

超音波による計量診断

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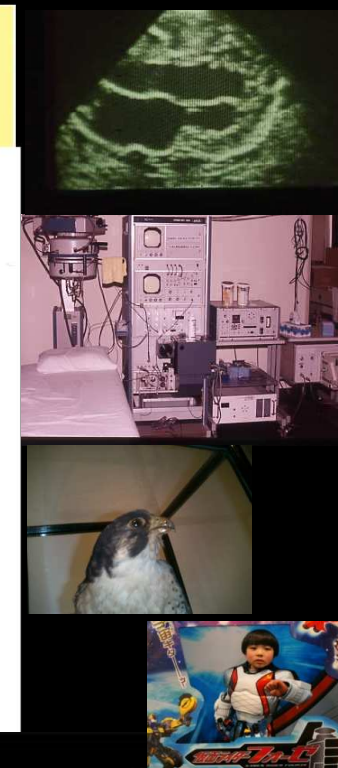
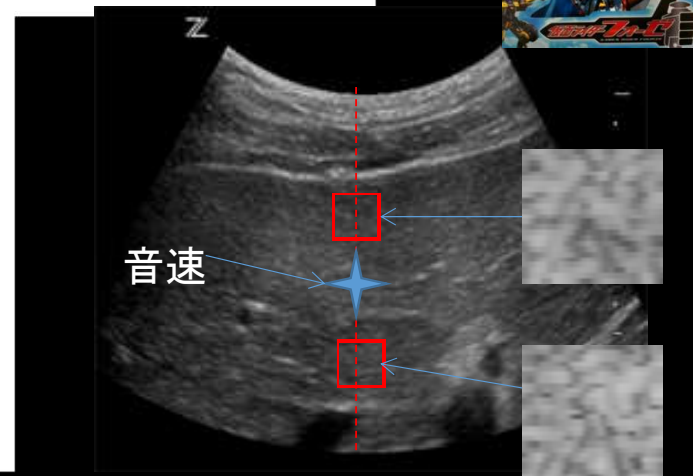
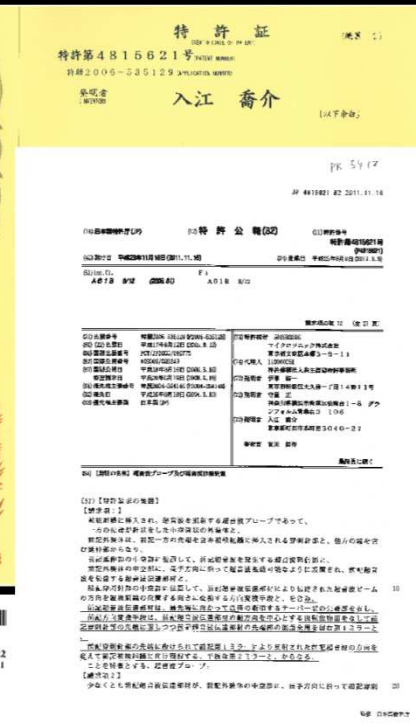
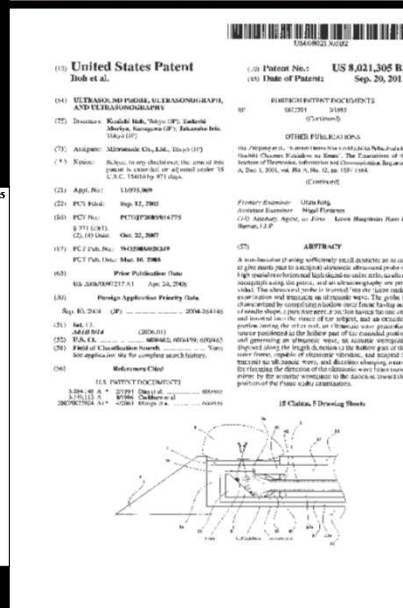
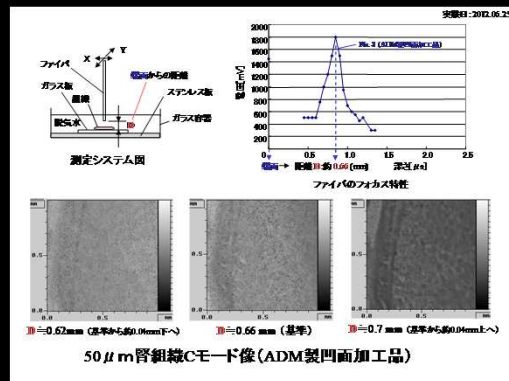
日本学術会議医療技術開発学講演会

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内科診断学
超音波医学
医療技術開発学





特 許 証

(CERTIFICATE OF PATENT)

特許第4815621号
(PATENT NUMBER)

発明の名称
(TITLE OF THE INVENTION) 超音波プローブ及び超音波診断装置

特許権者
(PATENTEE) 東京都文京区本郷3-9-11
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(INVENTOR) 伊東 紘一
守屋 正

出願番号
(APPLICATION NUMBER) 特願2006-535129
出願日
(FILING DATE) 平成17年 9月12日(September 12, 2005)
登録日
(REGISTRATION DATE) 平成23年 9月 9日(September 9, 2011)

その他別紙記載

この発明は、特許するものと確定し、特許原簿に登録されたことを証する。
(THIS INVENTION IS DETERMINED TO BE PATENTABLE AND IS REGISTERED ON THE REGISTER OF THE JAPAN PATENT OFFICE.)

平成23年 9月 9日(September 9, 2011)

特許庁長官
(COMMISSIONER, JAPAN PATENT OFFICE)

岩井良行



特 許 証

(CERTIFICATE OF PATENT)

(続き 1)

特許第4815621号 (PATENT NUMBER)

特願2006-535129 (APPLICATION NUMBER)

発明者
(INVENTOR)

入江 喬介

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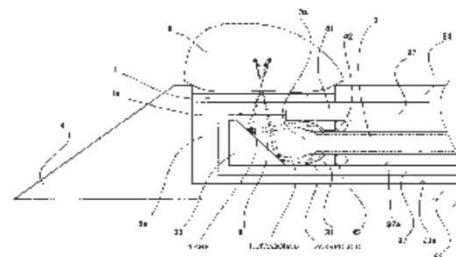
US008021305B2

(12) United States Patent
Itoh et al.**(19) Patent No.:** **US 8,021,305 B2**
(45) Date of Patent: **Sep. 20, 2011****(34) ULTRASOUND PROBE, ULTRASONOGRAPHY,**
AND ULTRASONOGRAPHY**FOREIGN PATENT DOCUMENTS**
JP 0672391 3/1995
(Continued)**(75) Inventor:** **Kunichi Itoh, Tokyo (JP); Takashi**
Moriya, Katsugawa (JP); Takaoike Irie,
Tokyo (JP)**(73) Assignee:** **Microsonic Co., Ltd., Tokyo (JP)****(*) Notice:** Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 971 days.**OTHER PUBLICATIONS**Ito, Tetsuo et al., "Kansetsu Jensa Shien no Mokusho Yoku Anshoku
Hoshiki Chosha no Katsugawa ni Kentei", The Transactions of the
Institute of Electronics, Information and Communication Engineers
A, Dec. 1, 2001, vol. J84-A, No. 12, pp. 1557-1564.

(Continued)

(21) Appl. No.: **11/975,069****(22) PCT Filed:** **Sep. 12, 2005****(56) PCT No.:** **PCT/JP2005/016775****§ 371 (c)(1).****(2), (4) Date:** **Oct. 22, 2007****Primary Examiner:** **Ursula Jorg**
Assistant Examiner: **Nigel Fortenox****Attorney, Agent, or Firm:** **Lowie Hauptmann Ham &**
Berner, L.P.**(87) PCT Pub. No.:** **W/O2006/028249****PCT Pub. Date:** **Mar. 16, 2006****(65) Prior Publication Data**
US 2006/0097217 A1 **Apr. 24, 2006****(30) Foreign Application Priority Data****Sep. 10, 2004 (JP)** **2004-264149****(51) Int. Cl.**
A61B 8/14 **(2006.01)****(52) U.S. Cl.** **600462; 600459; 600463****(58) Field of Classification Search:** **..... None**
See application file for complete search history.**(56) References Cited****U.S. PATENT DOCUMENTS****5,284,748 A *** **2/1994** **Das et al.** **600463**
5,745,113 A **8/1996** **Cochran et al.**
20070273504 A1 * **4/2007** **Morita et al.** **600463****(57) ABSTRACT**

A non-invasive (having sufficiently small diameter as not to give much pain to a subject) ultrasonic ultrasound probe of high spatial resolution and high signal-to-noise ratio, an ultrasonography using the probe, and an ultrasonography are provided. The ultrasound probe is inserted into the tissue under examination and transmits an ultrasonic wave. The probe is characterized by comprising a hollow outer frame having two of needle shape, a puncture part, a portion having the one end and inserted into the tissue of the subject, and an extended portion having the other end, an ultrasonic wave generating source positioned in the hollow part of the extended portion, and generating an ultrasonic wave, an acoustic waveguide disposed along the length direction in the hollow part of the outer frame, capable of ultrasonic vibration, and adapted to transmit an ultrasonic wave, and direction changing means for changing the direction of the ultrasonic wave beam transmitted by the acoustic waveguide to the direction toward the position of the tissue under examination.

15 Claims, 5 Drawing Sheets

PK 5412

JP 4815821 B2 2011.11.16

(10) 日本国特許庁 (12) 特 許 公 報 (32)
(11) 特許番号
特許番号 4815821 号
(42) 発行日 平成23年11月16日 (2011.11.16) (43) 発明日 平成23年8月8日 (2011.8.8)
(51) Int. Cl. F
A 61 B 8/12 (2006.01) A 61 B 8/12

請求項の表 12 (全 21 頁)	
(21) 出願番号 (22) 出願日 (23) 国際出願番号 (24) 国際公開番号 (25) 国際公開日 (26) 優先権主張番号 (27) 優先日 (28) 優先権主張国	(72) 特許権者 マイクロソニック株式会社 東京市文京区本郷3-9-1 (73) 代理人 特許権者法人共立通商特許事務所 伊藤 祐一 東京都新宿区大久保一丁目14番1号 (74) 発明者 守屋 正 神奈川県横浜市青葉区松岡台1-6 グラ ンフォールム青葉台 106 (75) 発明者 入江 龍介 東京都町田市赤羽田3040-27 審査官 宮川 剛博

54) 【発明の名称】超音波プローブ及び超音波診断装置

(57) 【特許請求の範囲】
【請求項1】
縦横断断に挿入され、超音波を照射する超音波プローブであって、
一方の先端が針状をなした中空筒状の外装体と、
前記外装体は、前記一方の先端を含む縦断断に挿入される穿刺針部と、他方の端を占
む延伸部からなり、
前記延伸部の中空部に位置して、前記超音波を発生する超音波発生部と、
前記外装体の中空部に、長手方向に沿って超音波伝達可能なように設けられ、前記超音
波を伝達する超音波伝達部材と、
前記穿刺針部の中空部に位置して、前記超音波伝達部材により伝達された超音波ビーム
の方向を縦断断の位置する向きに変換する方向変換手段と、を含む、
前記超音波伝達部材は、縦断断に向かって立降の形状を有するテーパ状の先端部を有し、
前記方向変換手段は、前記超音波伝達部材の軸方向を中心とする回転放物面を有して前
記穿刺針部の先端に面し、かつ前記超音波伝達部材の先端部の側面を面する凹部を有する
前記穿刺針部の先端に設けられて前記凹部をより反射された超音波の方向を
変えて前記超音波伝達部材に伝達する、方向変換手段を有する、
ことを特徴とする、超音波プローブ、
【請求項2】
少なくとも前記超音波伝達部材が、前記外装体の中空部に、長手方向に沿って前記穿刺



「超音波による計量診断」

1;どのようにして超音波で生体内部を見るのか

2;超音波医学の発展に貢献した日本人たち

3;生体内組織レベルの情報を得る方法

①超音波断層像 ②音響組織特性 ③血流情報

4;超音波を用いた定量的な診断法

(1)音響組織特性

①音響パラメーター ②組織レベルの情報

③定量的解析(数値化)

(2)ボリューム計測

①二次元画像利用 ②三次元画像利用

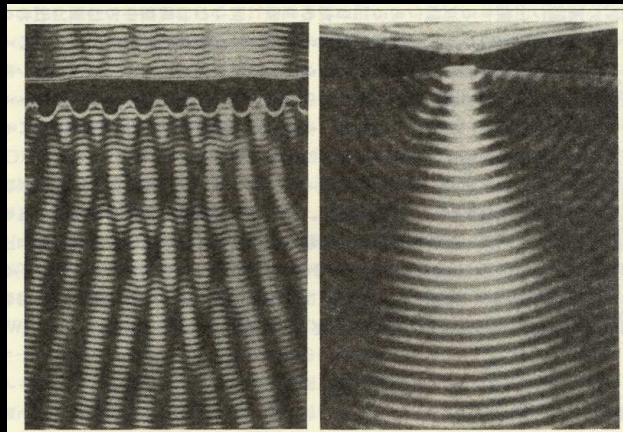
5;診断法

①存在診断 ②部位診断 ③質診断 ④グレード診断

超音波とは

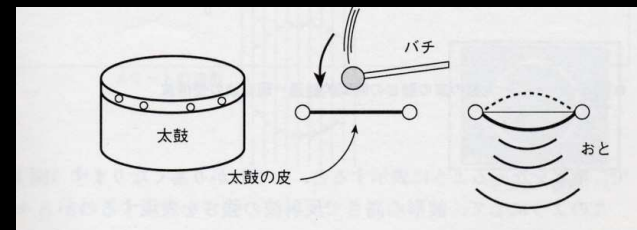


音響標識



- 動物ではコウモリ、イルカ、蛾、などが発信と受信を行っている。また、犬笛で知られているように、動物に聞き取れるが「人には聞き取れないようなレベルの周波数」を超音波という。
- 臨床診断に用いる超音波のレベルは、メガヘルツMHz(1--30)
- 治療にはキロヘルツKHz～細胞内の染色体や細胞や組織の構造描出も可能
- 探傷器、工業分野における利用は盛んである

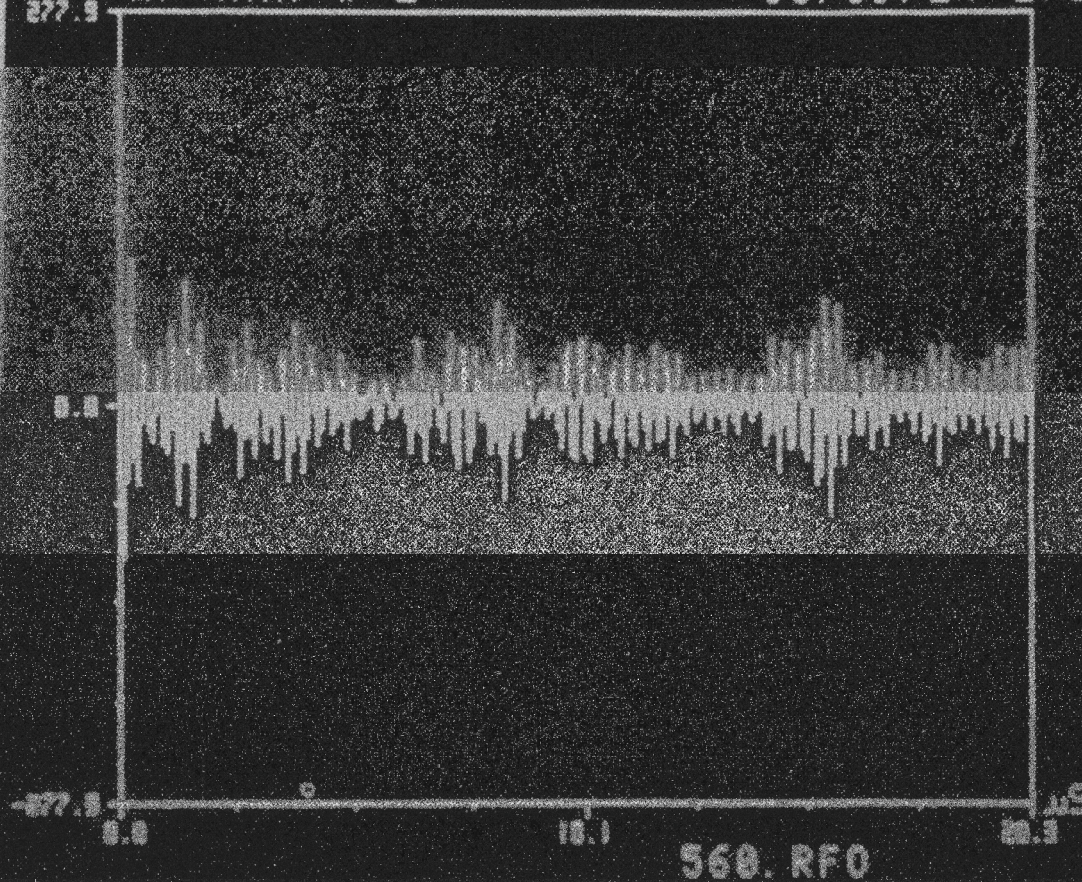
どの様にして超音波で 生体内部を見るのか



- Radio Frequency(RF) 信号から解剖学的断層像を作る
- 実時間超音波画像により高精細、動画像を得ることが可能になった
- ドプラ法による血流画像を得た
- 超音波造影剤(マイクロバブル)を利用する

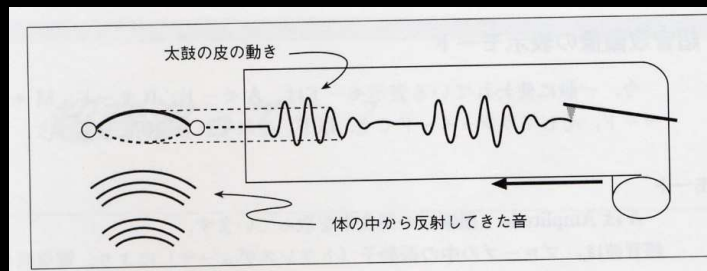
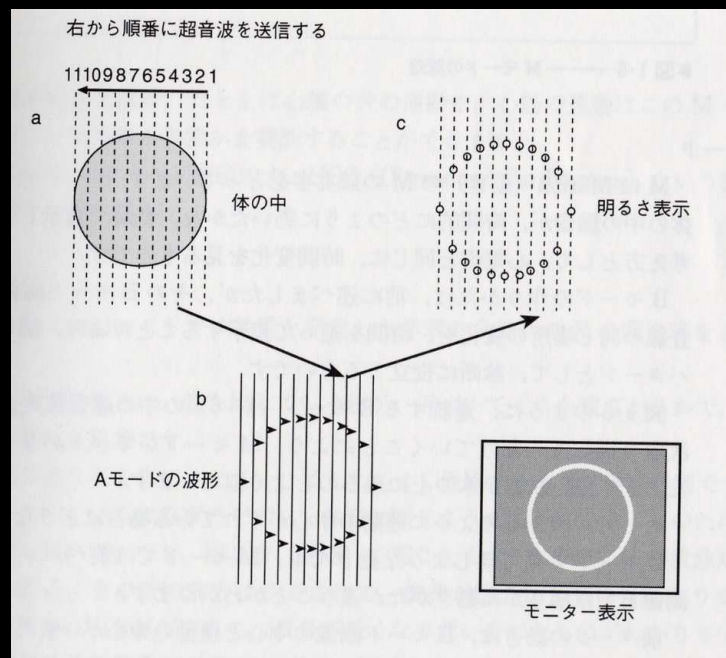
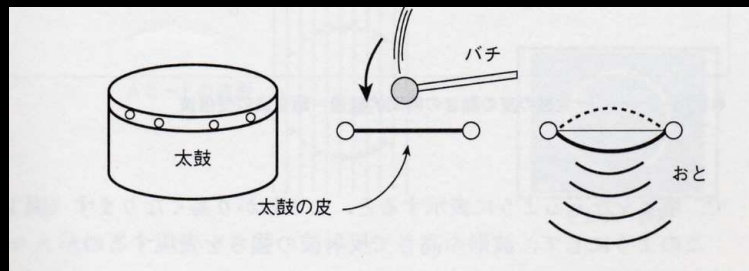
mV RF-RAW # 1

83/09/14 1/1

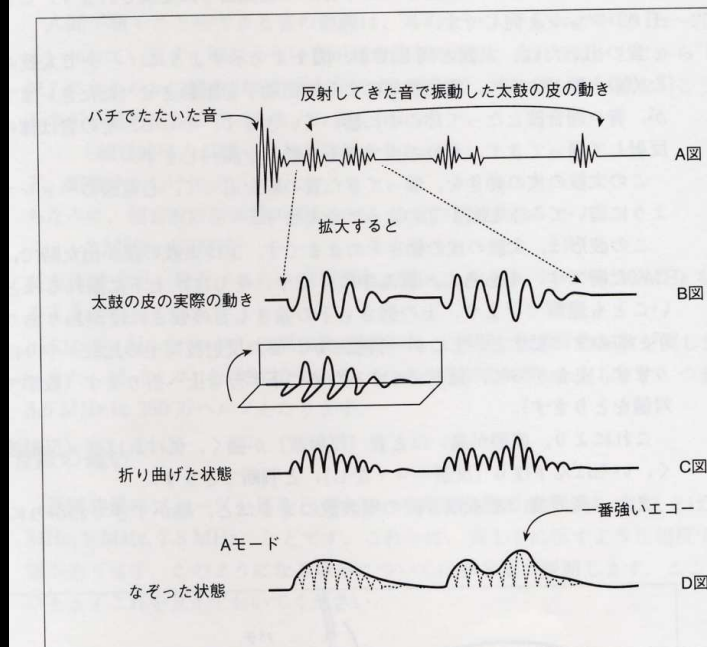


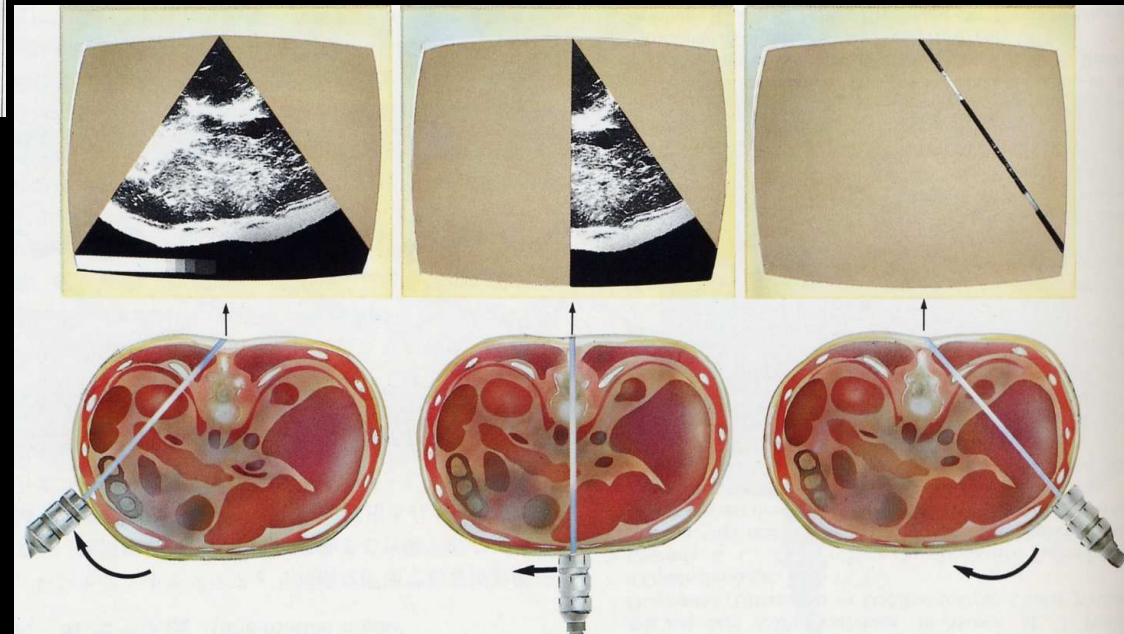
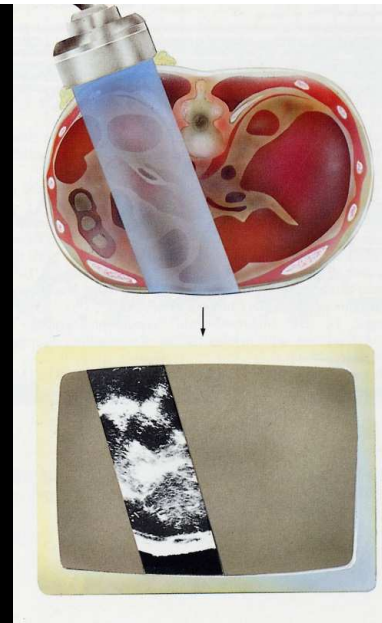
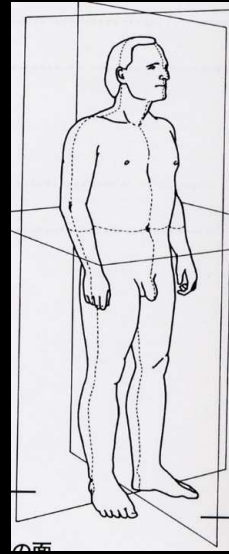
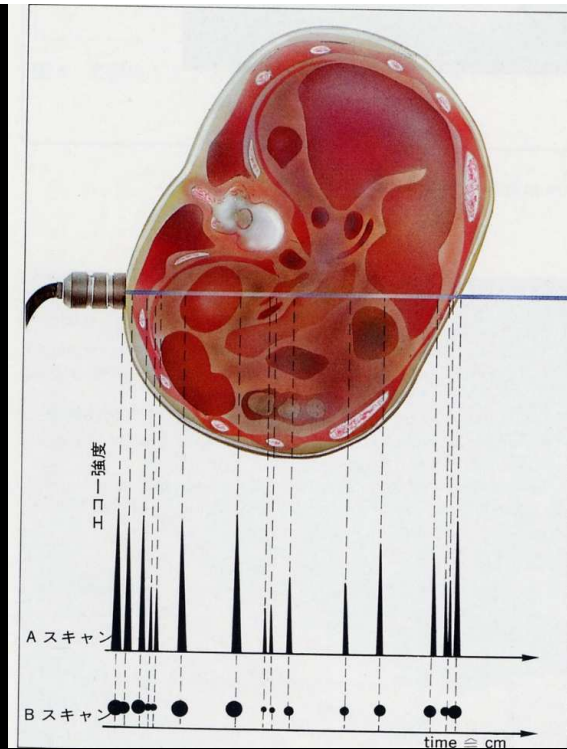
RFデータ

超音波画像構築法



●図1・2——受信時のモデル





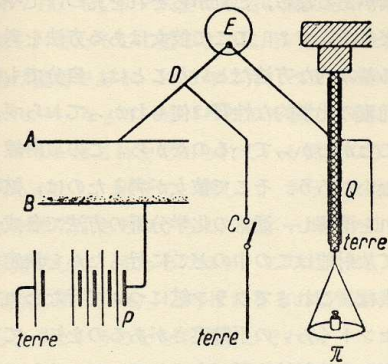
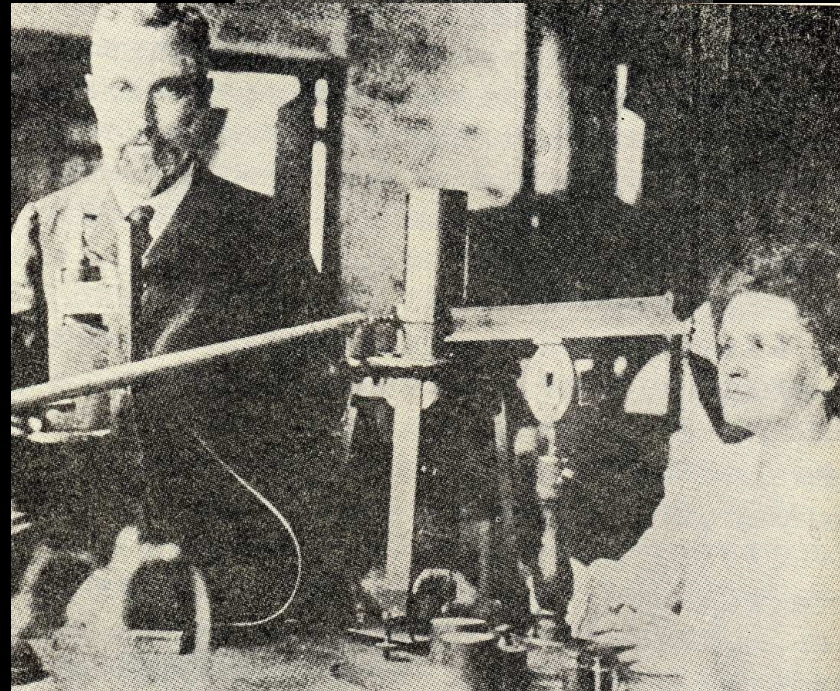


図 2.5 電位計の図解. *Revue générale des Sciences* [10, 41 (1899)] に載ったマリー・キュリーの論文より. この装置は, B に置かれた放射性物質から出る放射線によって起こる空気のイオン化の度合を測定するのに用いられた. コンデンサー AB の下側の極板 B に放射性物質が置かれている. 電位計 E は, ピエゾ電気を発生する水晶 Q に, おもりによって生じた電位差が, イオン化のために流れた電流による電位差を正確に打ち消すところを検出するために用いられる.

超音波の発展に貢献した日本

- 技術立国（平賀源内、からくり人形、他）
- 人工水晶生産（戦艦大和の大砲）
- 階調性画像
- スキャンコンバータの利用
- 電子型診断装置と振動素子
- カラードプラ装置
- コンベックス型振動子
- 多段フォーカス

オートクレーブのインストール



オートクレーブ内部の状態



育成後結晶引き上げの様子



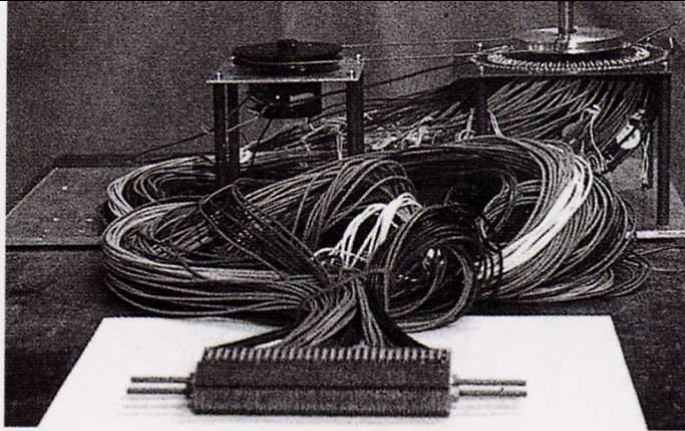
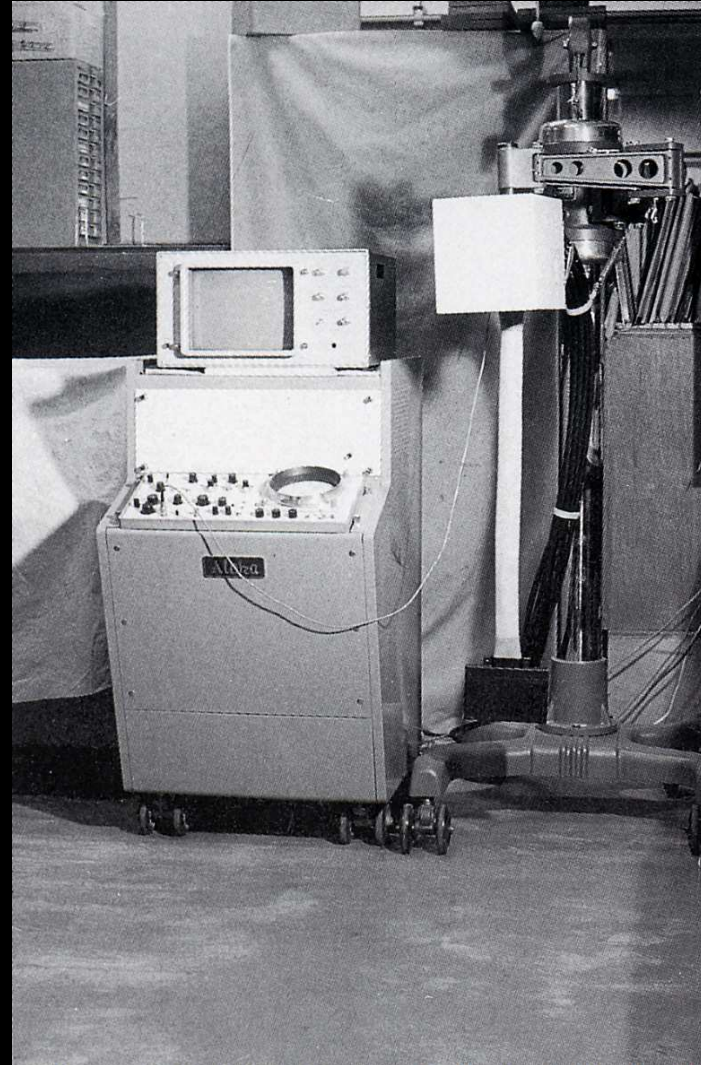
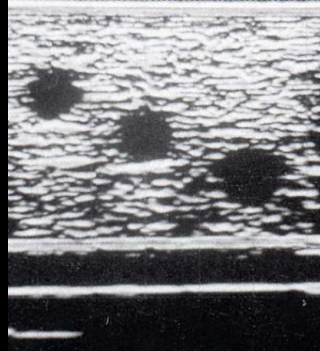
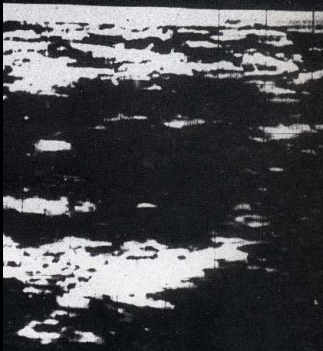
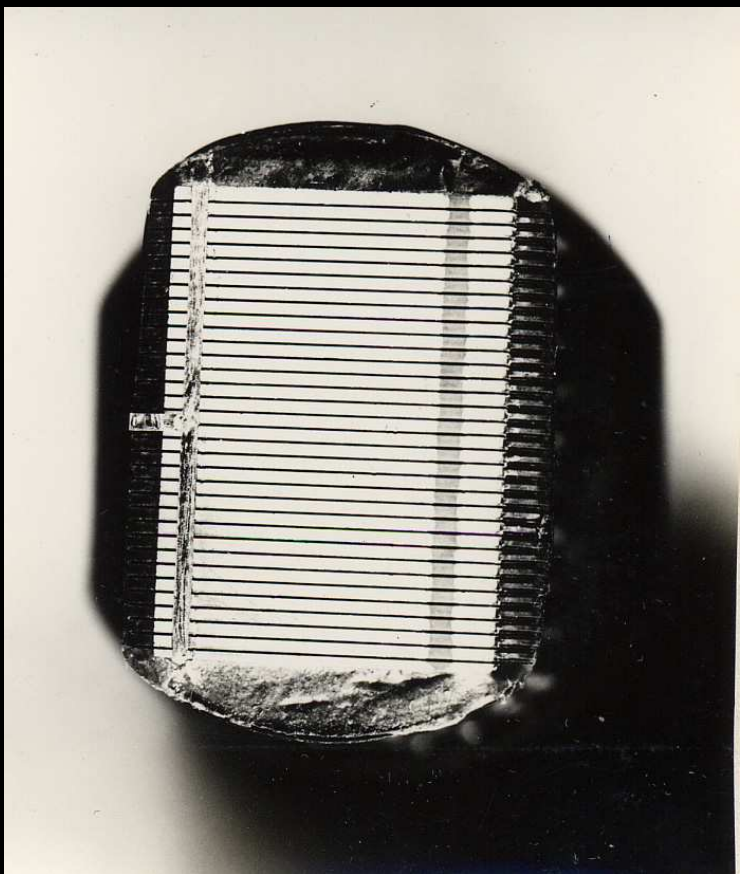
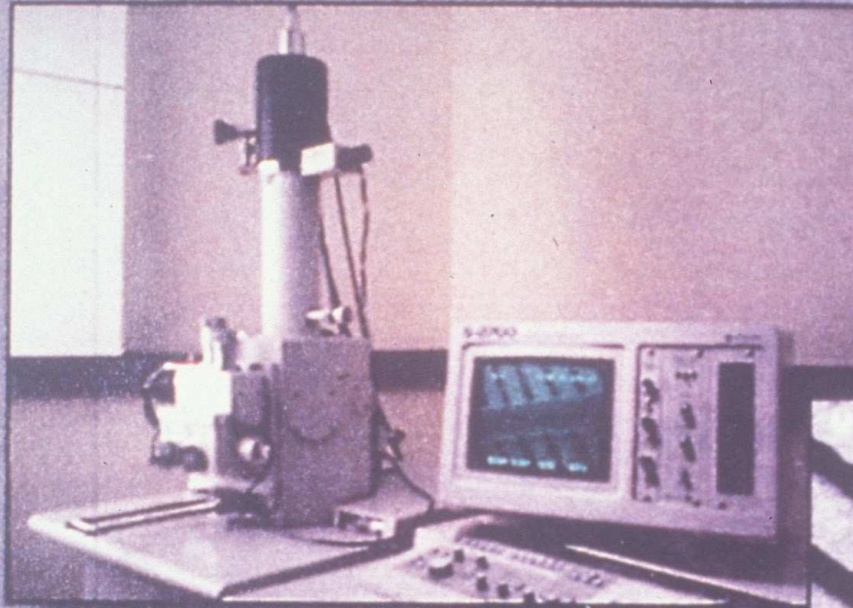


図2-2 簡易切り換えスイッチ

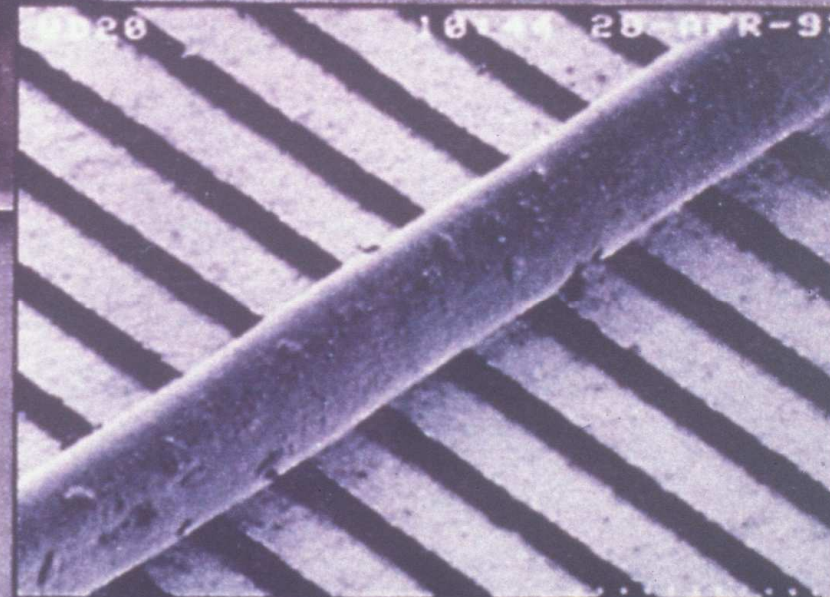


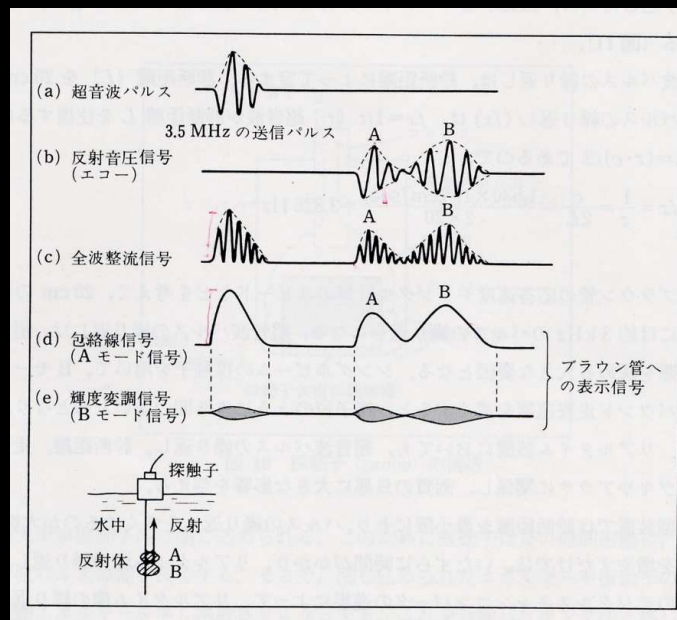
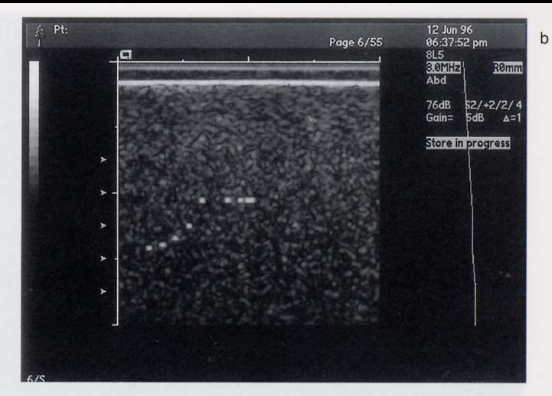
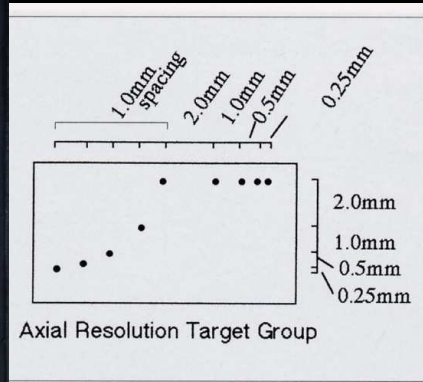
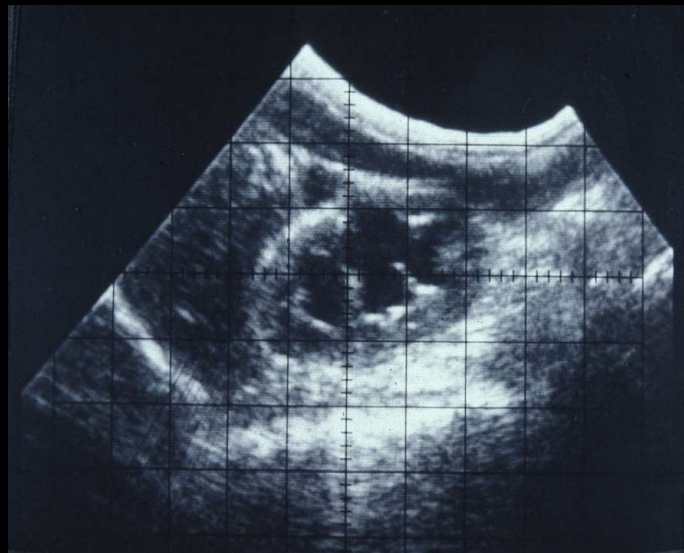




Scanning electron microscope

**Micrograph of a human hair
across the tiny elements
of the V7 transducer**

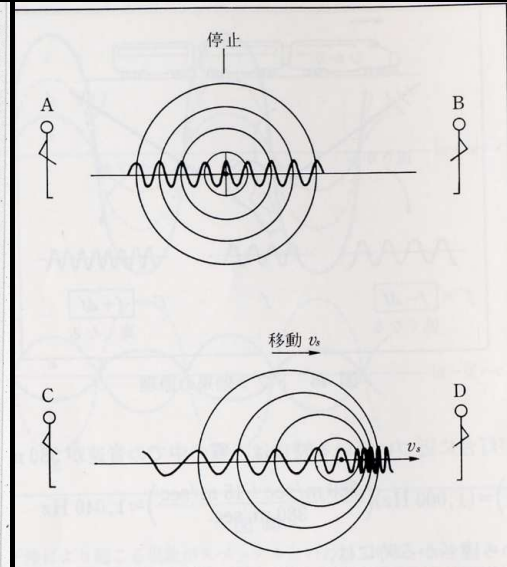






Christian J. Doppler
(1803-1853)

1803年11月29日ザルツブルクに生まれる
1853年3月17日ヴェネチアで没す
ウィーン大学物理学教授
ドプラ効果の発見 (1842)



光も音も波である



里村 茂夫

Satomura Shigeo (1920-1960)

大阪大学理学部物理学科卒

大阪大学産業科学研究所助教授 (没後教授)

1955年頃大阪産業科学研究所にて微小振動計測法として超音波ドプラ法の原理を考案し、生体への試みを提唱した仁村らの心臓への検討が始められると共に協力して研究をおこなった

大血管から得られる雑音様のドプラ信号が血流に関するドプラー信号である事を証明し血流計測への道を開いた

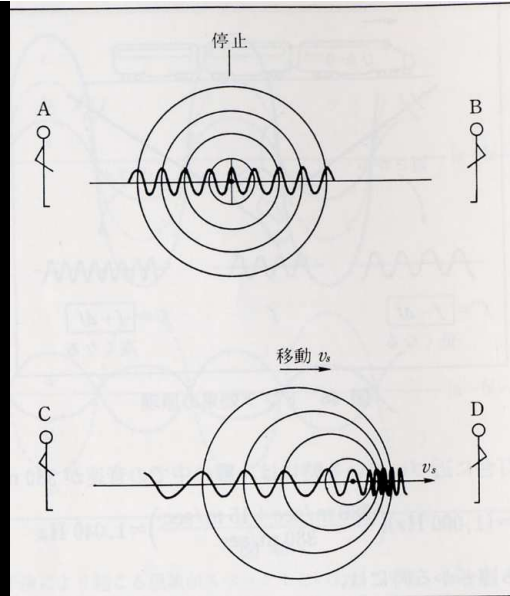


図 47

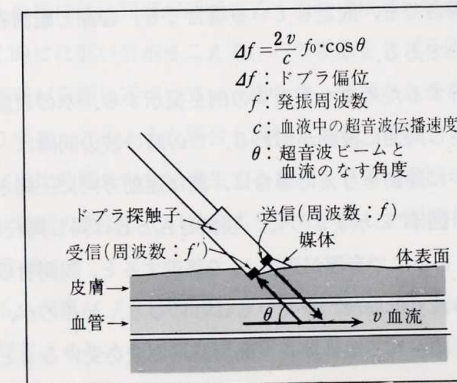
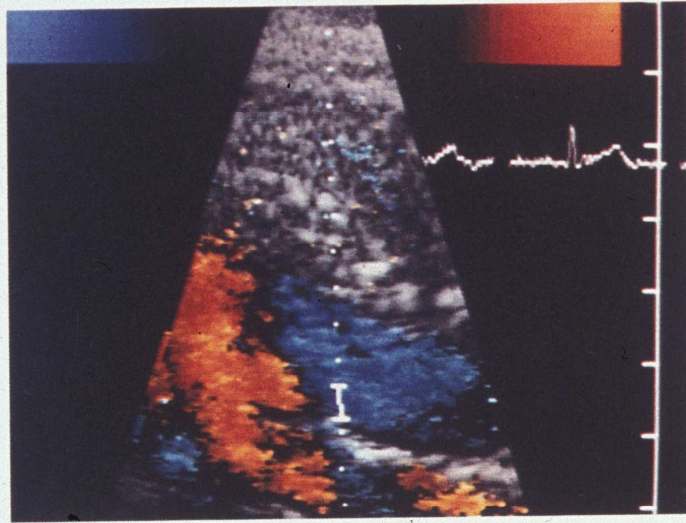


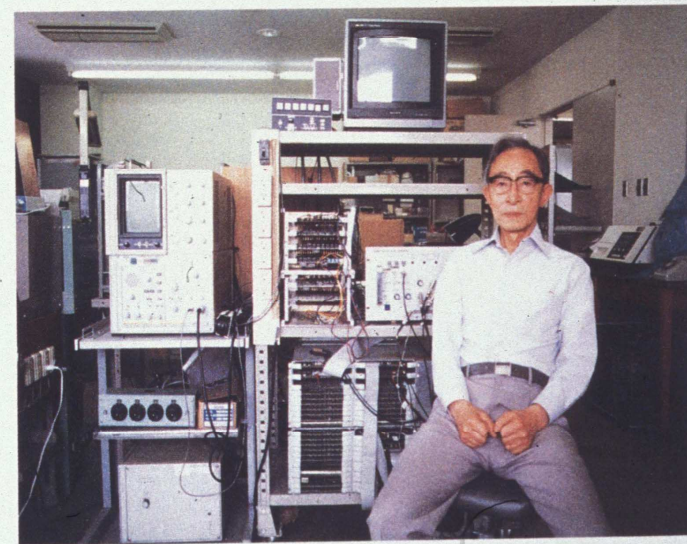
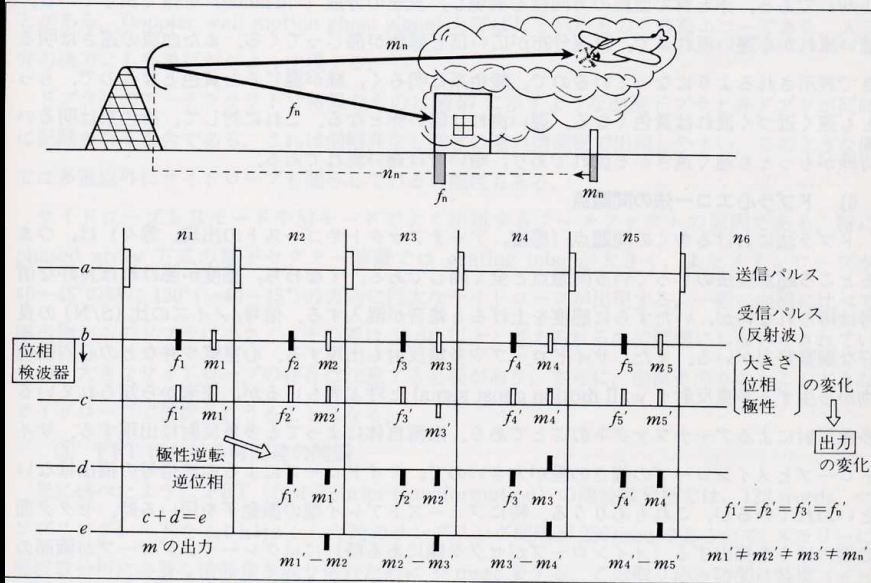
図 48 血流によるドプラ効果

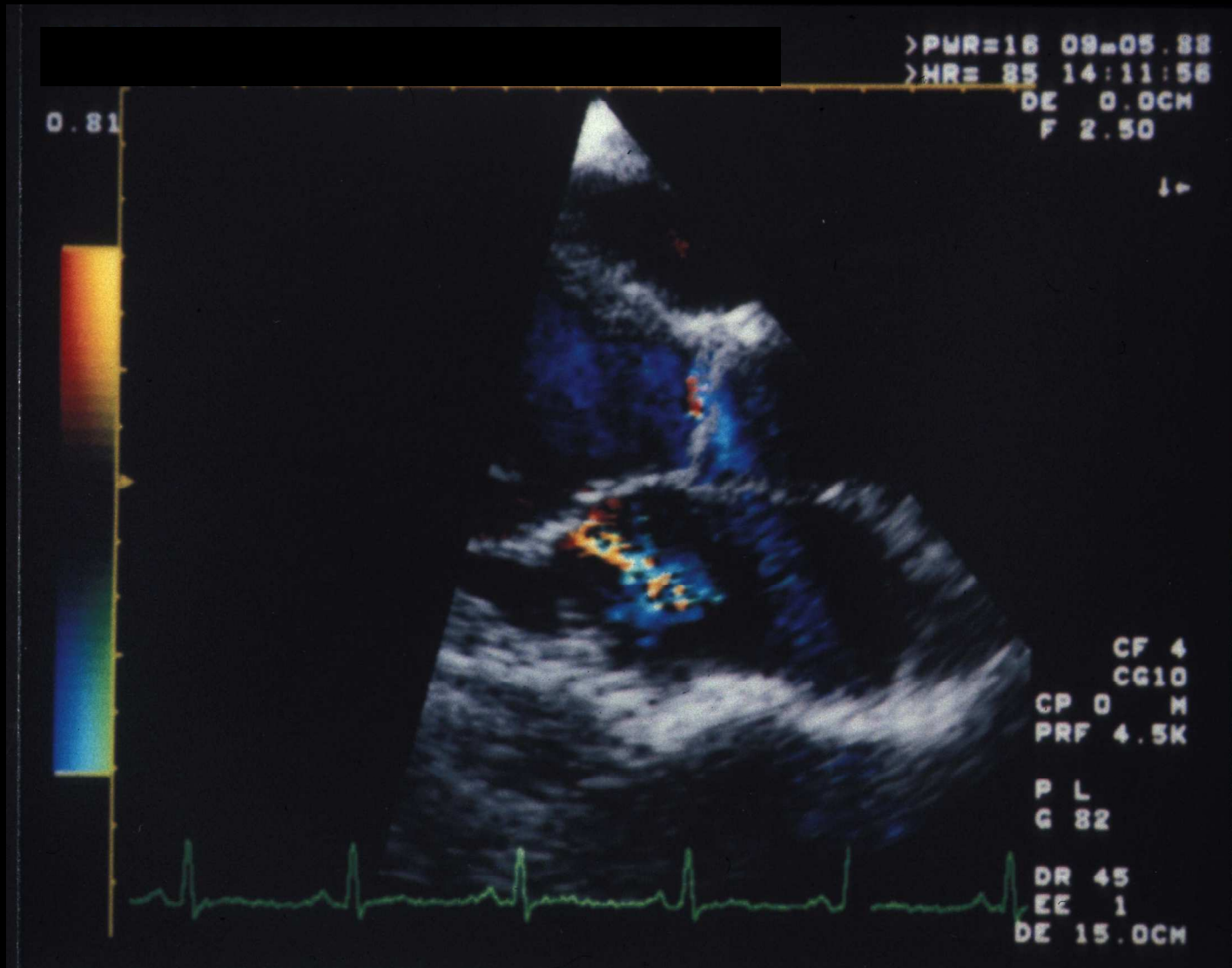
$$\Delta f = |f - f'| = \frac{2v \cdot \cos \theta}{c} \cdot f$$

$$v = \frac{c \cdot \Delta f}{2f \cdot \cos \theta}$$

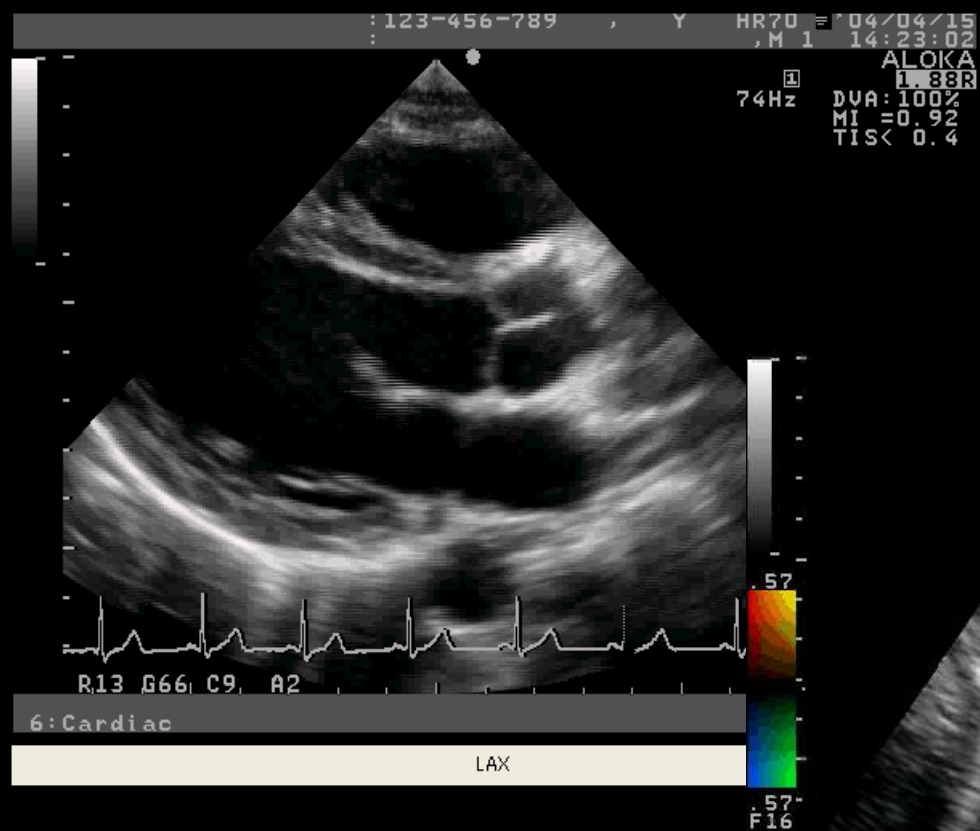


滑川孝六、小谷野明により発明された世界最初の2次元ドプラ断層（カラードプラ）は1980年に世界超音波医学生物学学術連合大会（イギリス、ブライトン市）で発表された。当時はメカニカルセクタースキャナーを用いた。（小谷野明）





動画



PT:

.09



.09



01-OCT-96

04:06:45PM

C3 - 7

4.0 MHz R32^m_m

GEN

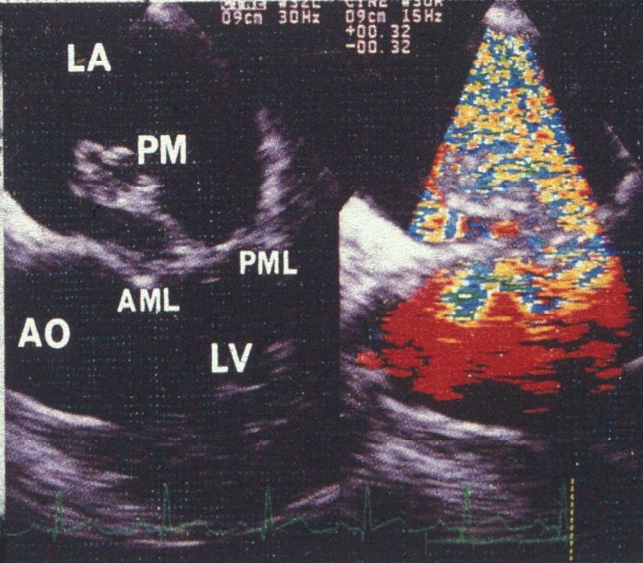
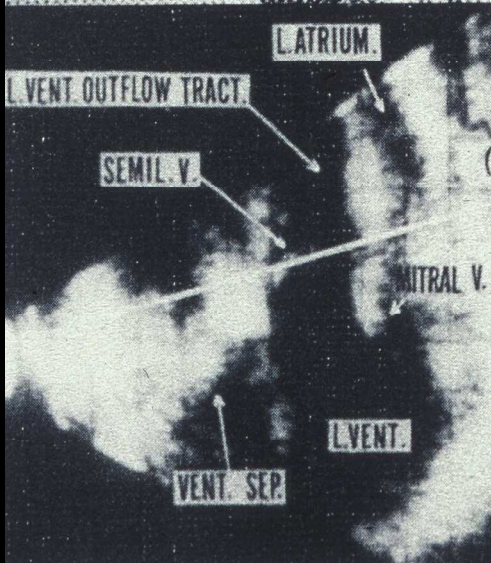
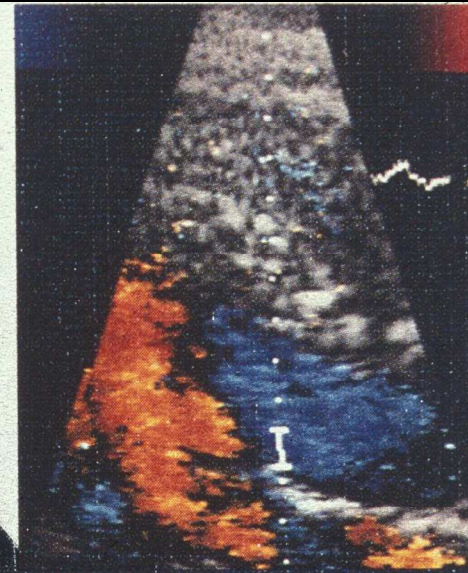
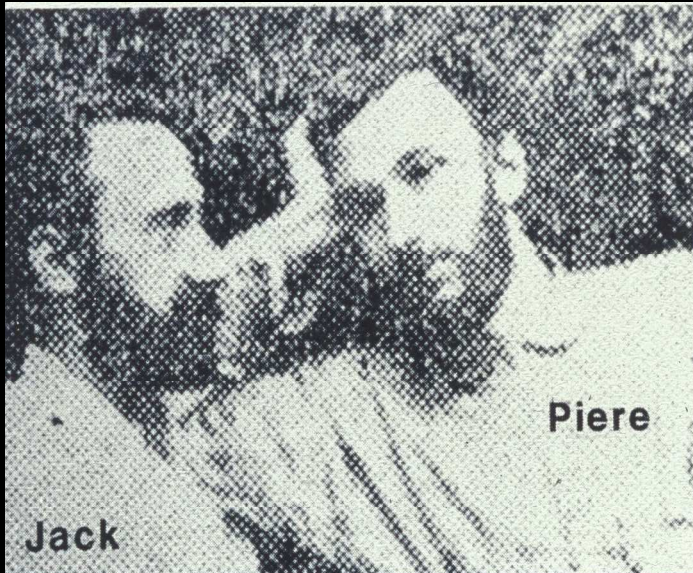
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1/1 3.5MHz

ENE 35dB

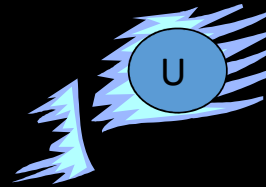
7:0 99%

CD GAIN= 76



Itoh's Ultrasound Labo.

- Today I will present of the studies of the quantitative diagnosis using ultrasound in my US Labo. with my co-workers.
- Nobuyuki Taniguchi, Kiyoka Omoto, Yasutomo Fujii,
- the others



Tissue Level Informations(1)

- Needle Aspiration Biopsy, Cytology
- Optical Microscope
 - Acoustic Pattern & Pathological findings
of the Breast Carcinoma
- Electron Microscope
- Acoustic Microscope
 - US-pattern & Acoustic Microscopic Findings
of Liver Carcinoma



Aspiration Biopsy

- The break-through episode of needle aspiration biopsy was to the Pancreatic Carcinoma under ultrasonic guidance by Hancke, Smith and Kouichi Itoh. After this episode the method of aspiration biopsy under ultrasonic guidance developed all over the world.
- We can take a specific finding by aspirated cells.
Adenocarcinoma, Plattenepithel carcinoma, and so on



Figure 4-53. Some of the dyskeratotic basal cells taken from the gingiva. Squamous-cell carcinoma cells show an increase in the thickness of the keratin which takes a brilliant orange stain. The nucleus is typically malignant with an irregular chromatin structure.

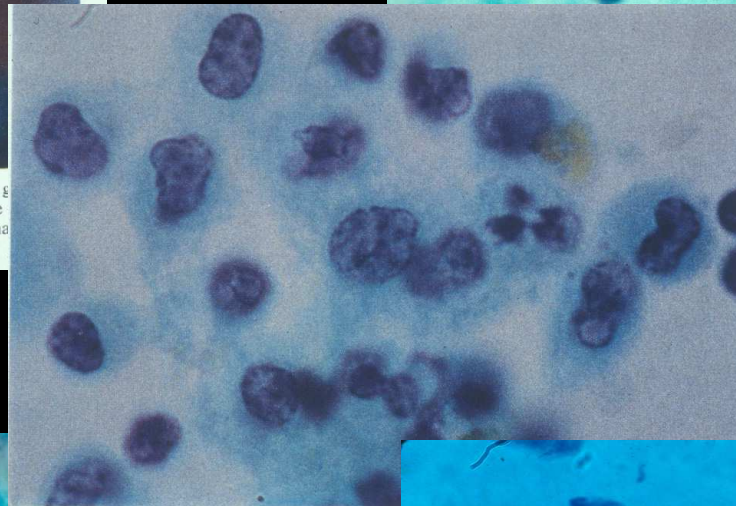
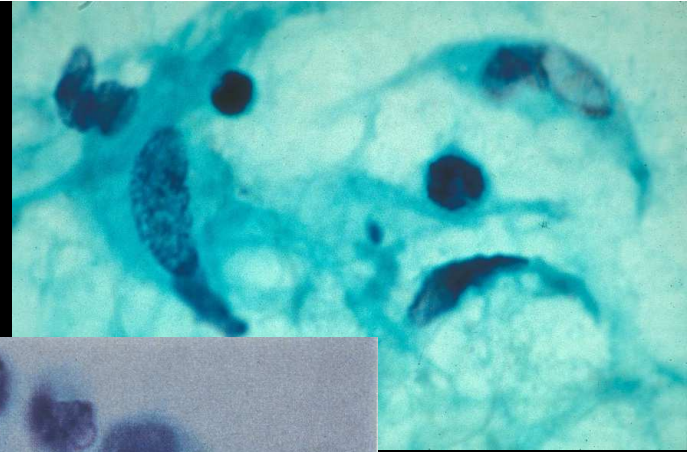
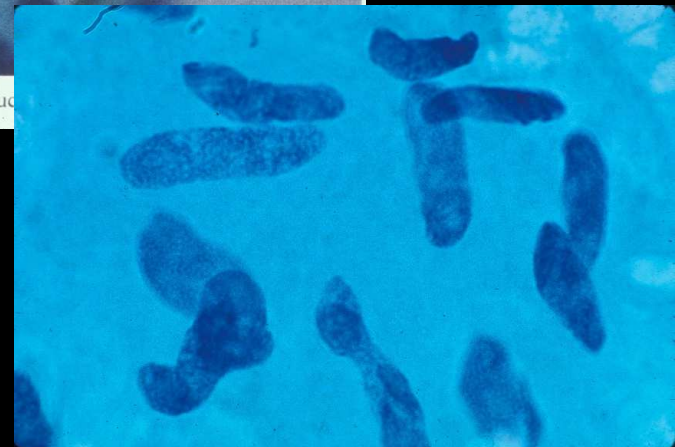
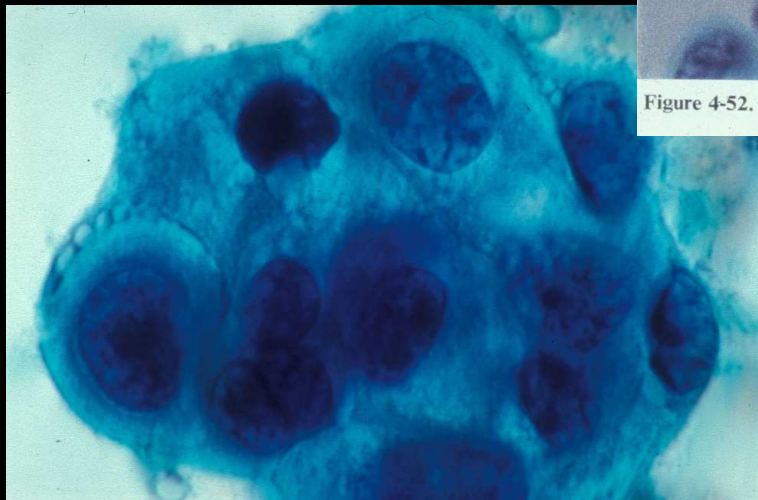
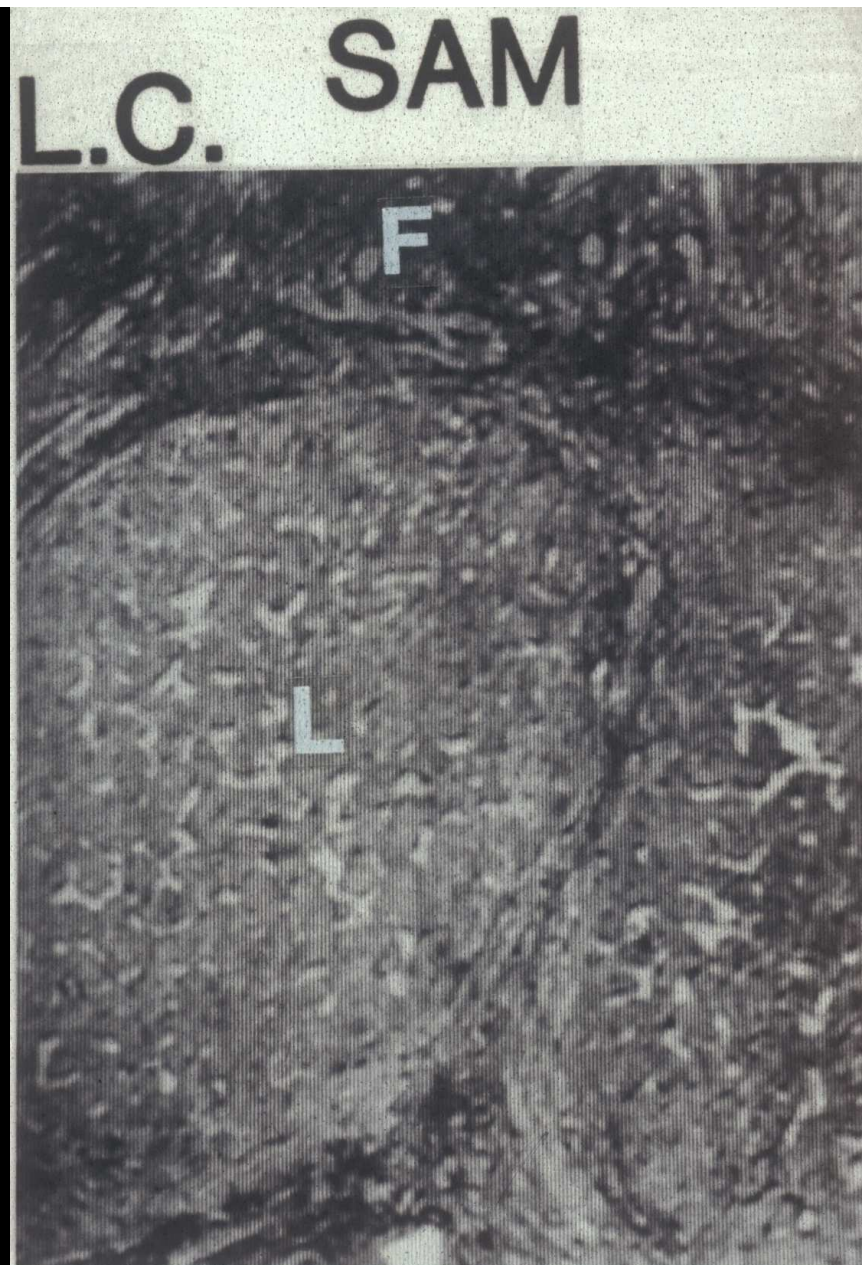


Figure 4-52. A large number of free nuclei.



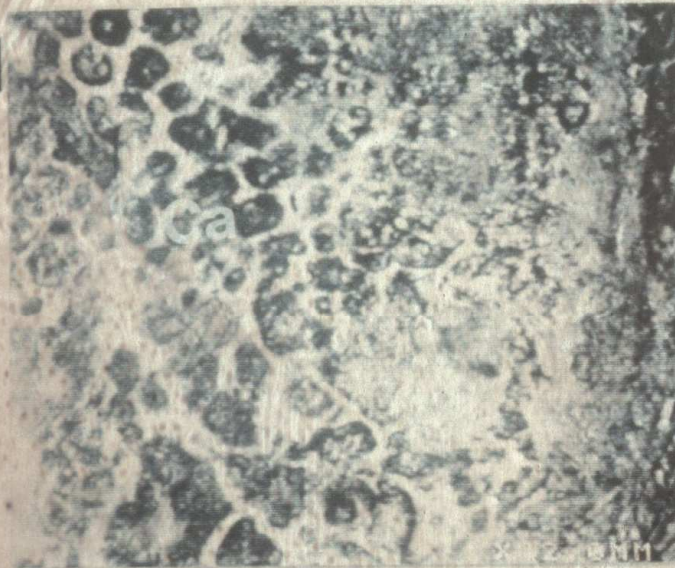
Scanning Acoustic Microscopy

- We investigated the tissue characterization of liver carcinoma using a scanning acoustic microscope(SAM).
- SAM shows the increase or decrease of attenuation in the tissue level.

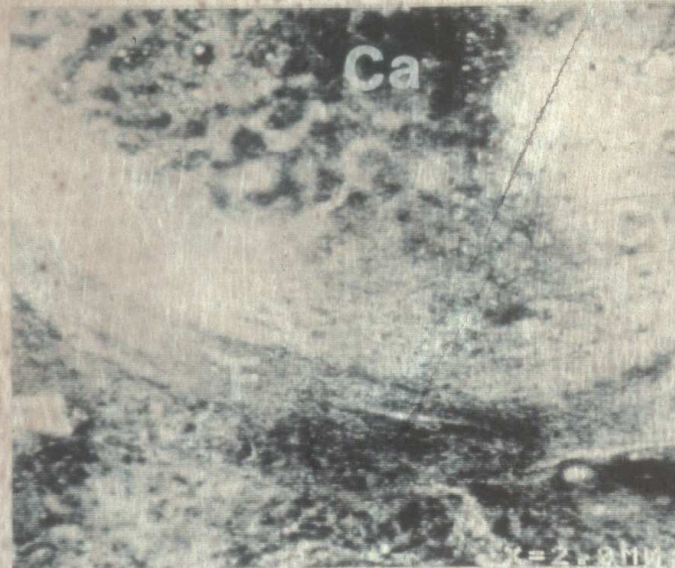


SAM

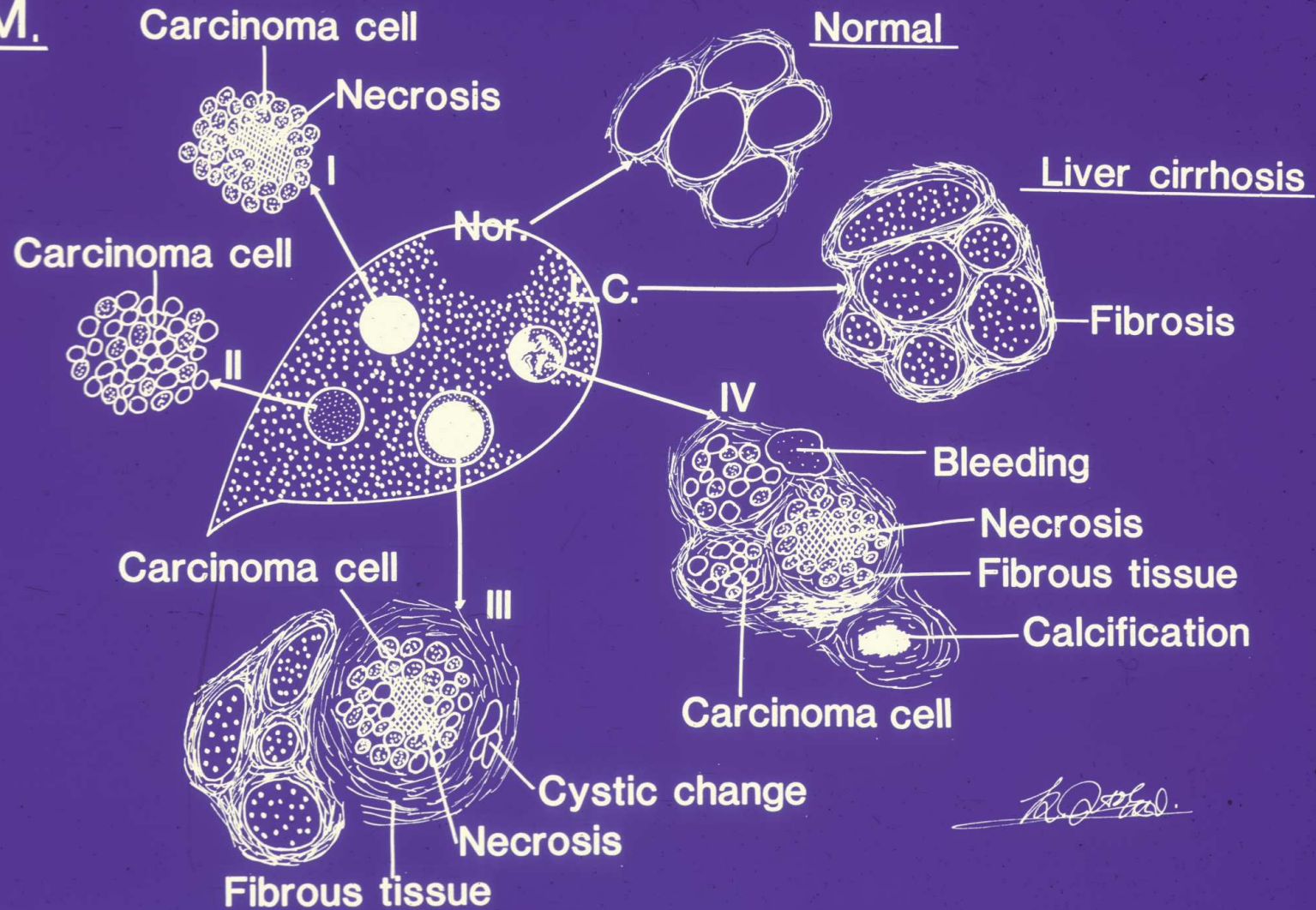
III



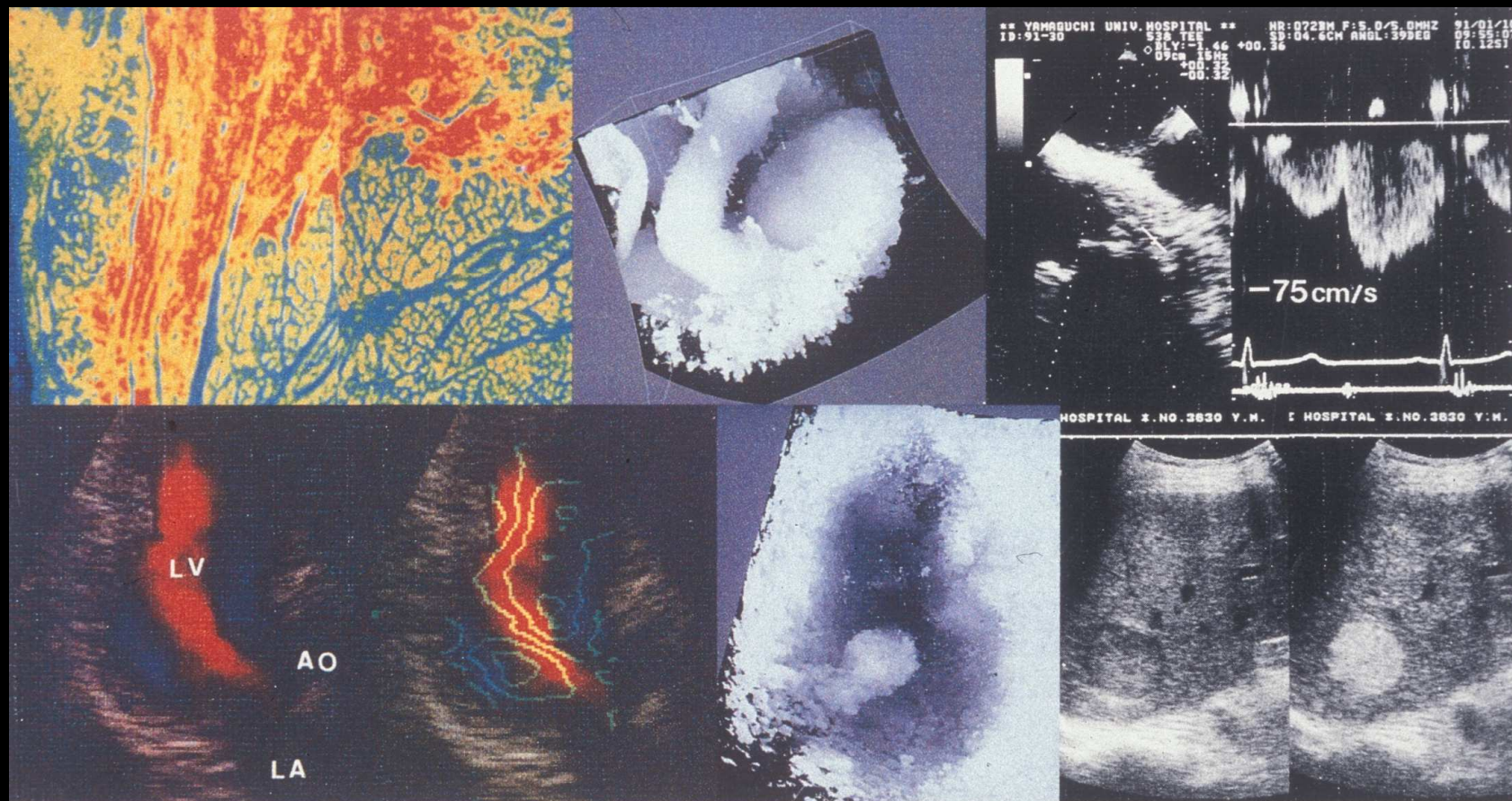
US



SAM.

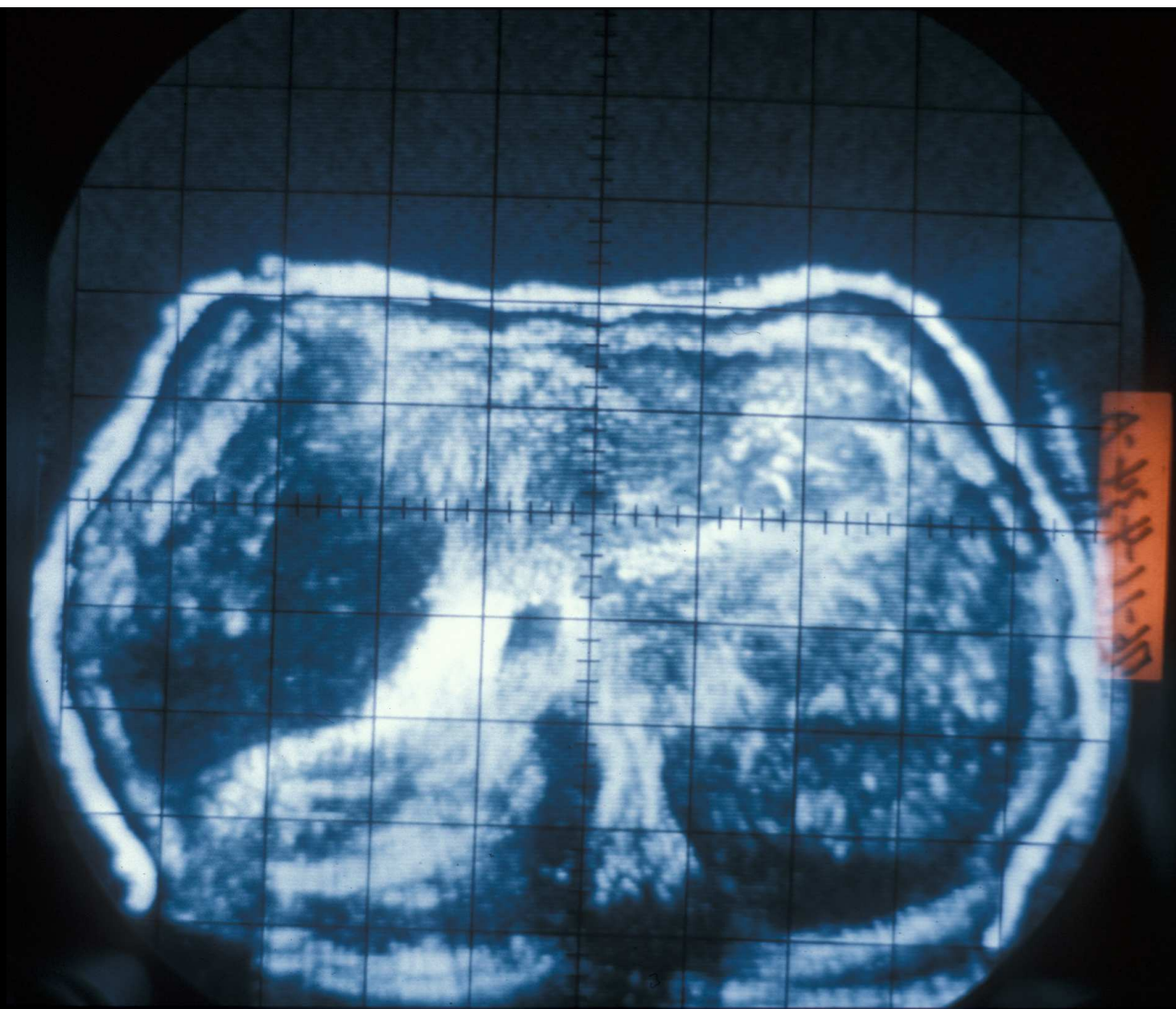


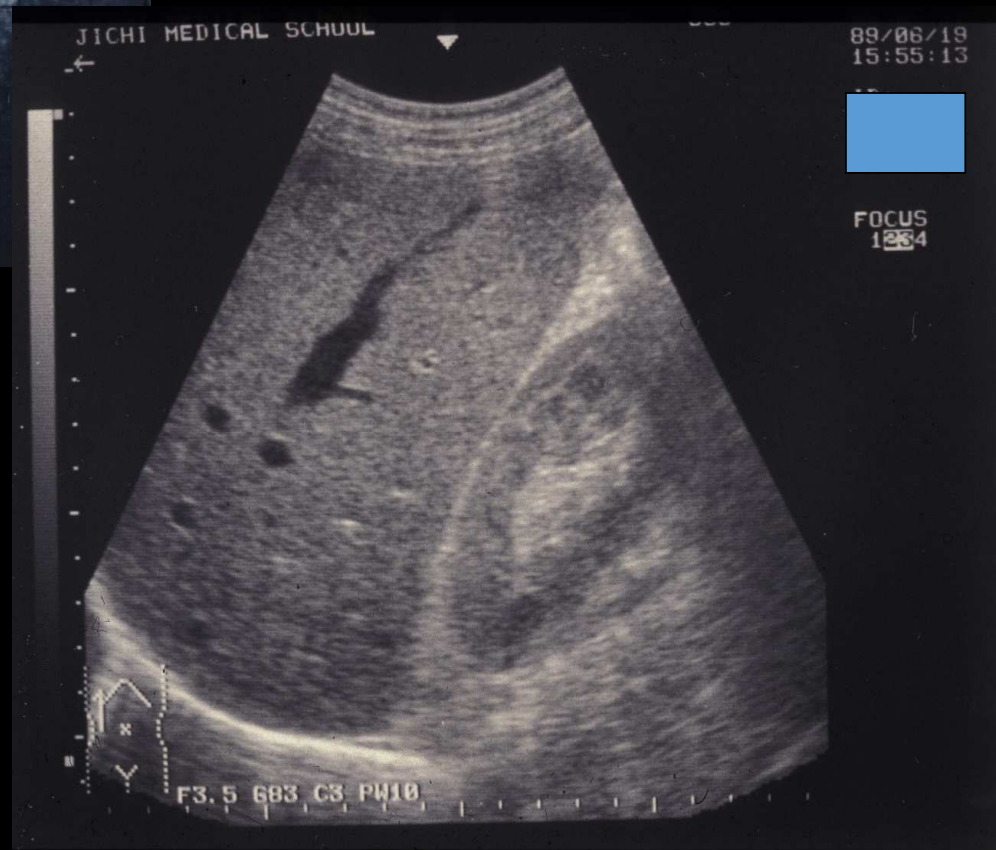
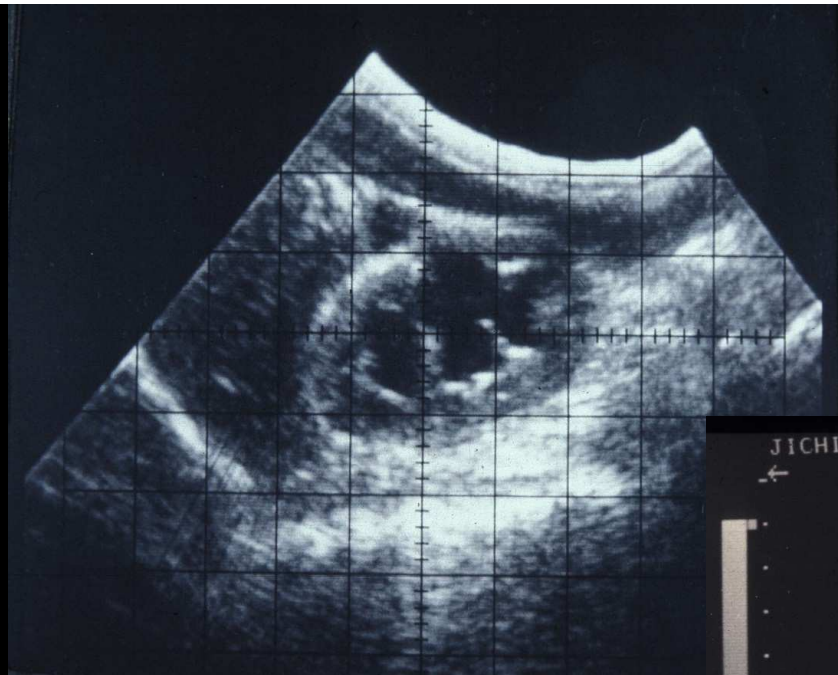
↓田中元直氏の
心筋データ

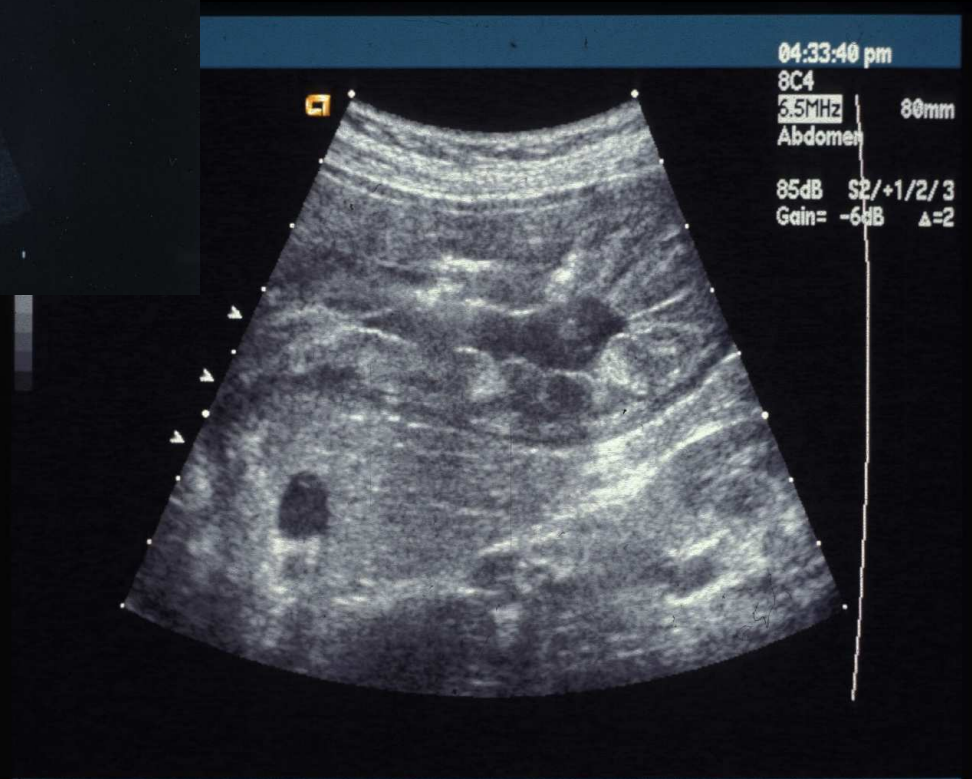
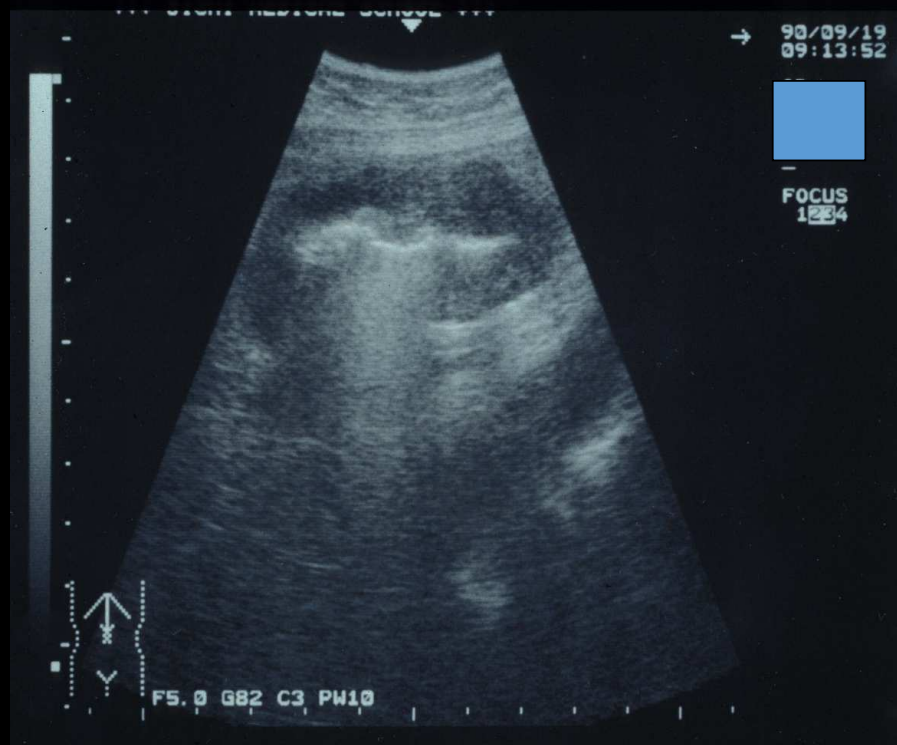


Tissue Level Informations

- Ultrasound Tomography
- Acoustic Tissue Characterization
- Blood Flow Information

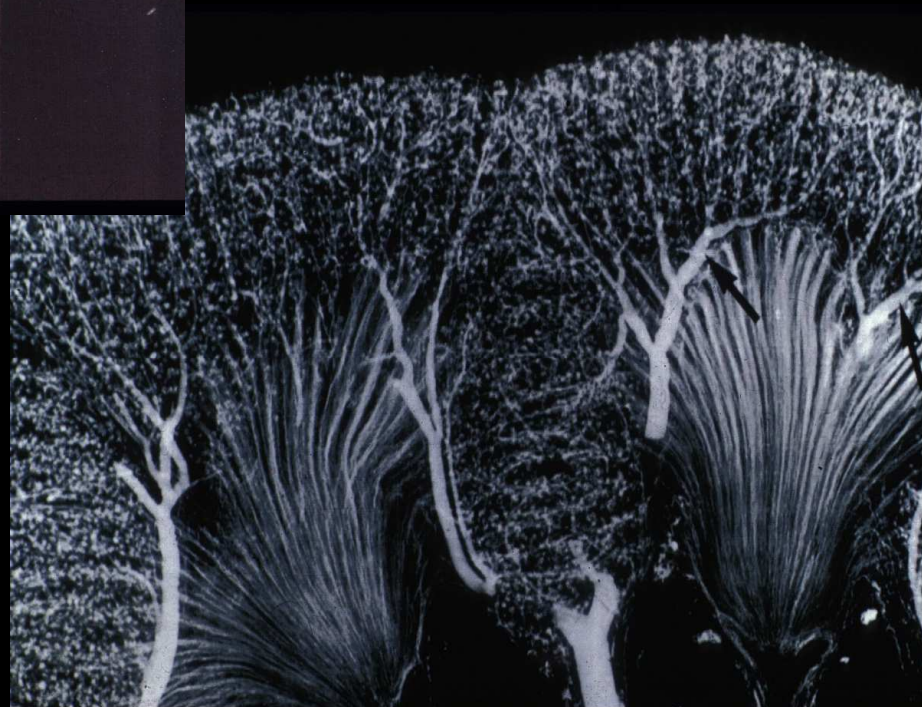








Volume
A80
9546 T1
Gain=140
Store in TA



PT:

.09



.09



01-OCT-96

04:06:45PM

C3 - 7

4.0 MHz R32^m_m

GEN

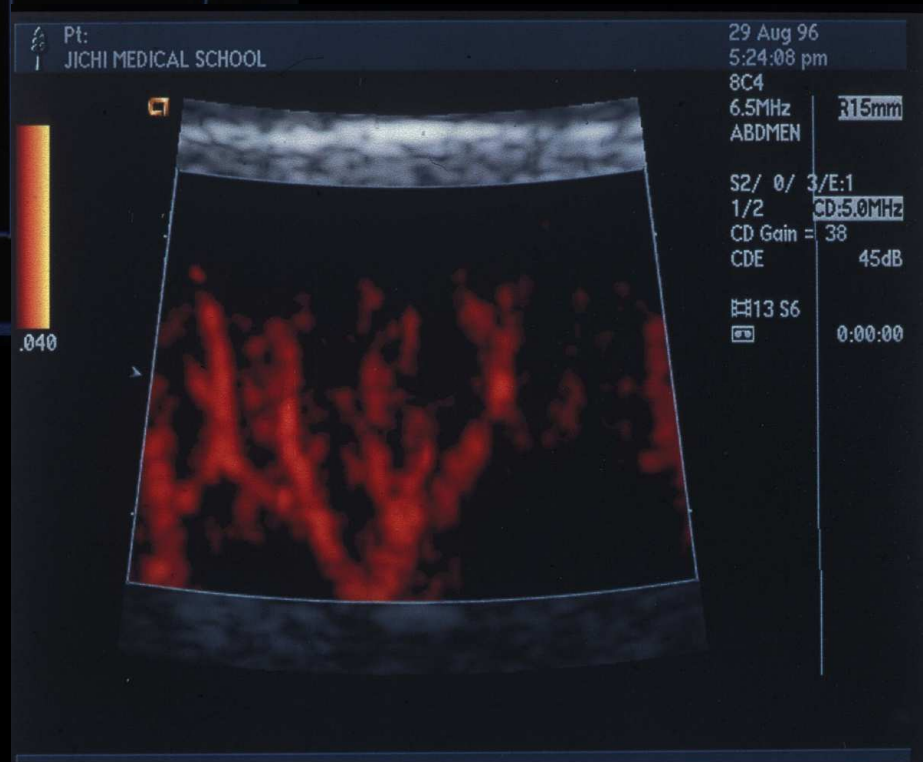
0/ -/3/E9+3

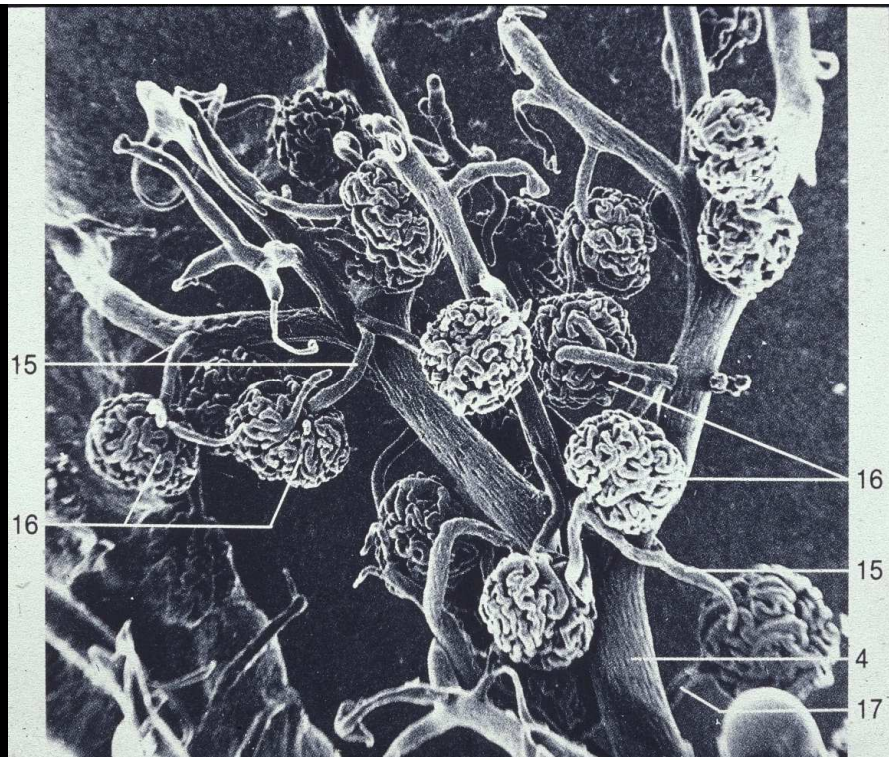
1/1 3.5MHz

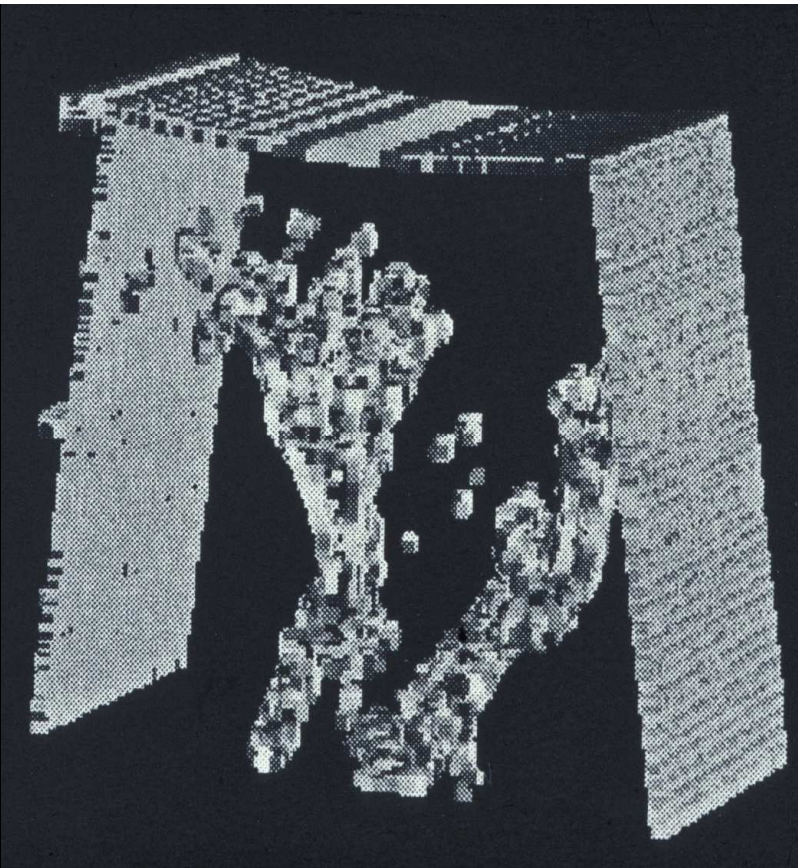
ENE 35dB

7:0 99%

CD GAIN= 76







Quantitative Diagnosis using Ultrasound

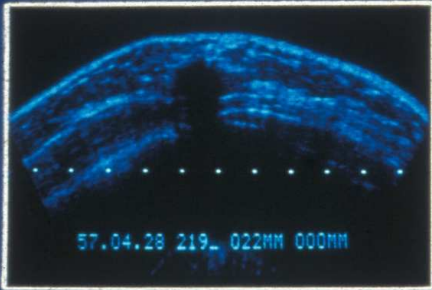
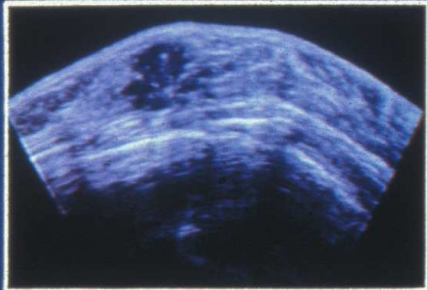
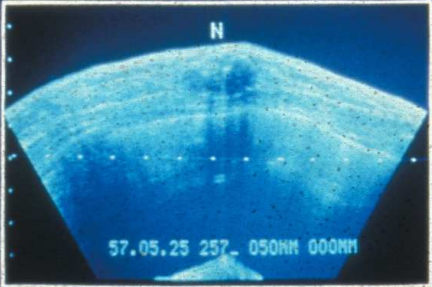
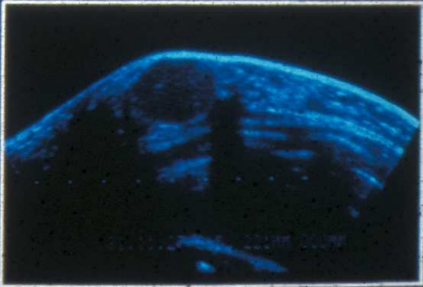
<Tissue Characterization>

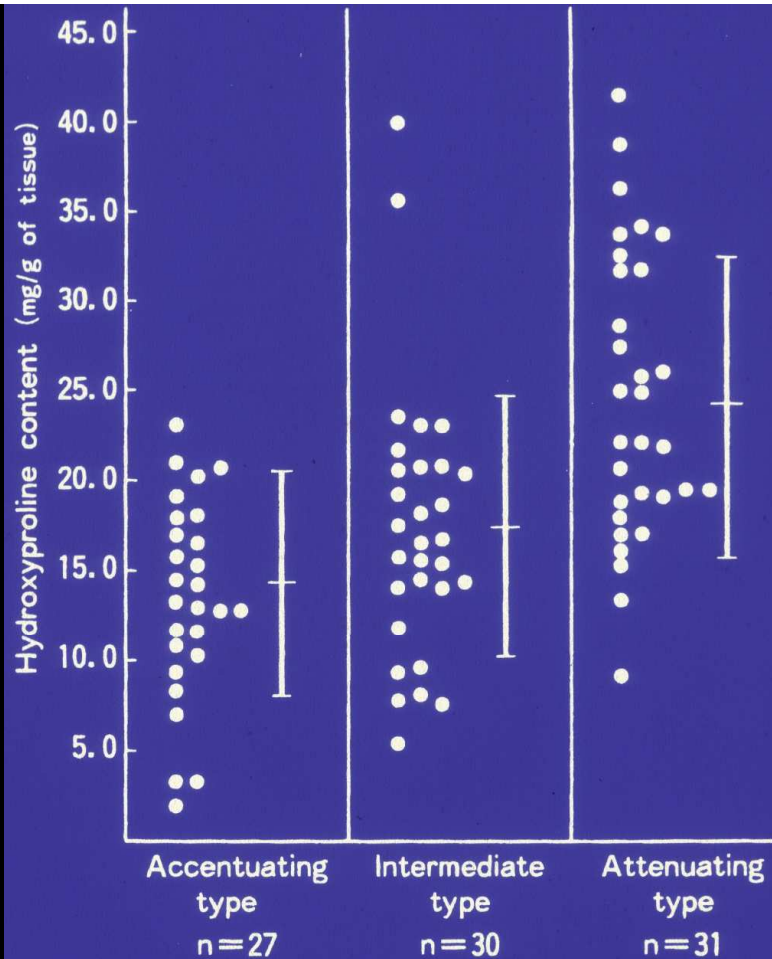
- * Informations of the Tissue level
- * Acoustic Physical parameters
 - Acoustic impedance, Sound velocity,
Attenuation, Elasticity,
- * Quantitative analysis

Tissue Level Informations

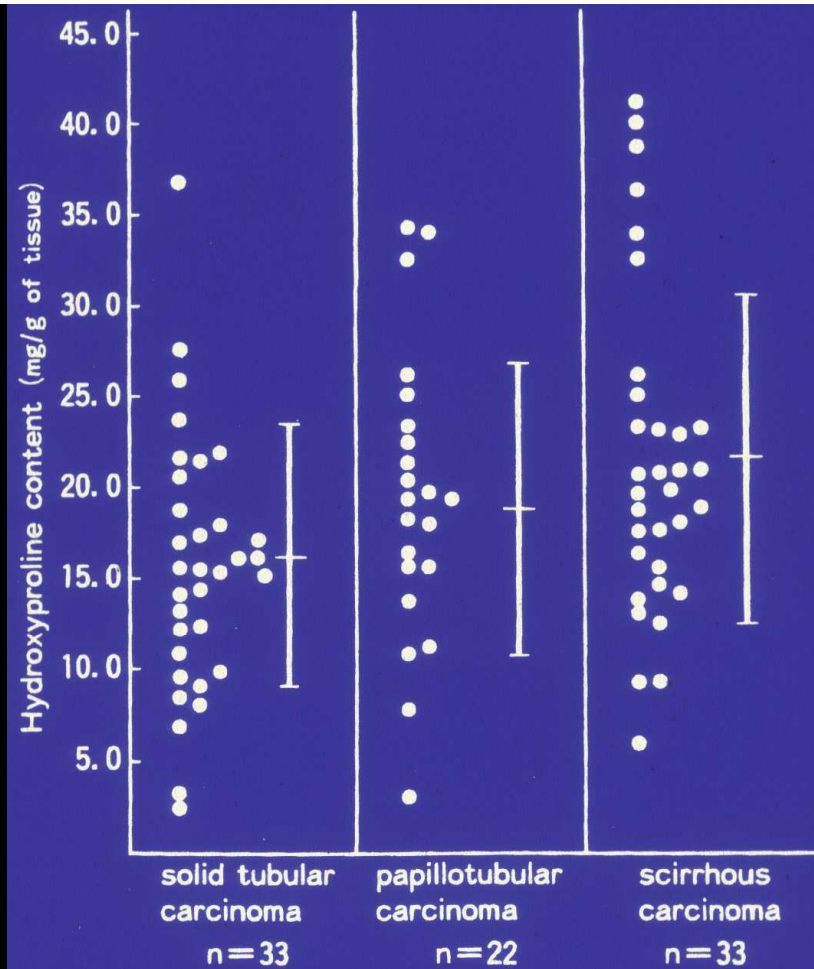
- Ultrasound Tomography
- Acoustic Tissue Characterization
- Blood Flow Information

PATTERNS OF BREAST TUMOURS

	ATTENUATION TYPE	INTERMEDIATE TYPE	ACCENTUATION TYPE
CANCER			
BENIGN			



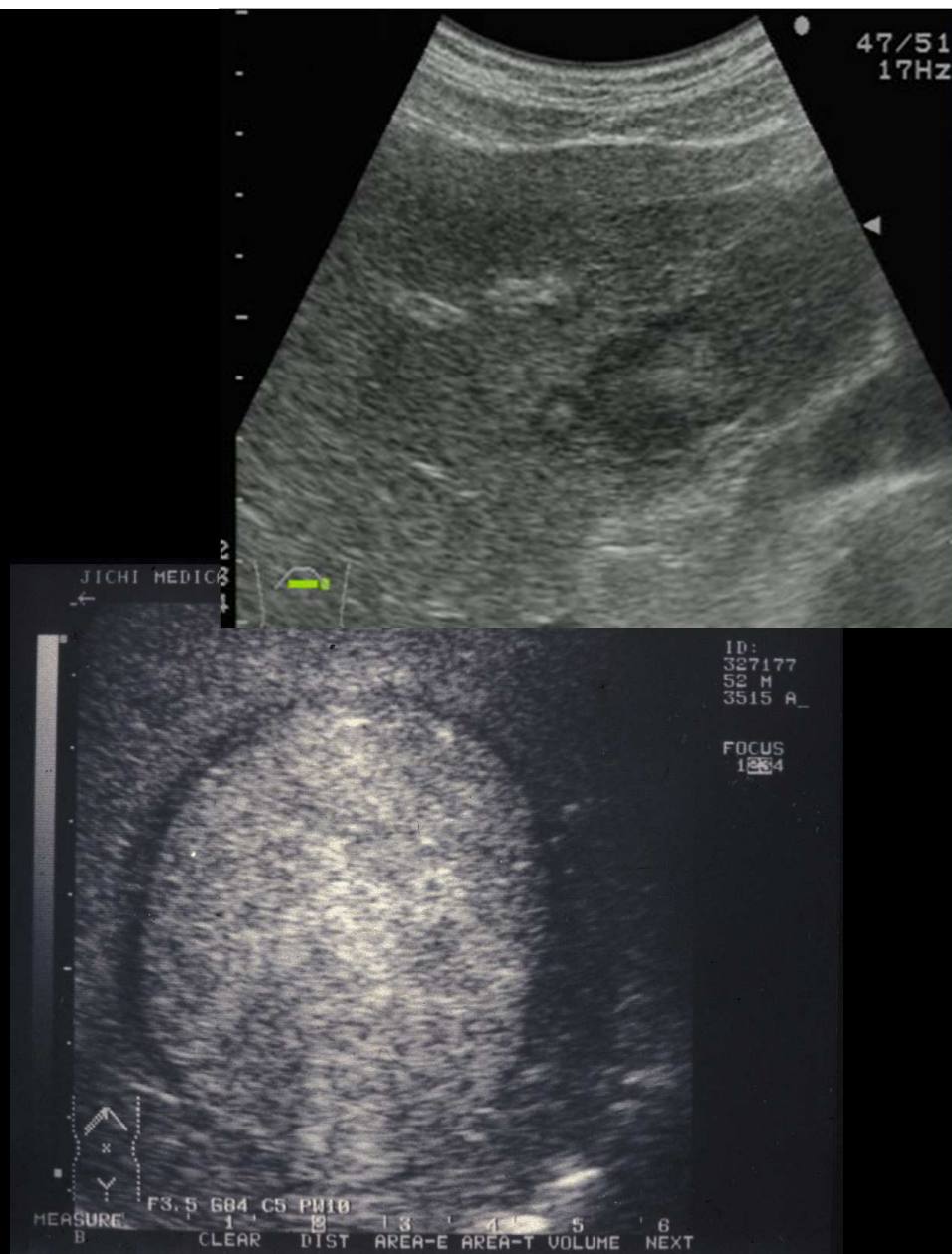
Correlation between hydroxyproline content and sonographic classification in 88 breast cancers. We have divided breast cancers into 3 classes according to those posterior echoes intensity and also assayed hydroxyproline content in each case.



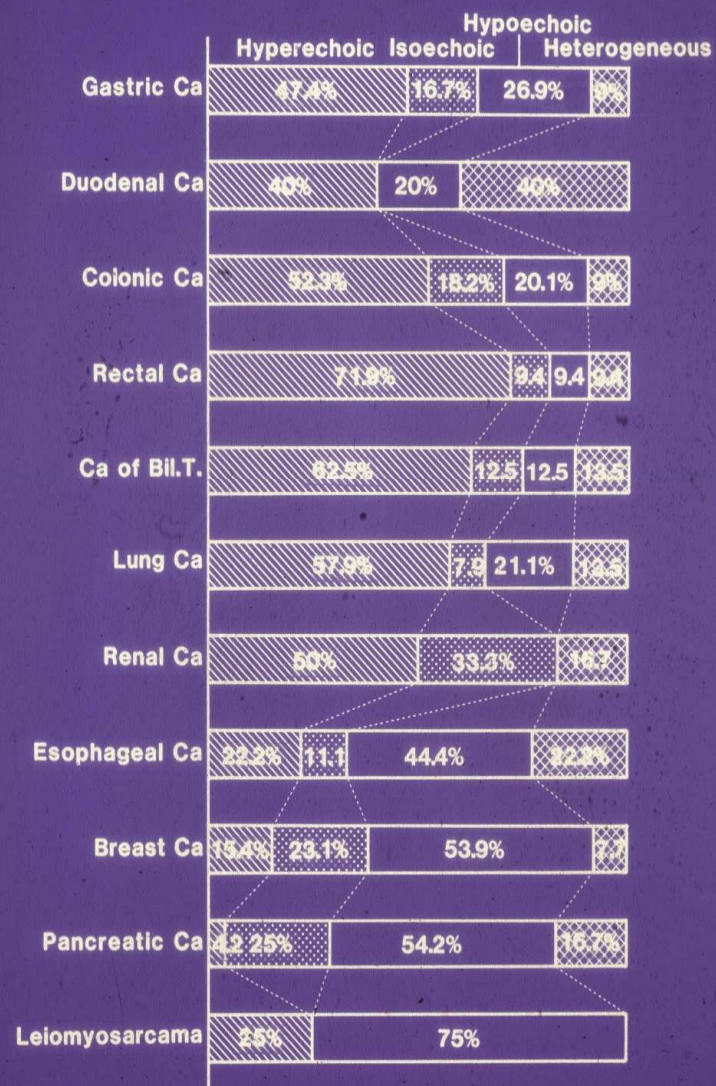
Correlation between hydroxyproline content and histological classification in 88 breast cancers. We have divided breast cancers into 3 classes according to histological classification and also assayed hydroxyproline content in each case.

Comparative findings of US and Pathology

- There are many papers comparing between US and Pathology
- **Breast Cancer has the specific findings of posterior echo**
- Metastatic Liver Carcinomas has the characters of primary focuses



Internal Echo Levels of Metastatic Tumors in the Liver



Comparative findings of US and Pathology

- There are many papers comparing between US and Pathology
- Breast Cancer has the specific findings of posterior echo
- **Metastatic Liver Carcinomas has the characters of primary focuses**

Tissue Level Informations

- Ultrasound Tomography
- Acoustic Tissue Characterization
- Blood Flow Information

Quantitative Diagnosis using Ultrasound

<Tissue Characterization>

- * Acoustic parameters

 - Acoustic impedance, Sound velocity,
Attenuation, Elasticity,

- * Information of tissue level

- * Quantitative analysis

Tissue Characterization

1;Informations of the Tissue level

2;Acoustic Physical Parameters

3;Quantitative Analysis

**** Acoustic Characters**

1;Uniform Substances

2;Statistic Characters

3;Dynamic Characters

Acoustic Parameters

- Acoustic Velocity
- Attenuation
 - Absorption, Refraction, Reflection, Scatter,
 - Frequency-Dependent-Attenuation
- Elasticity
- Blood Flow
- Acoustic Impedance : ρC

+++ JICHI MEDICAL SCHOOL +++



RNG04



RNG04

92/06/25

09:46:54

ID:
440569
118
3263A



HIST-TRACE

+T: 1902

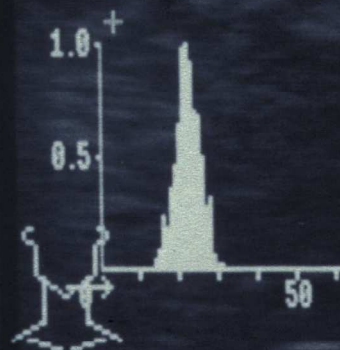
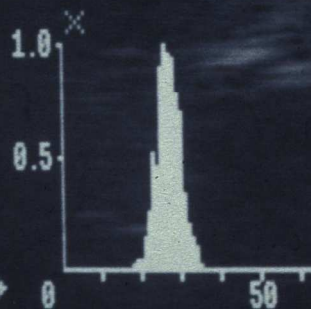
L: 22

M: 68

X T: 1568

L: 26

M: 56



HISTOGRAM F10 G90 C3 PW10
1 2
EXIT CLEAR

HIST-B HIST-T F10 G90 C3 PW10
3 5 6

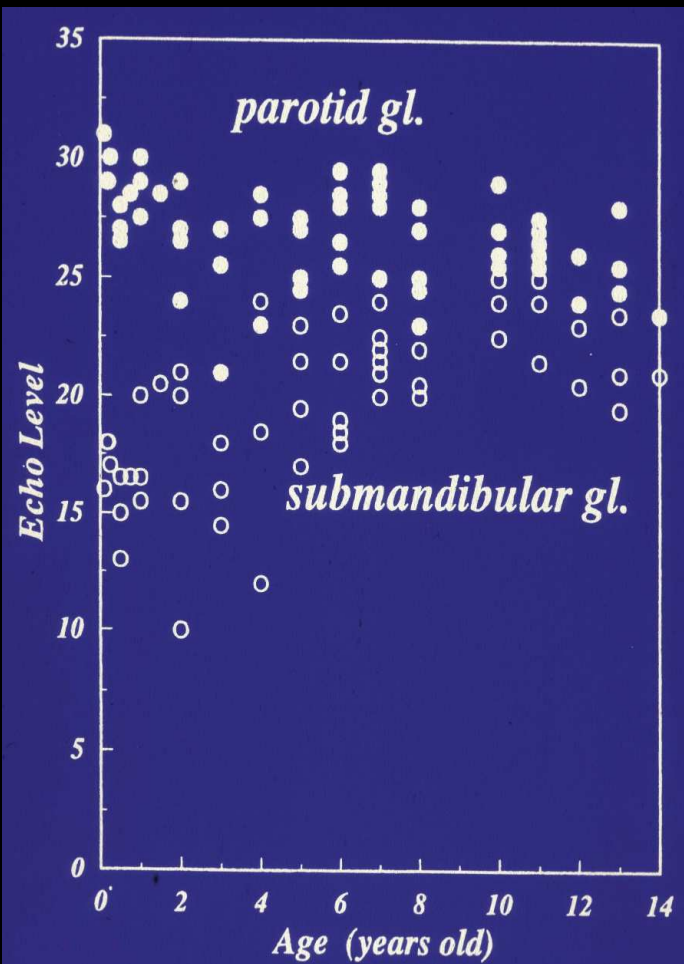


Fig. 3 L values of the salivary glands. Parotid glands show relatively stable L value through time, while L value of submandibular glands increases with age.

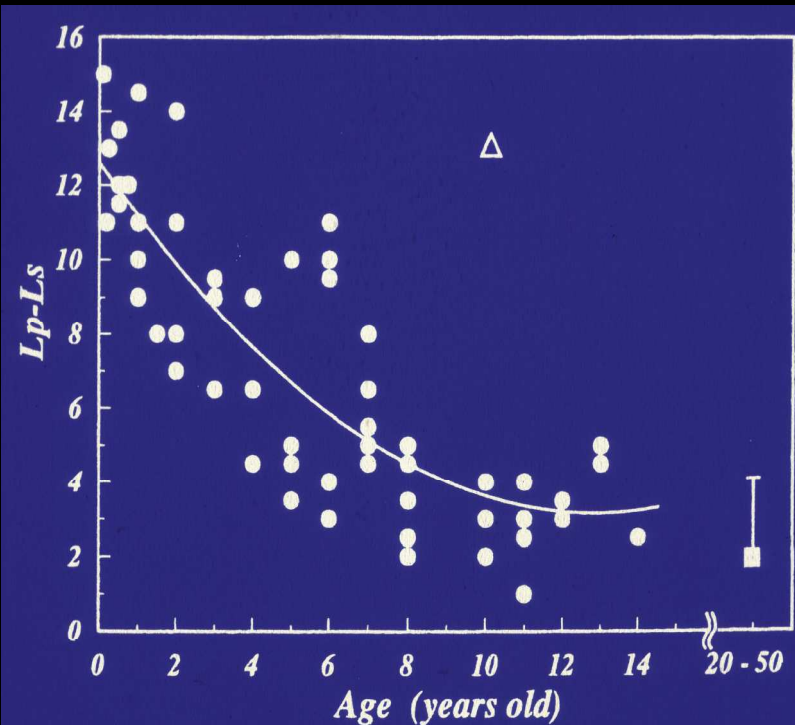
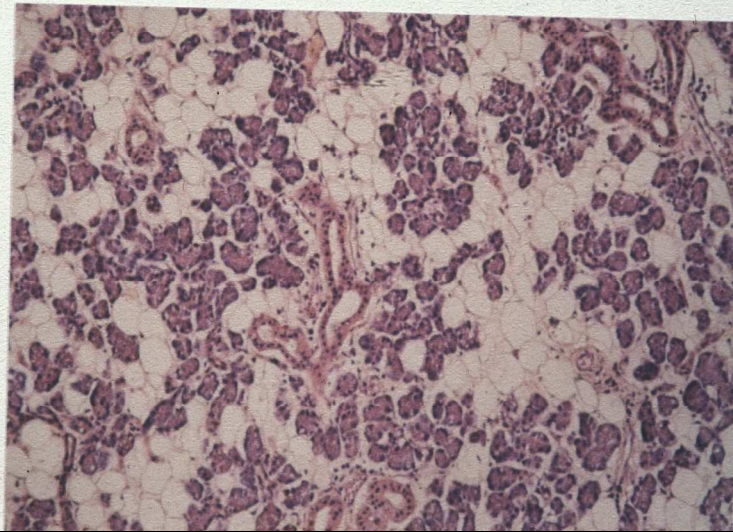
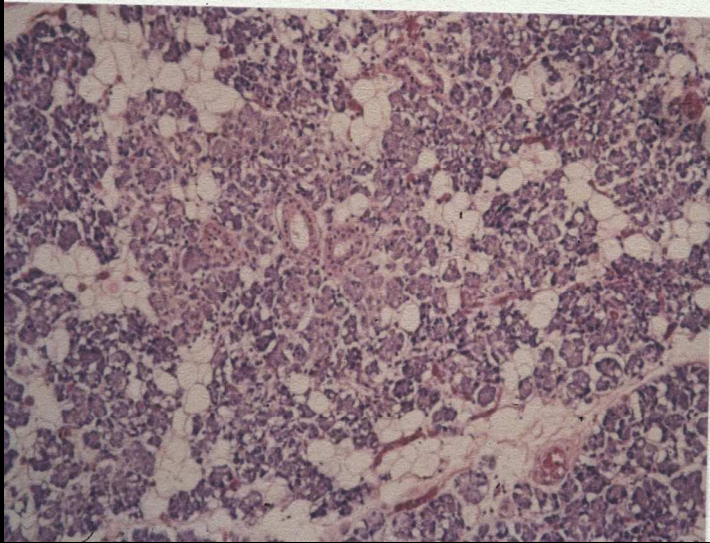
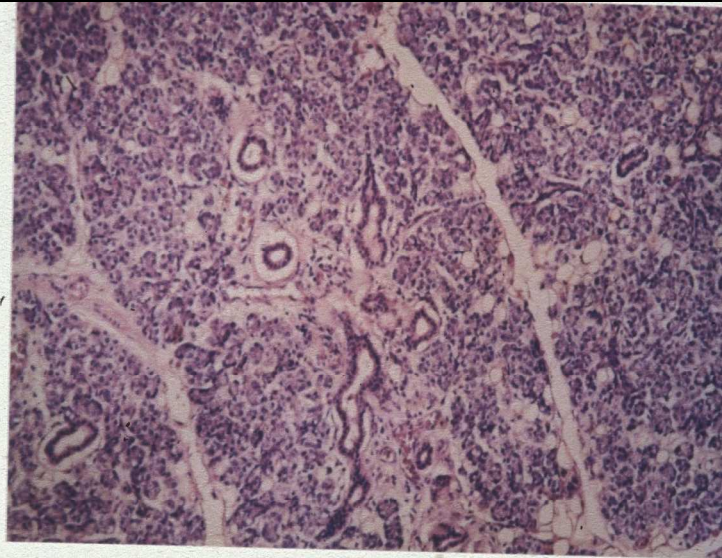
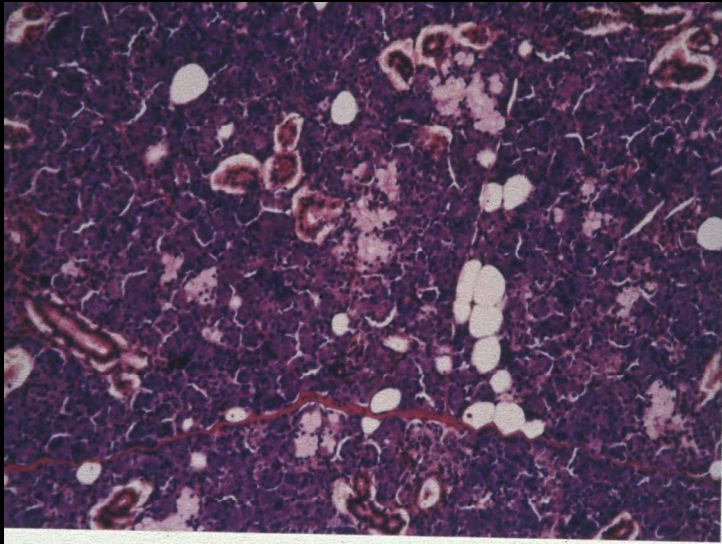
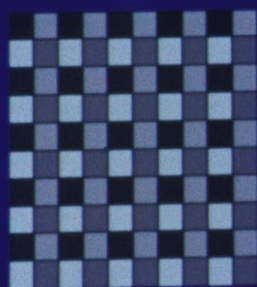
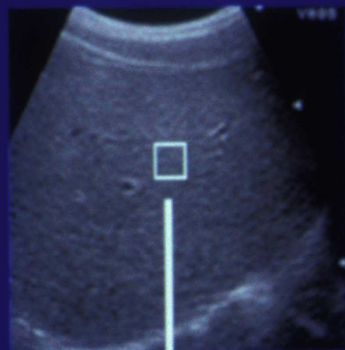


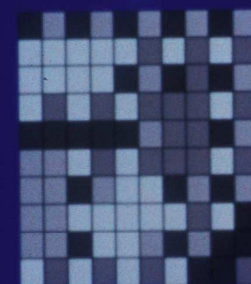
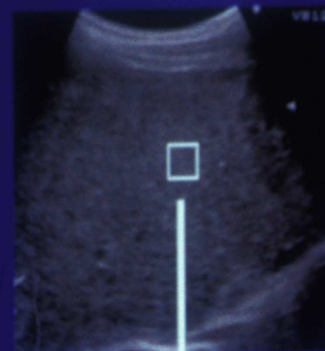
Fig. 4 Correlation of Lp-Ls and age. Clear negative correlation was demonstrated between Lp-Ls and age. (Correlation coefficient ; -0.85 ; $p < 0.01$). Δ indicates a patient with submandibulitis ; $\blacksquare$, mean value and standard deviation of control adults.



正常肝



肝硬変



← Normal liver
LC →

Texture analysis

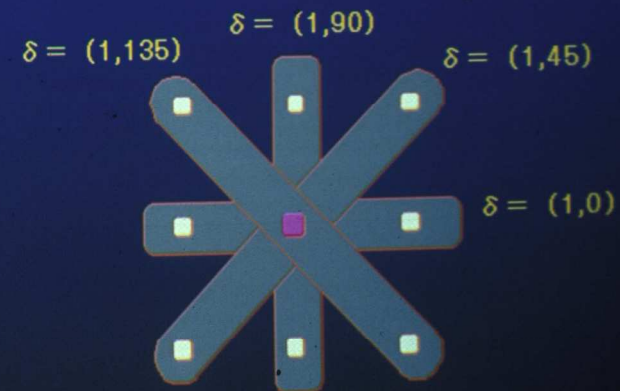
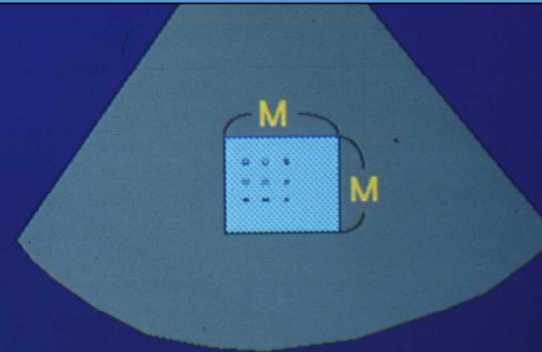
Measurement of Characters using Co-occurrence (同時生起行列)

M×Mの小領域の切り出し

ヒストグラムの平滑化
(濃度レベル削減)

$P_{\delta(i,j)}$ の計算
 $\delta = (1,0)$ 、 $(1,45)$
 $(1,90)$ 、 $(1,135)$ の4種類

特徴量の計算
 14×4 種類 = 56 種類
の特徴量の算出



同時生起行列からの特徴量の計算法

$$P_x(i) = \sum_{j=0}^{n-1} P_s(i,j) \quad , \quad P_y(j) = \sum_{i=0}^{n-1} P_s(i,j) \quad i=0,1,\dots,n-1$$

1. angular second moment

$$\sum_{i=0}^{n-1} \sum_{j=0}^{n-1} \{P_s(i,j)\}^2$$

2. contrast

$$\sum_{k=0}^{n-1} k^2 \cdot P_{x-y}(k)$$

3. correlation

$$\frac{\sum_{i=0}^{n-1} \sum_{j=0}^{n-1} i \cdot j \cdot P_s(i,j) - \mu_x \cdot \mu_y}{\sigma_x \sigma_y}$$

ただし $\mu_x = \sum_{i=0}^{n-1} i P_x(i)$

$$\mu_y = \sum_{j=0}^{n-1} j P_y(j)$$

$$\sigma_x^2 = \sum_{i=0}^{n-1} (i - \mu_x)^2 P_x(i)$$

$$\sigma_y^2 = \sum_{j=0}^{n-1} (j - \mu_y)^2 P_y(j)$$

4. sum of square: variance

$$\sum_{i=0}^{n-1} \sum_{j=0}^{n-1} (i - \mu_x)^2 \cdot P_s(i,j)$$

5. inverse difference moment

$$\sum_{i=0}^{n-1} \sum_{j=0}^{n-1} P_s(i,j) / \{1 + (i-j)^2\}$$

6. sum average

$$\sum_{k=0}^{2n-2} k \cdot P_{x+y}(k)$$

$$P_{x+y}(k) = \sum_{i=0}^{n-1} \sum_{j=0}^{n-1} P_s(i,j) \quad i=0,1,\dots,2n-2$$

$$P_{x-y}(k) = \sum_{i=0}^{n-1} \sum_{j=0}^{n-1} P_s(i,j) \quad i=0,1,\dots,n-1$$

7. sum variance

$$\sum_{k=0}^{2n-2} (k - \text{sum average})^2 \cdot P_{x+y}(k)$$

8. sum entropy

$$-\sum_{k=0}^{2n-2} P_{x+y}(k) \cdot \log\{P_{x+y}(k)\}$$

9. entropy

$$-\sum_{i=0}^{n-1} \sum_{j=0}^{n-1} P_s(i,j) \cdot \log\{P_s(i,j)\}$$

10. difference variance

$$\sum_{k=0}^{n-1} \{k - \sum_{k=0}^{n-1} k \cdot P_{x-y}(k)\}^2 \cdot P_{x-y}(k)$$

11. difference entropy

$$-\sum_{k=0}^{n-1} P_{x-y}(k) \cdot \log\{P_{x-y}(k)\}$$

12. information measure of correlation

$$H_{XY} - H_{XY1}$$

$$\max(H_X, H_Y)$$

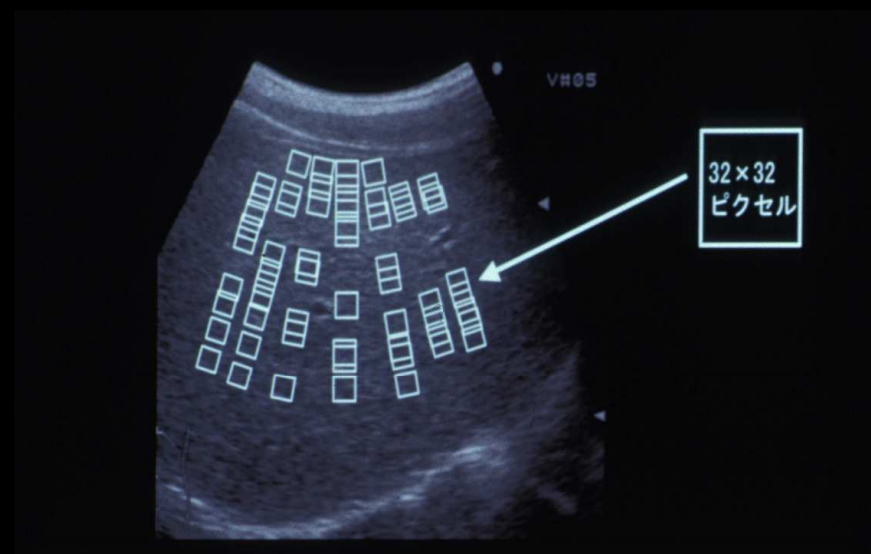
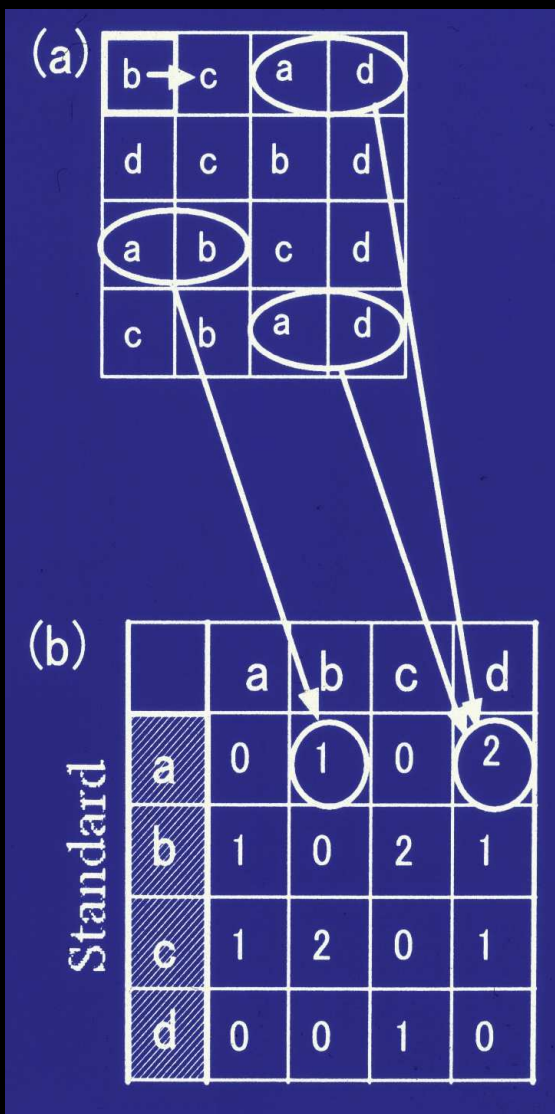
13. information measure of correlation

$$[1 - \exp\{-2.0(H_{XY2} - H_{XY})\}]^{1/2}$$

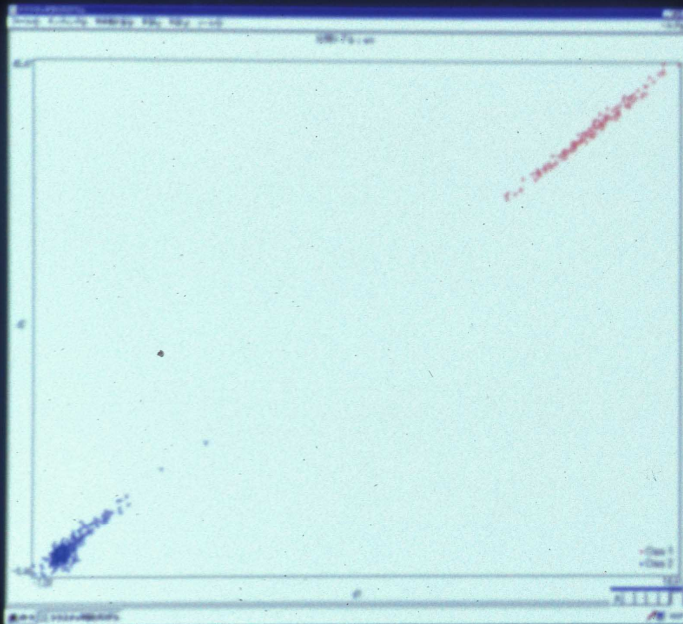
14. maximal correlation coefficient

Qの2番目に大きい固有値

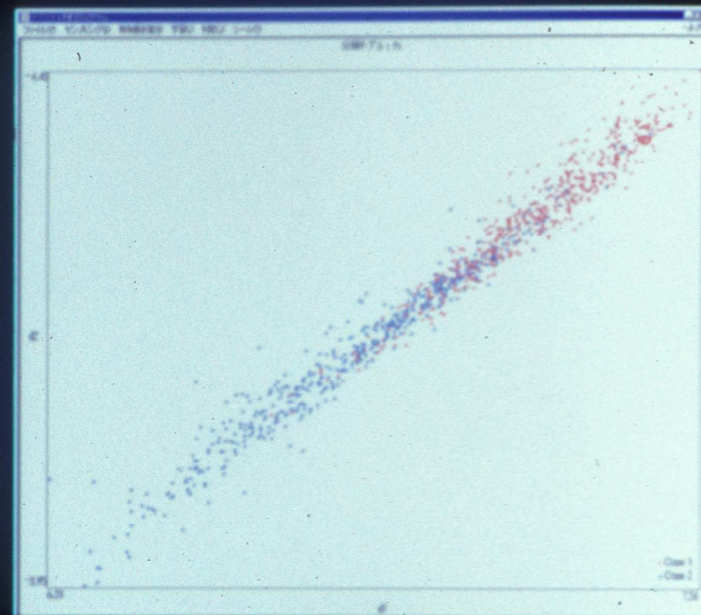
$$\text{ただし、} Q(i,j) = \frac{\sum_{k=0}^{n-1} P_s(i,j=k) \cdot P_s(k,j)}{P_x(i) \cdot P_y(j)}$$



ROI on the Ultrasound image

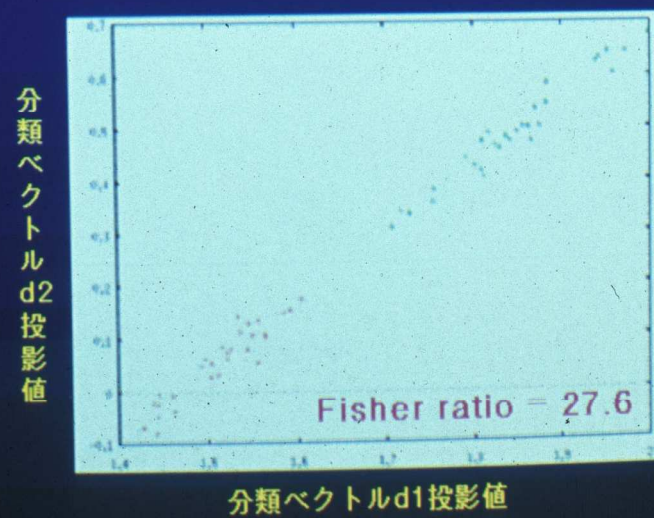
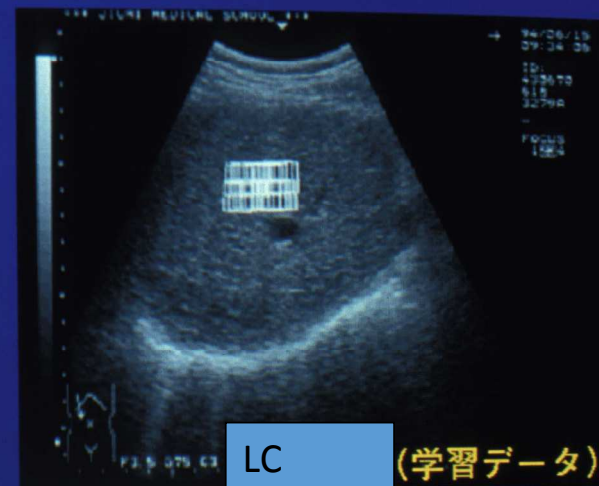


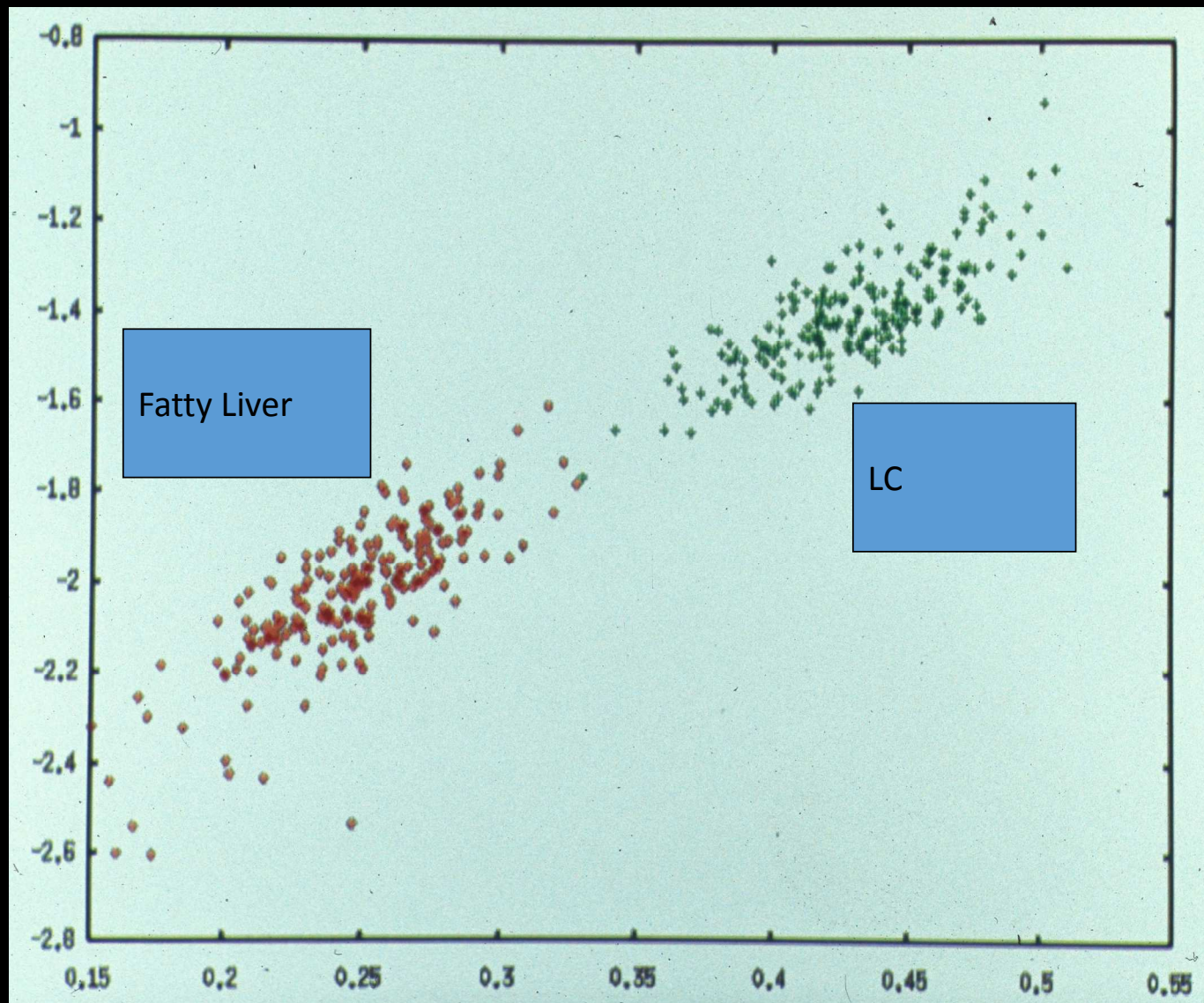
Good separation of
The 2 groups(FR=314.4)

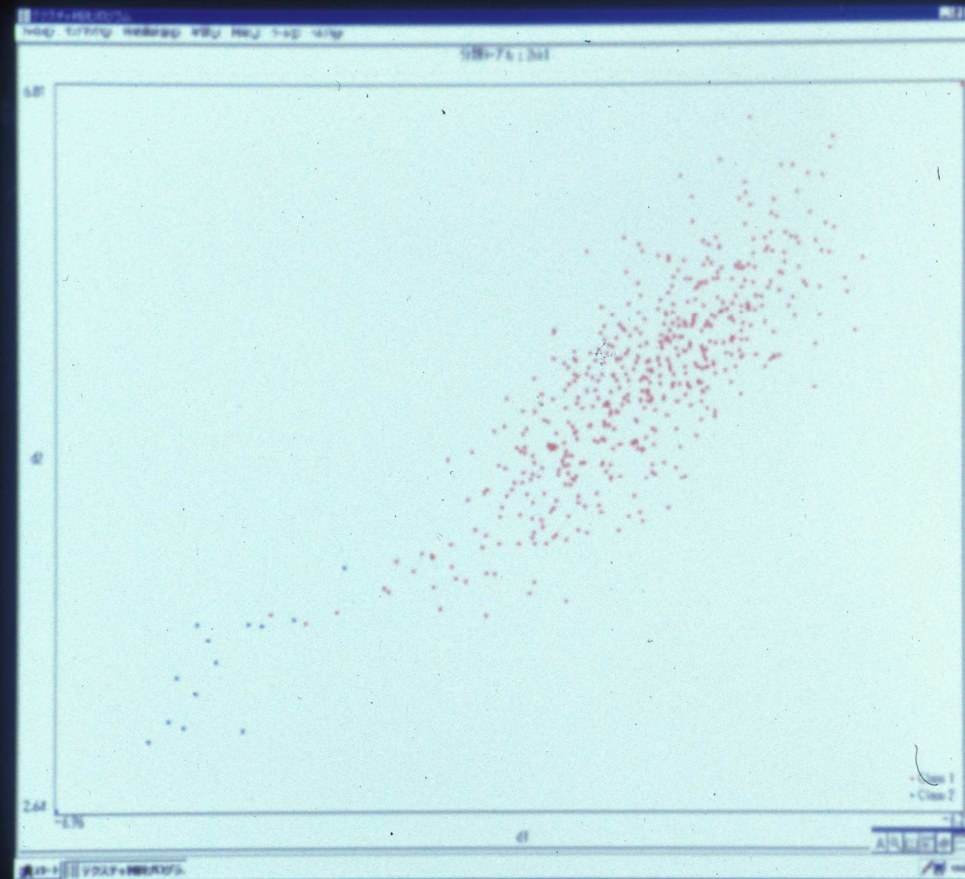


Non good separation of
The 2 groups(FR= 3.9)

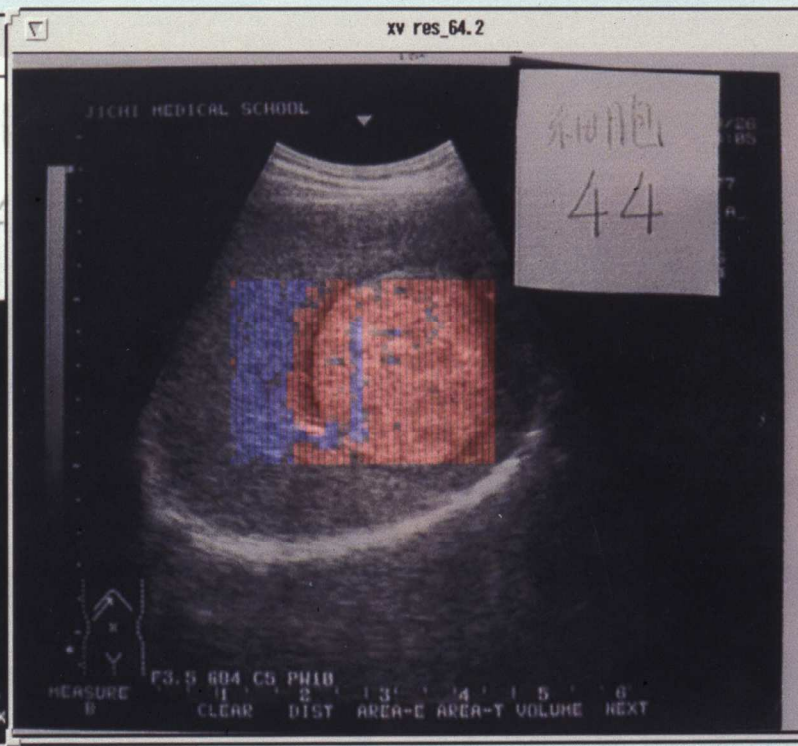
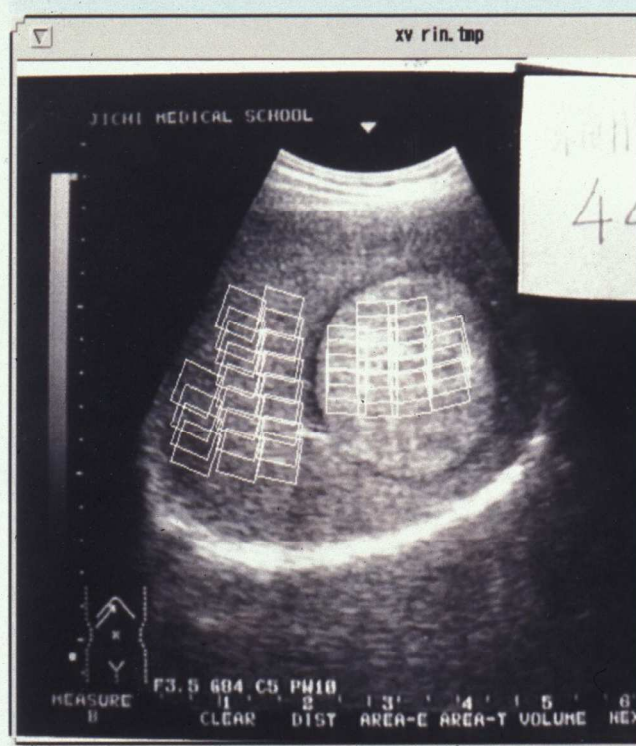
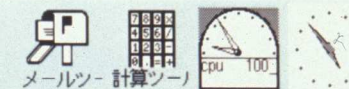
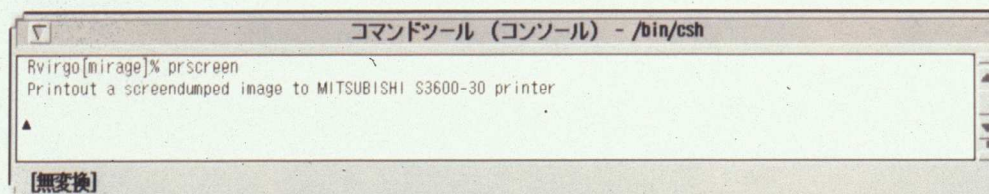
正常肝臓と肝硬変の分類結果







Normal Liver;20cases(red) and LC(blue)
(FR=20.6)



Quantitative Diagnosis using Ultrasound

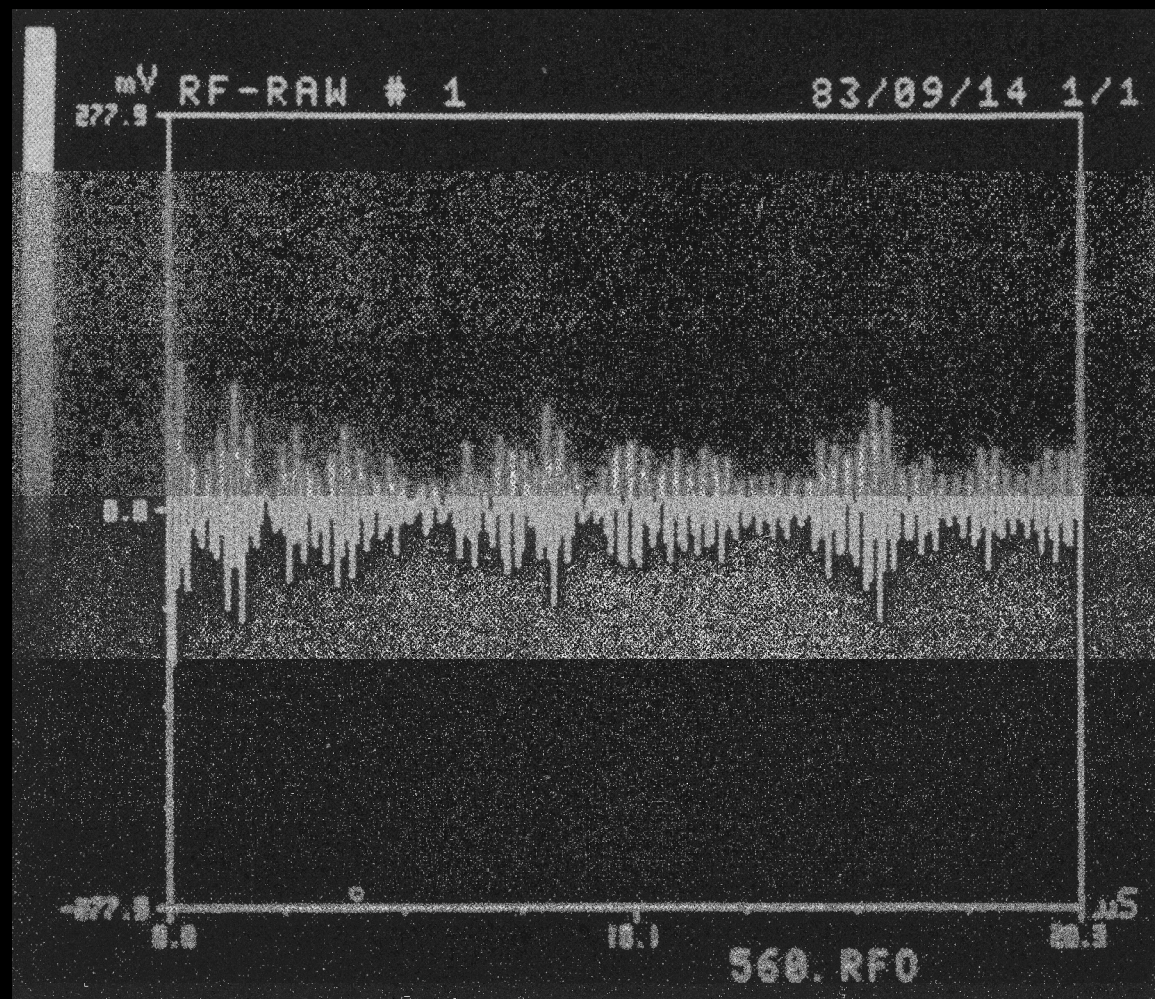
<Tissue Characterization>

- * Acoustic parameters

 - Acoustic impedance, Sound velocity,
Attenuation, Elasticity,

- * Information of tissue level

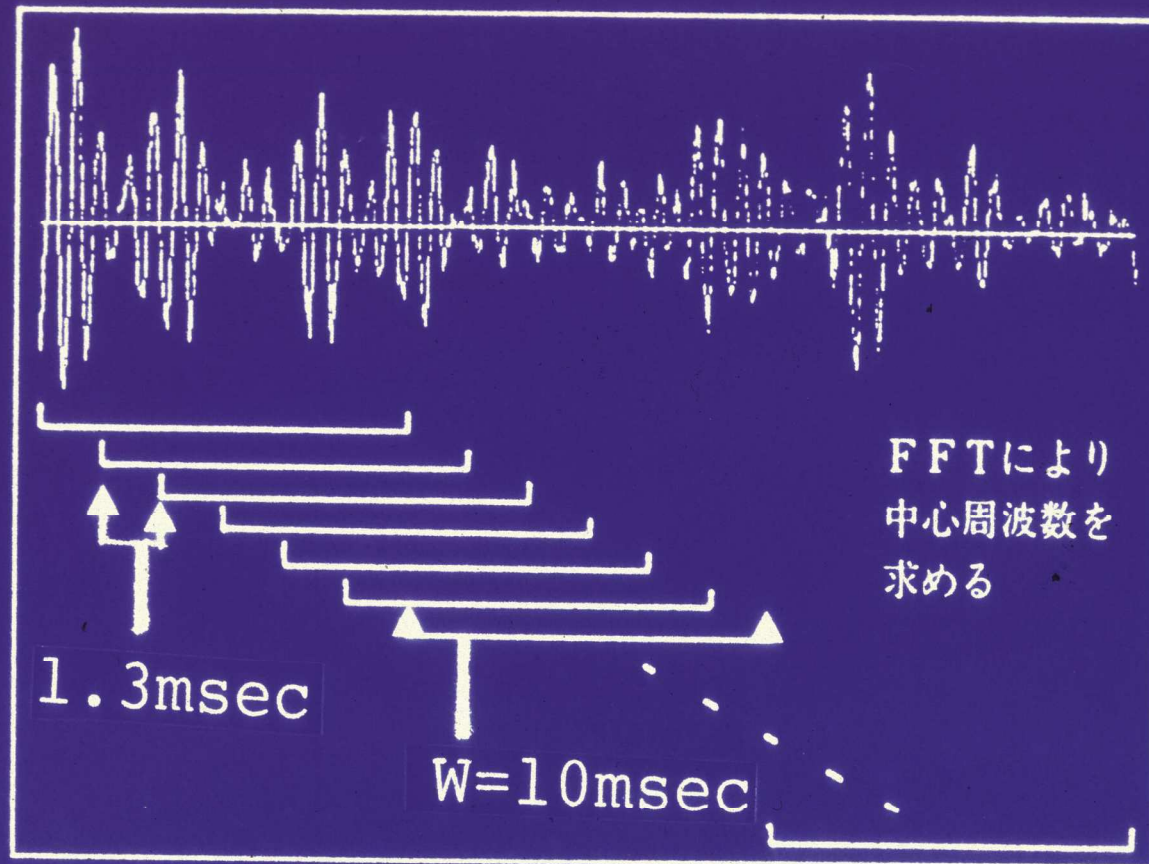
- * Quantitative analysis



RFデータ

Short Time Fourier Analysis

Spectral-shift mean-frequency



ショートタイムフーリエ法

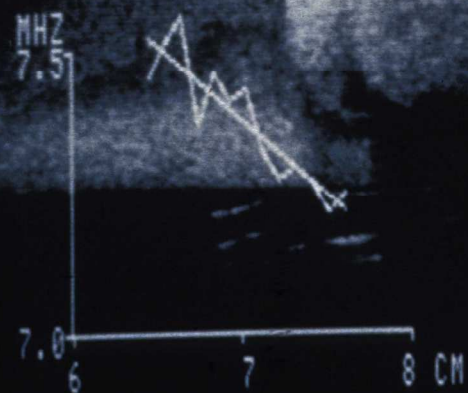
JICHI MEDICAL SCHOOL

DATE 01.21.92
03.1CM TIME 01:06:51
ID:1

1 C 3.5MHZ
2 C 3.5MHZ
3 A 7.5MHZ ACT

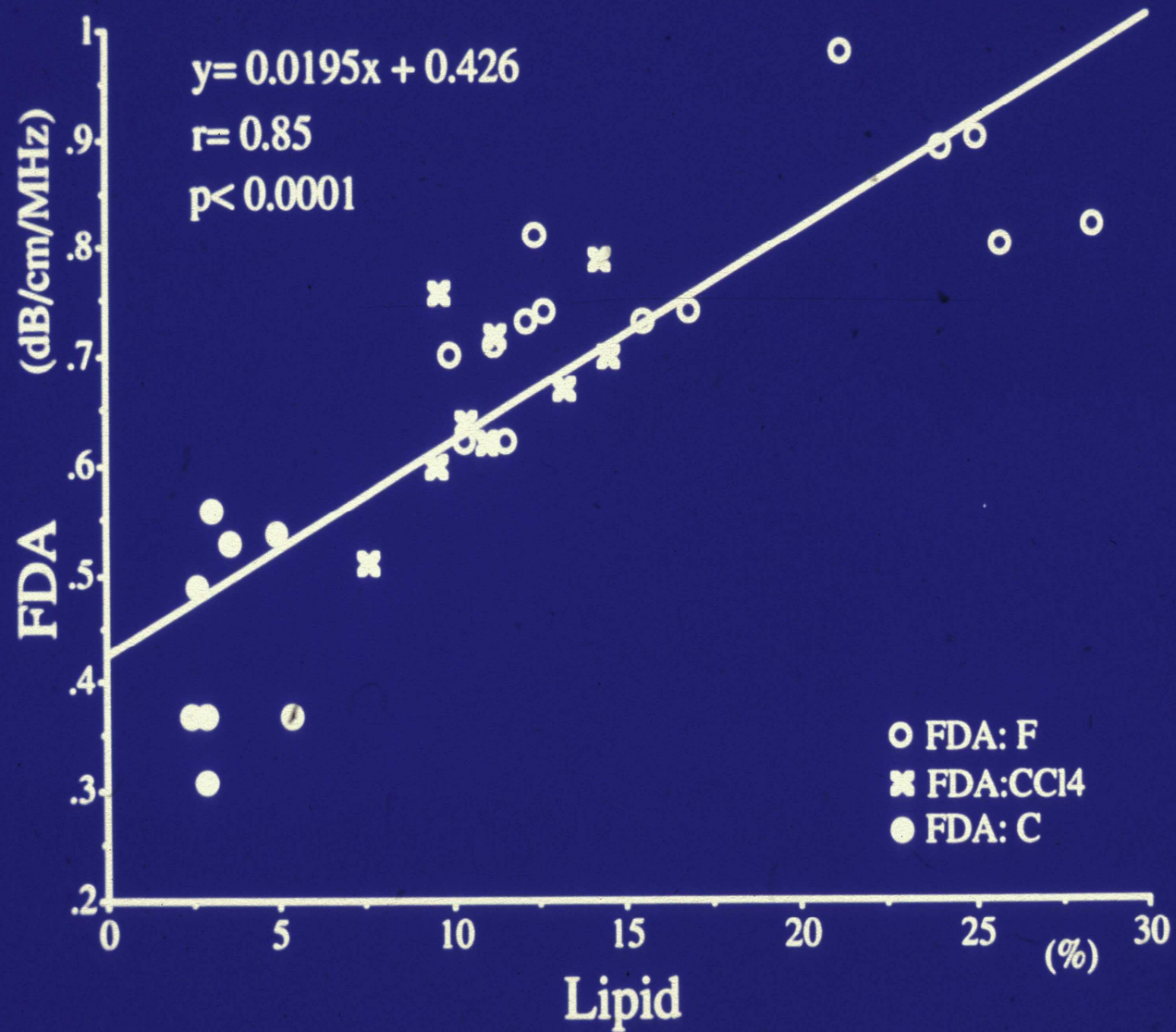
FOCUS: 45STEPS
GAIN: 700B
D.R: 630B

GAMMA: B
SCALE: 1.000CM



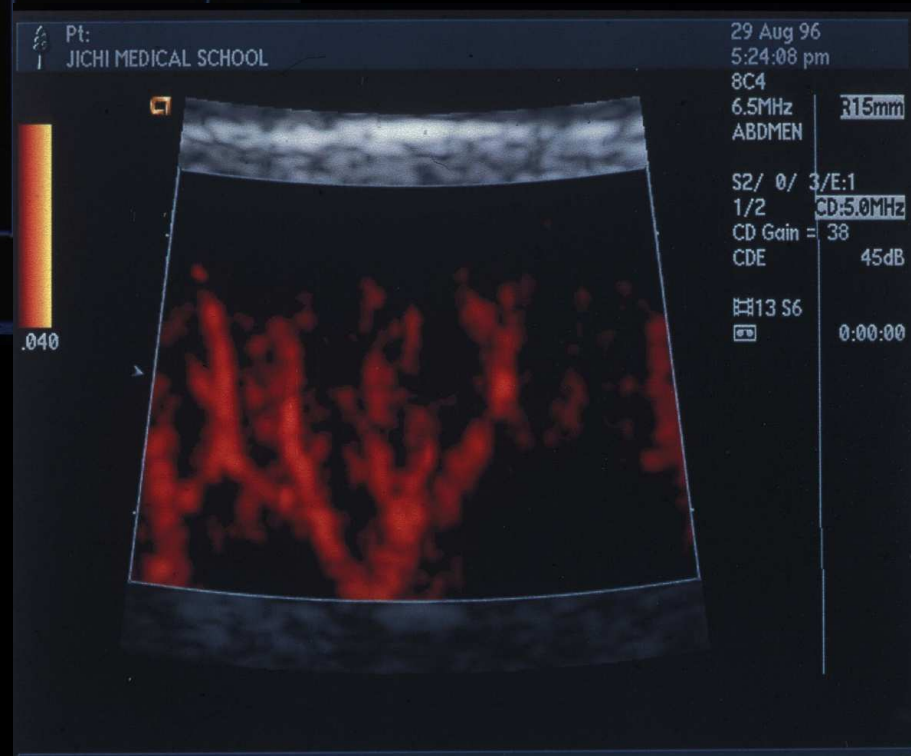
NO	FDA	SD	AUE
1	0.63	0.14	0.74
2	0.85	0.11	0.75
3	0.73	0.10	0.74
4	0.74	0.11	0.74
5	0.81	0.10	0.74
6	0.85	0.10	0.73
7	0.72	0.11	0.72
8	0.73	0.09	0.71
9	0.66	0.10	0.71
10	0.75	0.12	0.73
11	0.68	0.10	0.72
12	0.75	0.11	

ENH:ORIGINAL



Tissue Level Informations

- Ultrasound Tomography
- Acoustic Tissue Characterization
- Blood Flow Information



KAMITSUGA SOUGOU <ID:038850 304
HOSPITAL<KIMURA ZENJI

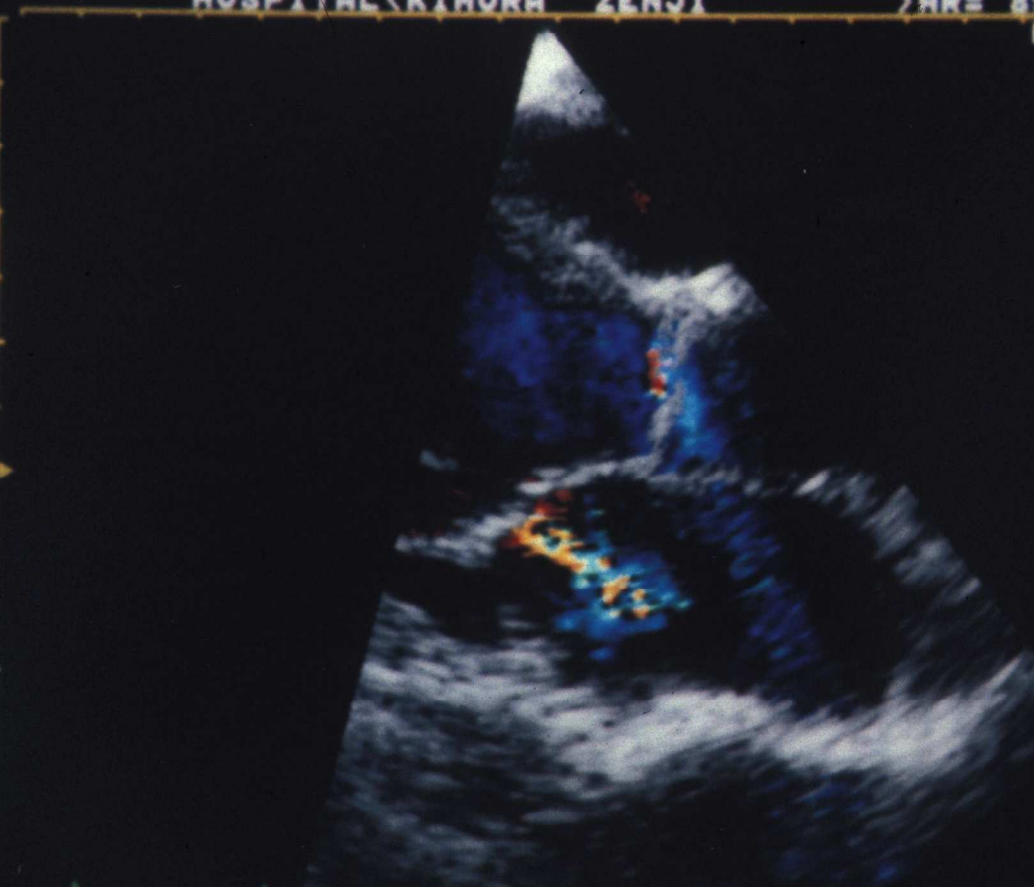
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>HR= 85 14:11:58

DE 0.0CM

F 2.50

0.81



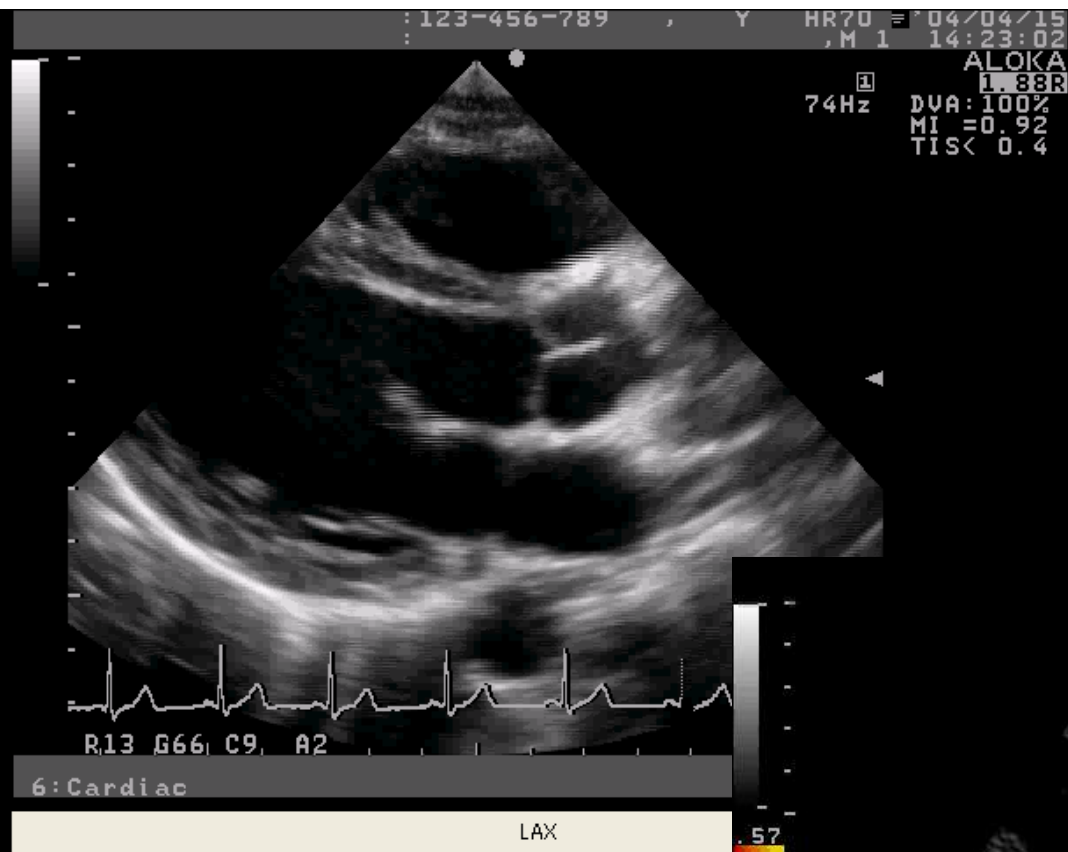
1-

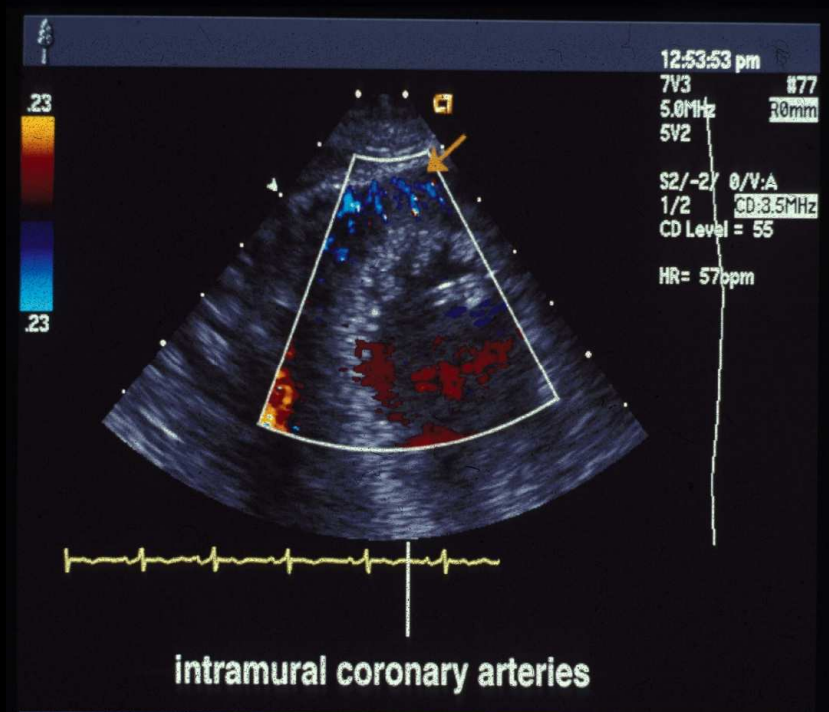
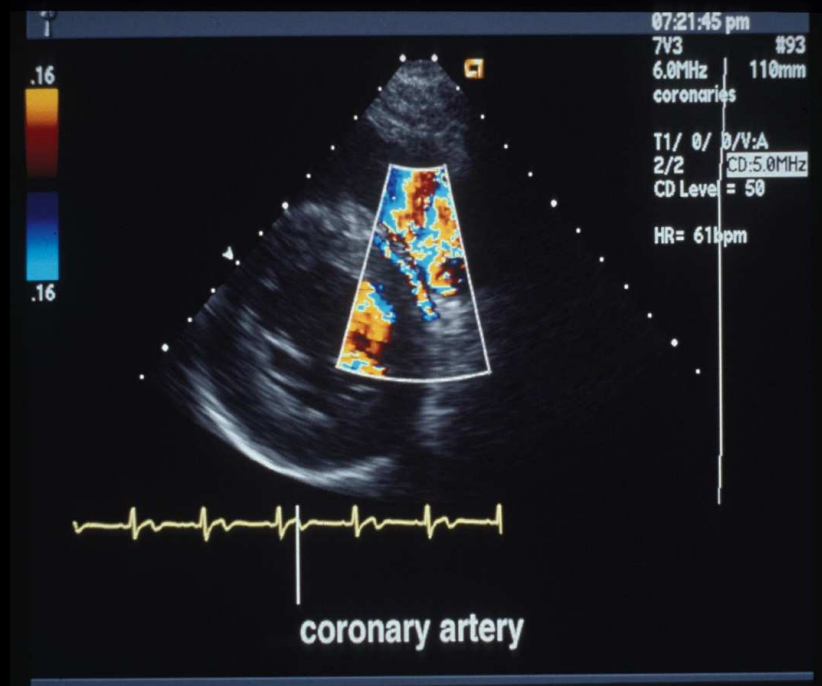
CF 4
CG10
CP 0 M
PRF 4.5K

P L
G 82

DR 45
EE 1
DE 15.0CM







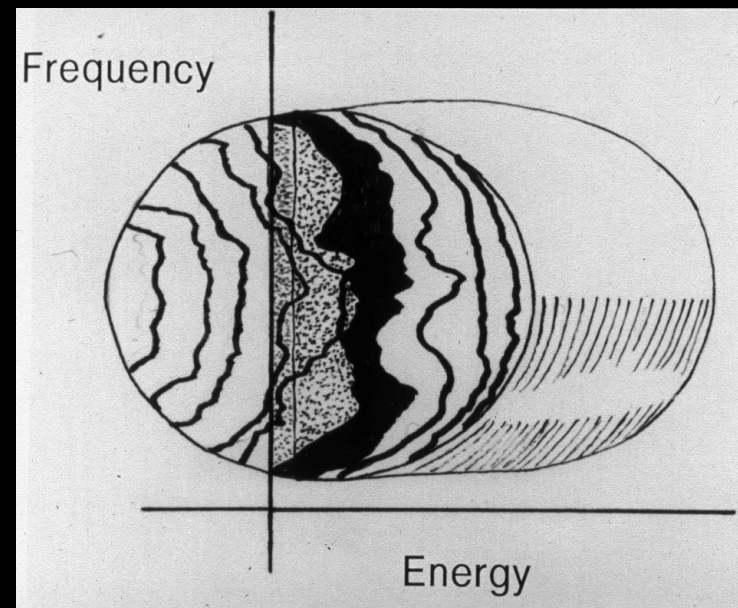
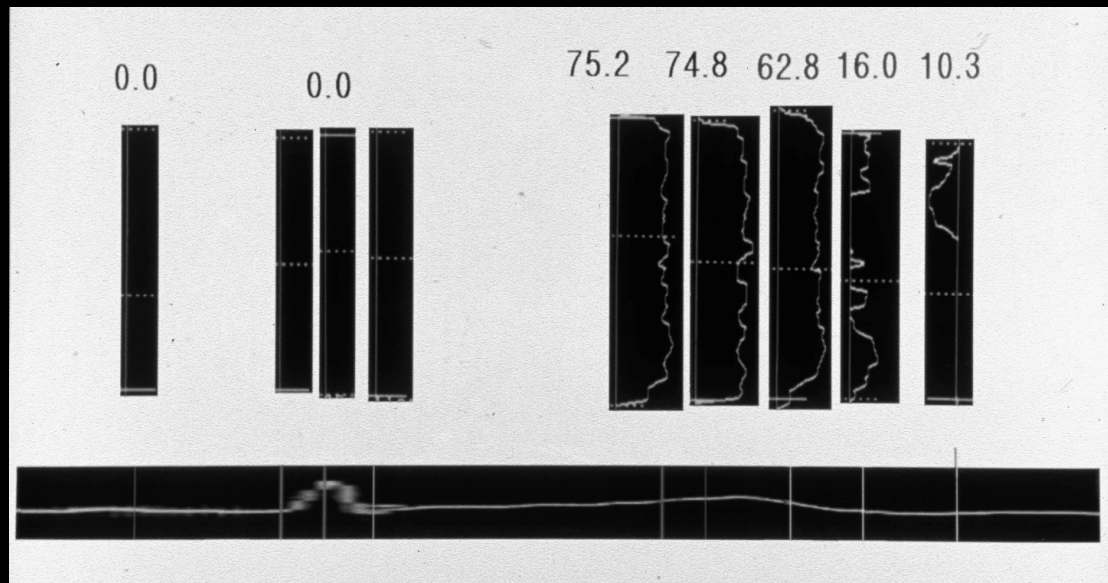
JICHI MED ID:
SCHOOL 2000 [

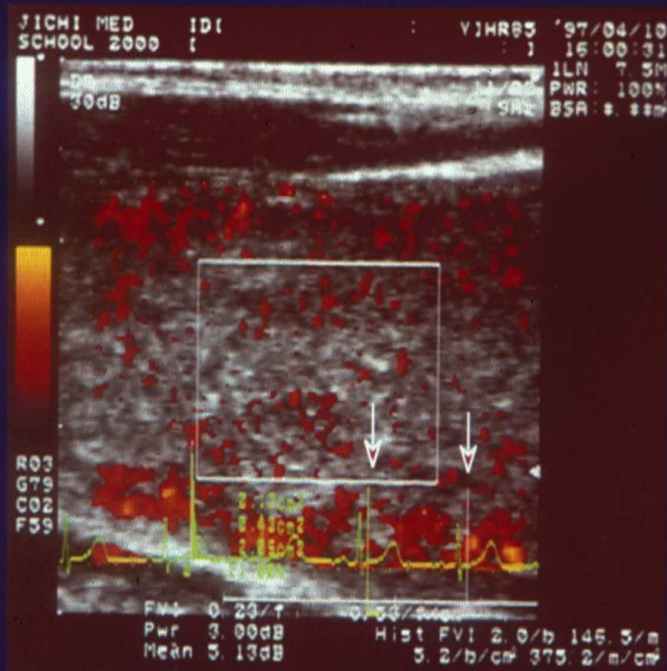
: YJHR56 '95/07/19
: 1 17:35:13
ICV 7.5M
26/51 PWR: 100%
15Hz BSA:*. **m²

DR
30dB

R04
G05
C02

Dist 0.61cm
EL 8.28dB
Pwr 13.00dB
Mean 9.61dB





The ultrasound image is shown on the monitor, and the ROI is delineated in the lesion or the site to be examined. Arrows are placed on the two adjacent R wave of the electrocardiogram simultaneously shown on the monitor. The computer then automatically calculates the total strength of Doppler signals per cardiac cycle in the ROI.

ISS

The index of signal strength per minute in the ROI.

$$F = \int_{t1}^{t2} \sum s_i p_i dt$$

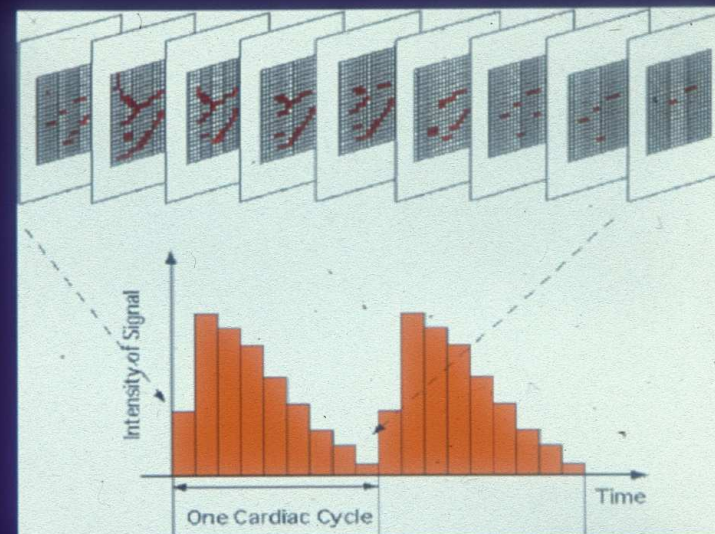
Equation for determining in total signal strength of accumulated Doppler signals during one cardiac cycle in the ROI.

F : tissue blood flow signals during one cardiac cycle in the region of interesting

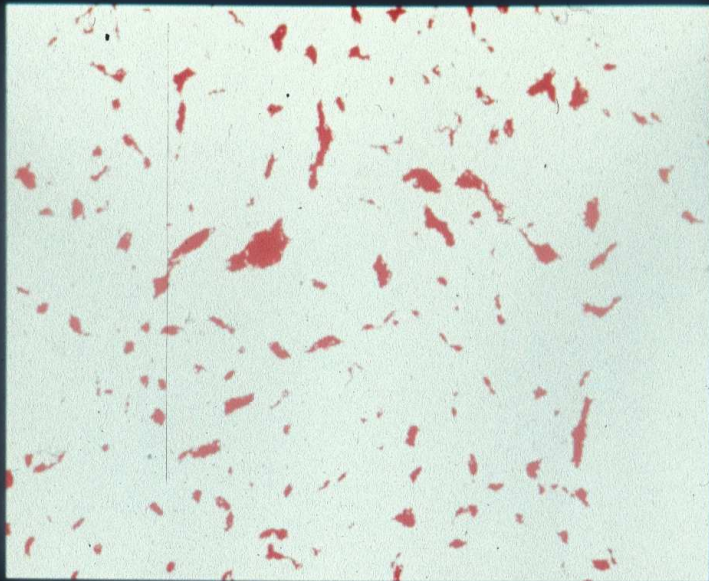
$t1-t2$: one cardiac cycle

s_i : area of one pixel

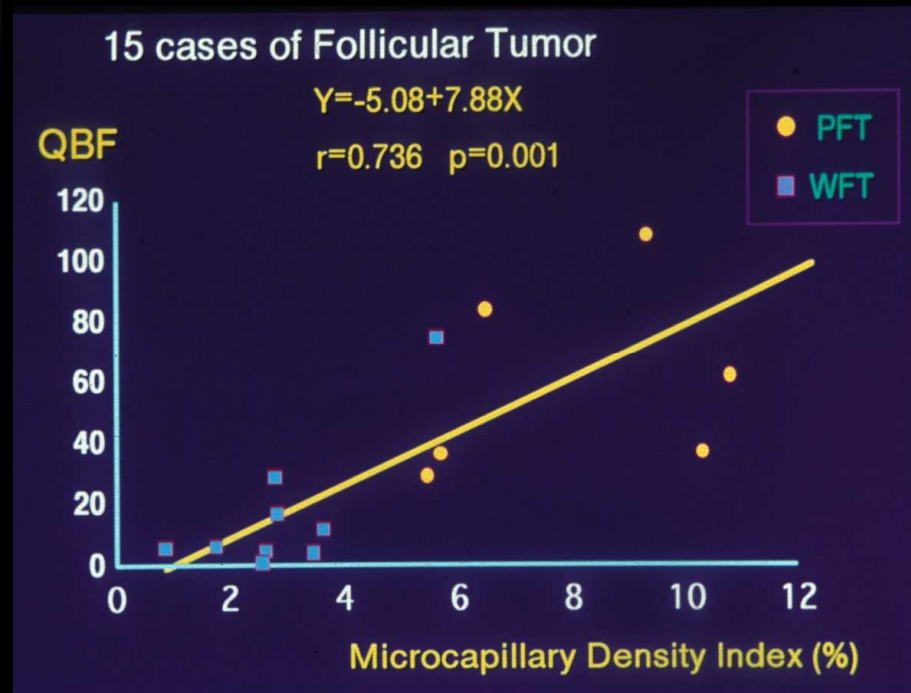
p_i : intensity of power Doppler signals in one pixel



Schematic drawing of the equation



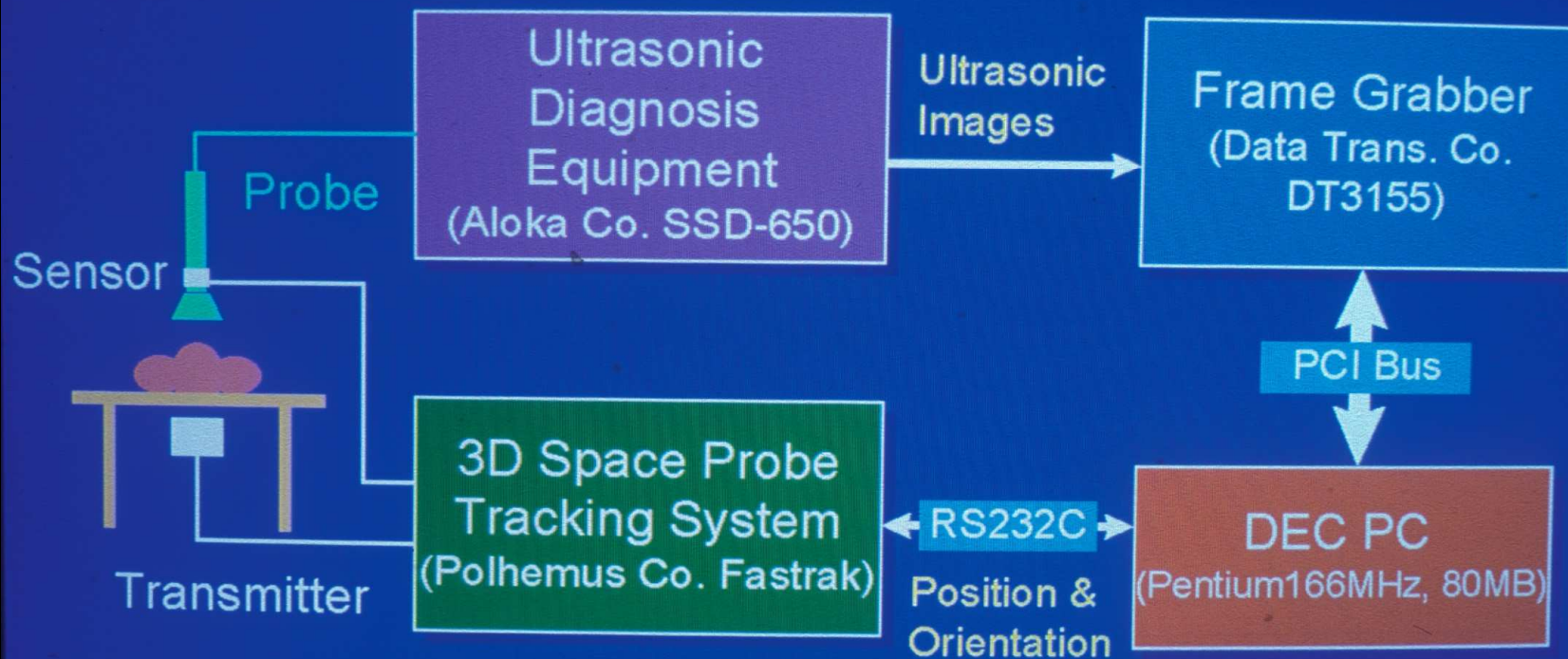
Microcapillary density index (%)



Volume measurement

- * Cardiac function;
Ejection fraction, Cardiac output,
LV-volume, LV-muscle volume,
LV-fractional shortening, MeanVcf,
etc.
- * Volume rendering of OB/GY
- * Growth parameter of fetus

Image Capturing System



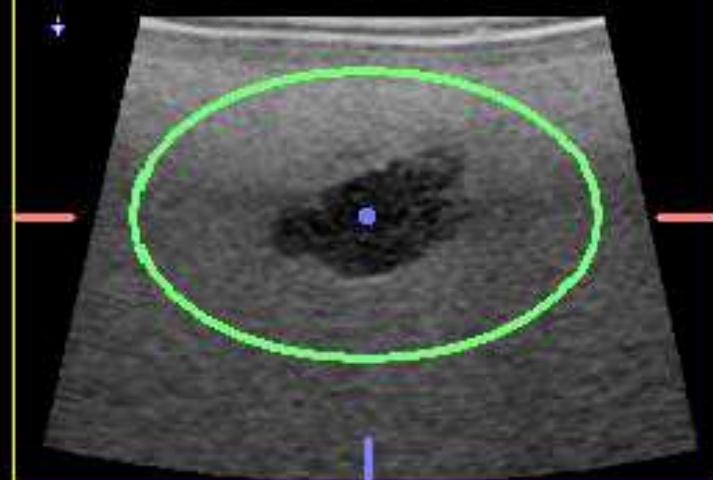
(Ultrasoundic Probe: Mechanical Sector Scanning of 10MHz)

Jichi Med. School
SSD-5500-1

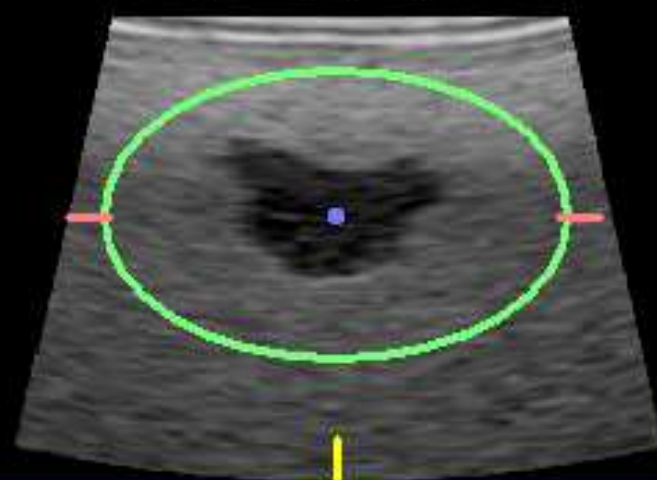
: TEST

04/05/07
18:40:32
ALOKA

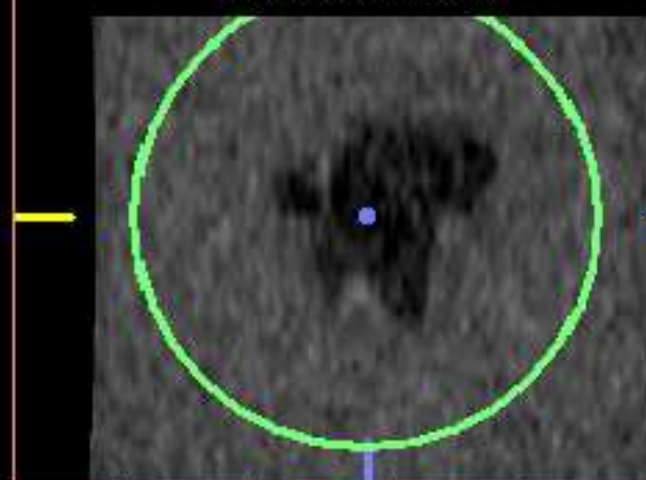
X-Y (Front View)



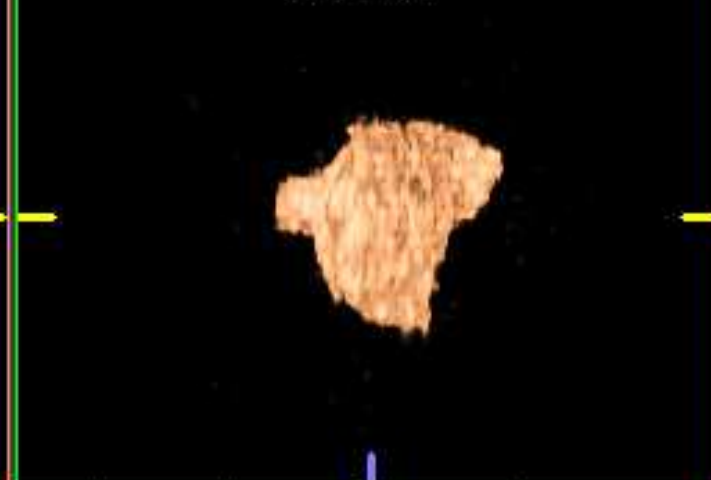
Z-Y (Side View)



Z-X (Top View)



3D View

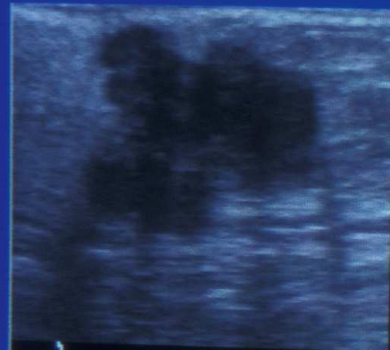


SR: 2.00Hz FR: 92Hz
13: SMPart 5539

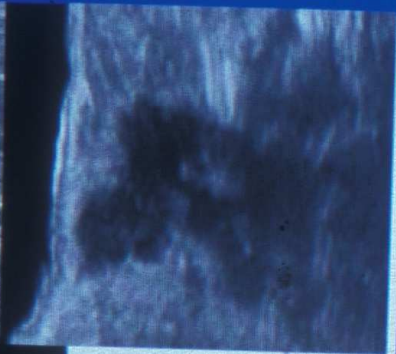
R04 G60 C5 A4
13.0 DVA: 90%

Malignant Tumor

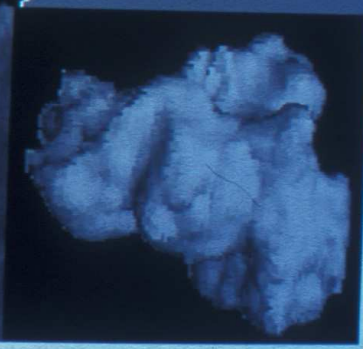
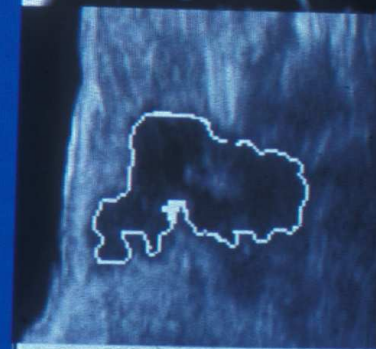
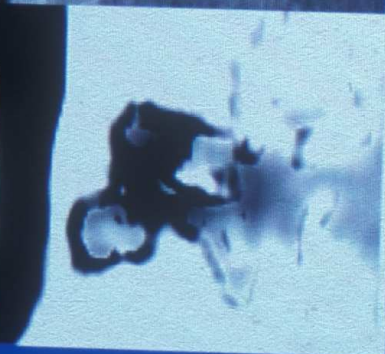
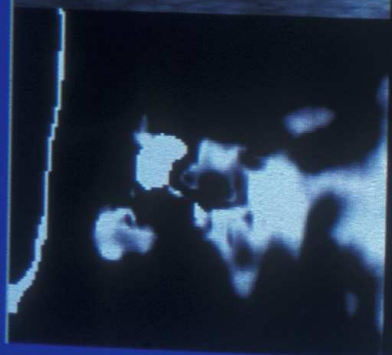
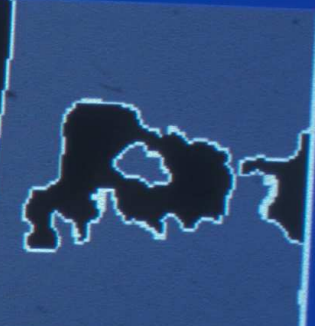
Original pixel data



Voxel data



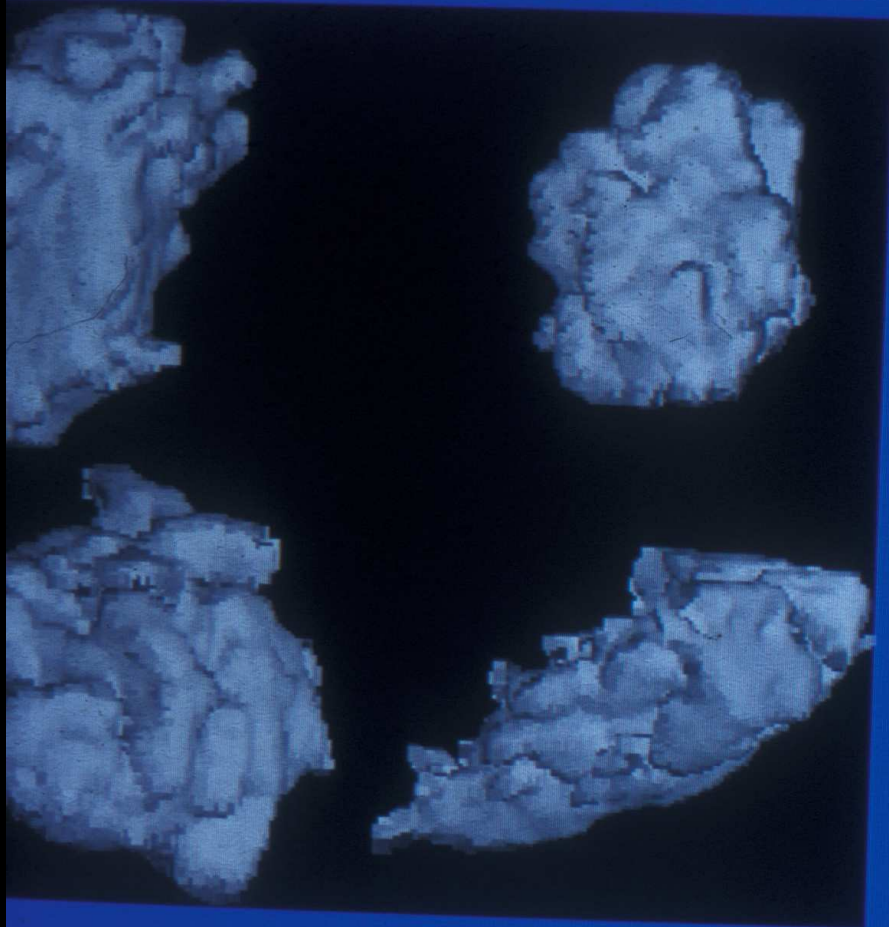
Grade of boundary Classified region



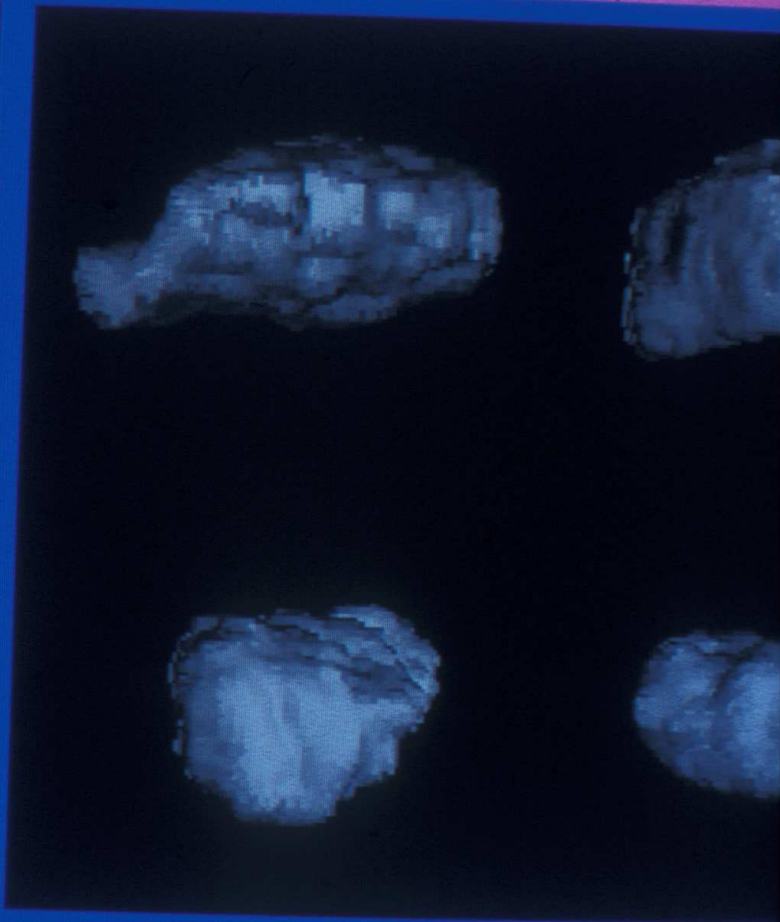
Grade of tumor Grade of normal tissue

Extracted tumor 3D surface image

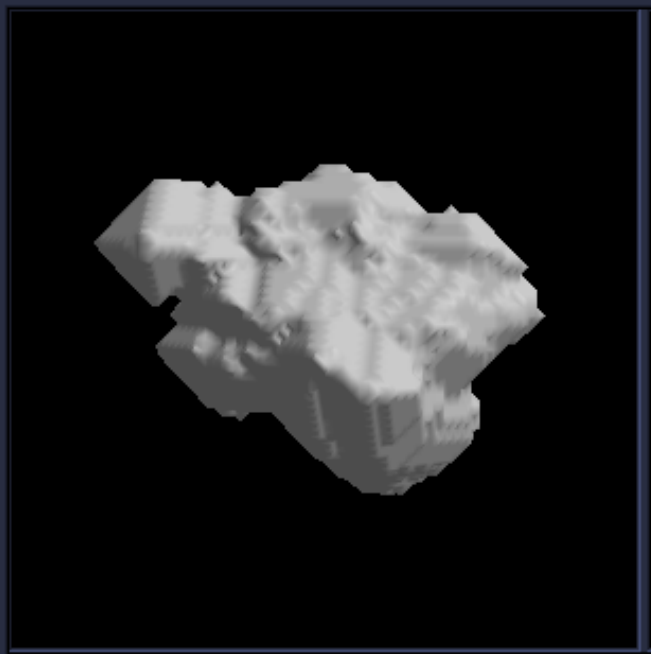
Extracted Tumors



Malignant tumors



Benign tumors



3-D tumor image

Surface:1.858455
Volume:0.880597
S/V-Ratio:2.000761
Depth:0.307613
Width:0.278983
D/W-ratio:1.10431
Minkowski:2.000761

Automatic Evaluation

Malignancy Probability %

100%

50%

0%



まとめ

超音波による計量診断は可能になり、それは「疾病のグレード診断」への道を開くものであり、疾患に対する治療効果の評価に用いられるようになるものと考えられる。

超音波による診断は存在診断、部位診断、質診断に加えて、グレーディング(程度)診の全てにおいて貢献することができる。

χ_x 

plog

pres [x 10**6]



2-d axisymmetric model
Pressure field at current time in analysis

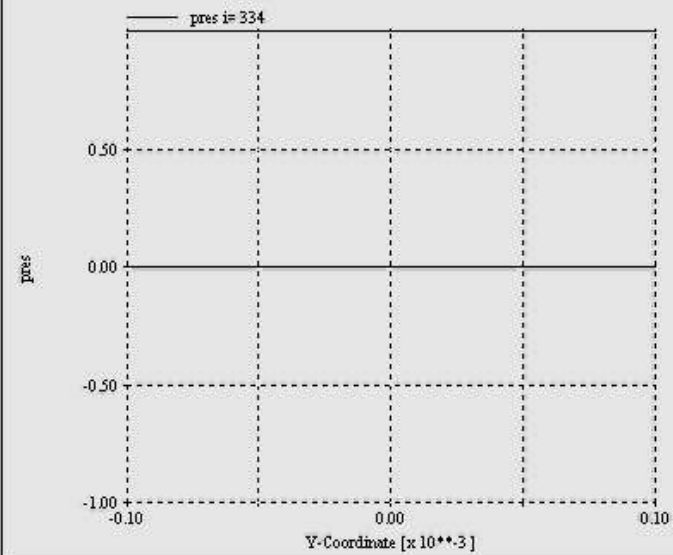
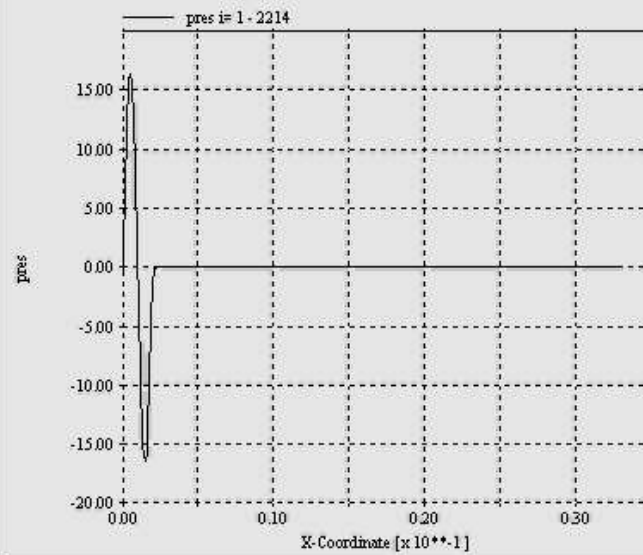
y
x



pres

1.64E+01
8.00E-02
6.00E-02
4.00E-02
2.00E-02
5.59E-09
-2.00E-02
-4.00E-02
-6.00E-02
-8.00E-02
-1.67E+01

Timestep = 173
Time = 0.2002E-06



2-d axisymmetric model

Pressure field at current time in analysis