italy), 1 Ioversol
(Optiray 350, Mallincrodt, Quebec, Canada) 50 ml 3
ml
. (tilt: 10°,
slope: 20°), R- R 40%
2 3 25
- . 4

:

(cine mode) 7 mm 8
. EBT
, ⁹⁹ᵐTc- MIBI 1
gamma camera (Varicam , Elscint, Israel)
⁹⁹ᵐTc- MIBI .
1
, 11
, dipyridamole adenosine .
6 1 0.14 ml/kg
dipyridamole 50 ml (STC-
527, Termo, Tokyo, Japan) 4

. 4

20 mmHg, 30 ST
1 mm , 210 mmHg

, 17
adenosine 140
(g/kg/min dipyridamole

4 .
Dipyridamole 6 adenosine 3 ,
, dipyridamole
10 , adenosine 3 ⁹⁹ᵐTc-
MIBI 20 mCi EBT
⁹⁹ᵐTc- MIBI
.

,

,
, (American Society
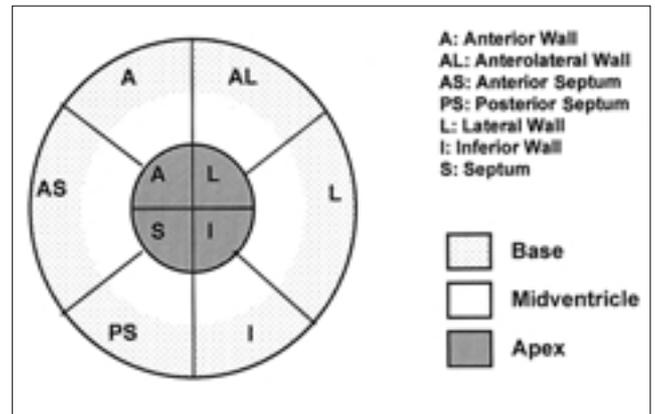of Echocardiography) 16
50 (Fig. 1). CT
, -

Fig. 1. Sixteen segments proposed by American Society of Echocardiography. Region of interests (ROI) was drawn according to the 16 segments on images of EBT.

.

CT

(Ultraacess , Imatron Inc., San Francisco, U.S.A.)

.

(indicator dilution theory)   -

        CT   CT   ,

        -

                (9).

        ,

        SPECT

.

⁹⁹ᵐTc- MIBI

        ,   ,   ,

        ,

.

        16   EBT   ⁹⁹ᵐTc- MIBI

                2

        ⁹⁹ᵐTc- MIBI

                ,

                EBT

        . , SPECT

        EBT

        .

        17± 2.8   ,

                3

(Fig. 2).   6   7

                4   16

                EBT   , 3

        (Table 1).   17   16

                        0.71± 0.14

ml/g/min,   1.16± 0.24 ml/g/min

        ,   1.68± 0.38   .

                (t- test, $p <$ 0.05)

                        .   17

        ,   EBT   ,

EBT

                .

        4   1

        ⁹⁹ᵐTc- MIBI

Table 1. Averaged Perfusion Value (ml/g/min) in All 16 Segments Measured by EBT in Normal Subjects

	Myocardial Perfusion		Coronary Blood
	Rest	Post-Stress	Flow Reserve
Normal Control (n = 6)	0.70± 0.17*	1.18± 0.24	1.73± 0.34
Diabetics (n = 7)	0.69± 0.10**	1.14± 0.27	1.67± 0.36
Atypical Chest Pain (n = 4)	0.75± 0.15***	1.16± 0.22	1.61± 0.52
Total (n = 17)	0.71± 0.14	1.16± 0.24	1.68± 0.38

There were no statistical differences of myocardial blood flow between control (*) and diabetics (**), control (*) and atypical chest pain (***), and diabetics (**) and atypical chest pain groups (***) (Analysis of Variances (ANOVA) test, $p <$ 0.01).
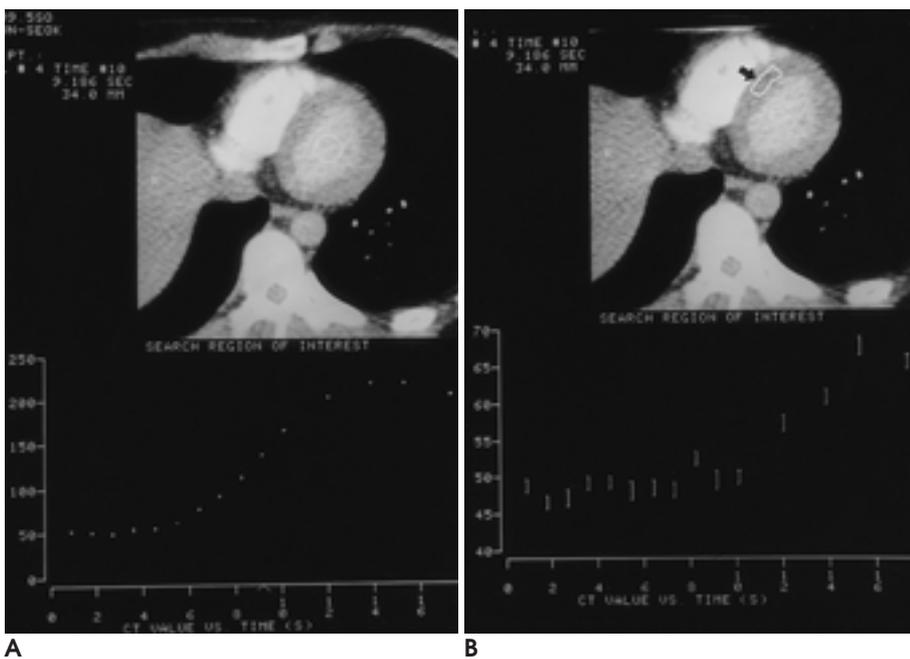

Fig. 2. Time-density curves were obtained from ventricular (**A**), and myocardial (**B**) enhancement in ROI drawn in anterior septum (arrow). Sixteen ROIs were drawn in the same way.

A   **B**

28   0.54 (0.19 ml/g/min   ,   .

52   0.86 (0.33 ml/g/min   PET

        .   99mTc- MIBI   (3, 4),   ,

                              0.93 (0.25 ml/g/min,   ,

        0.58 (0.15 ml/g/min   38%   (5- 8),   ,

    .

                                                    0.42   .

(0.19 ml/g/min   0.54 (0.28 ml/g/min   1.26   (EBT)   X

(0.14   . 99mTc- MIBI

                                                                                              ,

        0.62 (0.21 ml/g/min,   0.88   .

(0.10 ml/g/min,   1:1.41 (0.24   .   ,

                22   352   99mTc- MIBI

            28   EBT   0.58 (0.19 ml/g/min,

        324   EBT   0.75 (0.22 ml/g/min

                                            (Mann-

Whitney test, z- value of difference= 3.22, p- value < 0.01)

(Fig. 3). UltraAcess software

                        color coding

99mTc- MIBI   (Fig. 4).
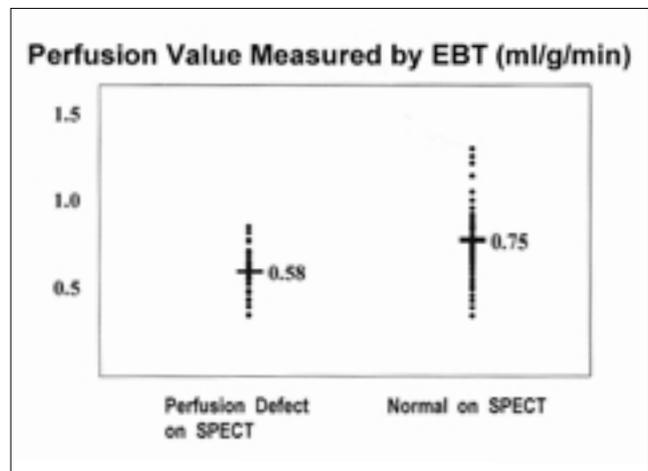
Fig. 3. Segmental perfusion values obtained from 352 segments in 22 patients and volunteers were plotted. Myocardial segments with normal SPECT findings were compared with the other segments that showed moderate to severe degree photon defect on 99mTc-MIBI scan. The segments with perfusion defect on radioisotope scan shows decreased perfusion value compared with that of normal segments.

                                Thallium 201

99mTc- MIBI   SPECT

                    .   ,

                              ,

    (subendocarcial)   (transmural)

                    ,

                        .

        ,   X-

A   B

Fig. 4. Perfusion map in 77-year-old male with myocardial infarction in inferior wall. Persistent perfusion defect is noted in resting (left) and stressed (right) images on EBT perfusion map (**A**). 99mTc-MIBI scan shows findings similar with EBT (**B**).

(10, 11),   (12, 13),
                (14),
        (15, 16)
                  ,
                        .
            CT   EBT   ,
MRI   gadolinium   ,
(intravascular contrast)   MRI   Gd-DTPA-albumin
            ,   thallium-
201, MRI   .

    EBT   MRI
                            . EBT

                        .
-            (time-concentration curve)   ,
                            ,
                        .
            1)
    , 2)   3)
                                    , 4)

    (17-20).

                    (vascular blood volume),
        ,   (integrity)
    .
                            ,
1   5-33%
            (22, 27).
                                    (mul-
ticompartment kinetic model)   ,
    (intercompartmental exchange kinetics)
                        .

                            2
        ,   ,   ,
        ,   ,   ,
            (22).
    Canty   (26)   Ioversol
            33±2%   ,
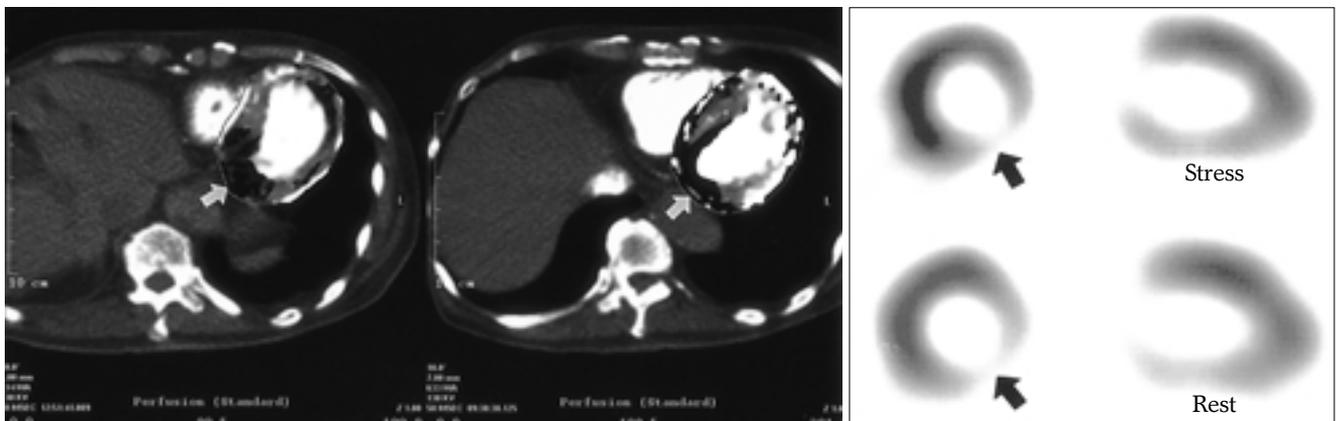   50±3% (p < 0.001)

            ,
                .   -
            ,
                .
                                        ,
                        . Wolfkiel (9)
                                ,
                (early washout)

                                        .

                .
        Wolfkiel (9)   CT
                        CT   (arte-
rial input function)
                ,

            .
                                        ,

                            0.71±0.14
ml/g/min   ,
            ,   .

                (Table 2) (3, 4, 27-29),
        EBT
    .   dipyridamole   adenosine

        ,   (1.68±0.38)
                (1.41±0.24)   PET
    (4)   ,

Table 2. Measurements of Myocardial Perfusion in Human and Dogs on Previous Investigations

Authors	Methods	Subjects	Measured Flow(ml/g/min)
Bergmann et al. (4)	PET	Human	0.90±0.22 (at rest)
			3.55±1.15 (dipyridamole)
Gould et al. (27)	EBT	Dog2	0.4 to 8
Hernandez et al. (28)	EFM	Dog	0.66
Shah et al. (3)	PET	Dog	0.44 to 2
Machnig T et al. (29)	MRI	Human	0.04 to 7.6
Lee et al*	EBT	Human	0.71±0.14 (at rest)
			1.16±0.24 (stress)

PET: Positron Emission Tomography
EBT: Electron Beam Tomography
EFM: Electromagnetic Flow Meter
MRI: Magnetic Resonance Imaging
*Present study, values measured in normal myocardium.

,

,

.

0.54± 0.19 ml/g/min

,

,

.

.

EBT

,

MRI

.   EBT

,   ,

,

,

.

EBT

.

EBT

.

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Measurement of Myocardial Perfusion with Electron Beam Tomography: Comparison with ^{99m}Tc-MIBI Scan[1]

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[2]*Nuclear Medicine,* [3]*Endocrinology,* [4]*Family Medicine*

Purpose: To compare the accuracy with which electron beam tomography (EBT) and ^{99m}Tc-MIBI scanning measure myocardial perfusion valve.

Materials and Methods: Twenty-two subjects [normal volunteers (n = 6), patients in whom ischemic heart disease was diagnosed (n = 5), and those in whom ischemic heart disease was suspected but who were found to be normal (n = 11)] were involved in this study. EBT was performed after bolus injection of contrast media (50 ml of Iopamiro 370 or Optiray 350, 3 ml/sec). The myocardium was divided into 16 segments according to the classification devised by the American Society of Echocardiography, and each myocardial perfusion value was calculated by post-image processing. A pharmacologic stress test was performed in all subjects except four patients with acute myocardial infarction, and myocardial perfusion reserve ratios were assessed. Single photon emission computed tomography (SPECT) was performed after the injection of 20 mCi of ^{99m}Tc-MIBI. Any segments with moderate to severe photon defect on visual analysis of SPECT were identified and perfusion values determined by EBT in normal and ischemic segments were compared.

Results: No difference in myocardial perfusion was found between volunteers and the suspected group. Their perfusion values were 0.71 ± 0.14 ml/g/min in the resting state and 1.16 ± 0.24 ml/g/min on the stress test and the myocardial perfusion reserve ratio was, therefore, $1:1.68 \pm 0.38$. In ischemic patients, ^{99m}Tc-MIBI scanning revealed a perfusion defect in 28 segments, and on EBT the measurement obtained was 0.54 ± 0.19 ml/g/min. The remaining 324 perfusion segments shown by SPECT to be normal showed a perfusion value of 0.79 ± 0.22 ml/g/min on EBT.

Conclusion: Compared with ^{99m}Tc-MIBI scanning, the measurement of myocardial perfusion by EBT provides absolute quantification of perfusion value and more detailed anatomic information.

Index words : Myocardium, blood supply
Myocardium, Electron Beam Tomography
Myocardium, ^{99m}Tc-MIBI scan
Myocardium, ischemia

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	26 ( )					27 ( )					28 ( )			
	A	B	C	D		A	B	C	D		A	B	C	D
08:00														
08:30	CC NR (1-3)	CC CR (1-3)				CC NR (4-6)	CC CR (4-6)				CC NR (7-9)	CC CR (7-9)		
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09:30						SL I					Symposium (PACS)			
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11:00					( )					( )	SL II			
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12:30	/					/					Panel Discussion ( )			
13:00														
13:30 / 13:40	Plenary Lecture													
14:00						What's New								
14:20 / 14:30	:													
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15:30 / 15:40														
16:00	Coffee Break													
16:10					( )					( )	,			
16:30					( )					( )				
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17:30														
18:00														
18:30														
19:00						Reception								

CC : Categorical Course   SL : Special Lecture   NR : Neuro Radiology   CR : Chest Radiology

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