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SONOLOGICAL EVALUATION OF VASCULAR ACCESSES FOR HEMODIALYSIS WITH A PARAMETER OF TIME-WISE CHANGES IN WAVE FREQUENCY OF VASCULAR SOUNDS

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(2)

Introduction

Stethoscopic auscultation of sounds of the vascular accesses for hemodialysis is useful and reliable for detection of their steno-obstructive changes on if done by well-experienced medical staffs.

However, inconvenient difficulties in the obtained information are :

- 1) non-representability, 2) non-storability,
 - 3) non-objectivity, 4) non-universal, and
 - 5) non-transferability to others
- i.e. “non-scientific”

(3)

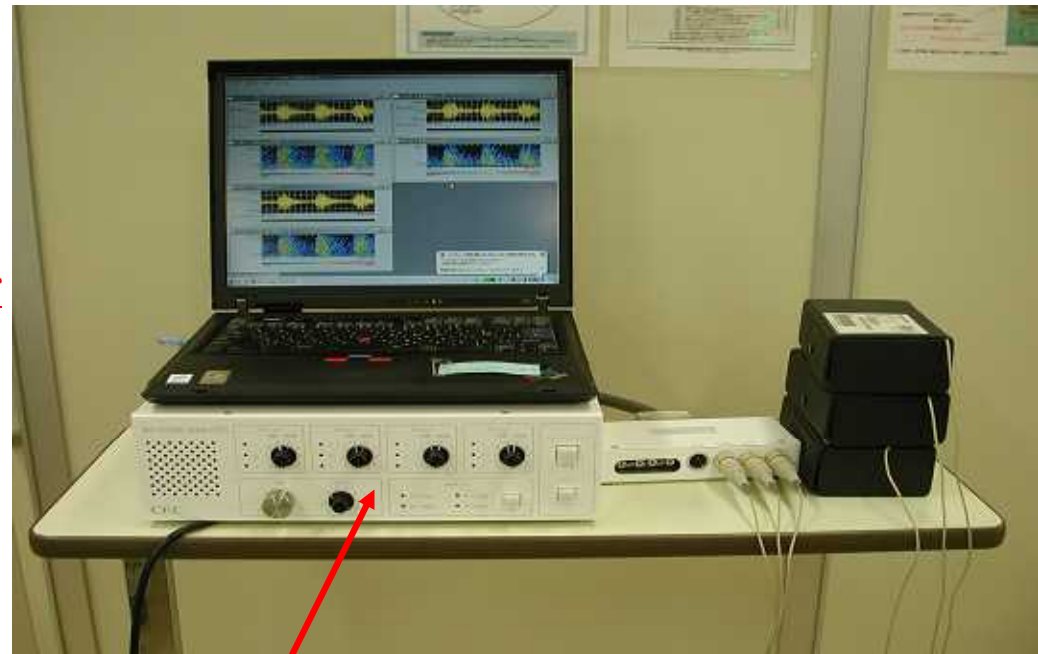
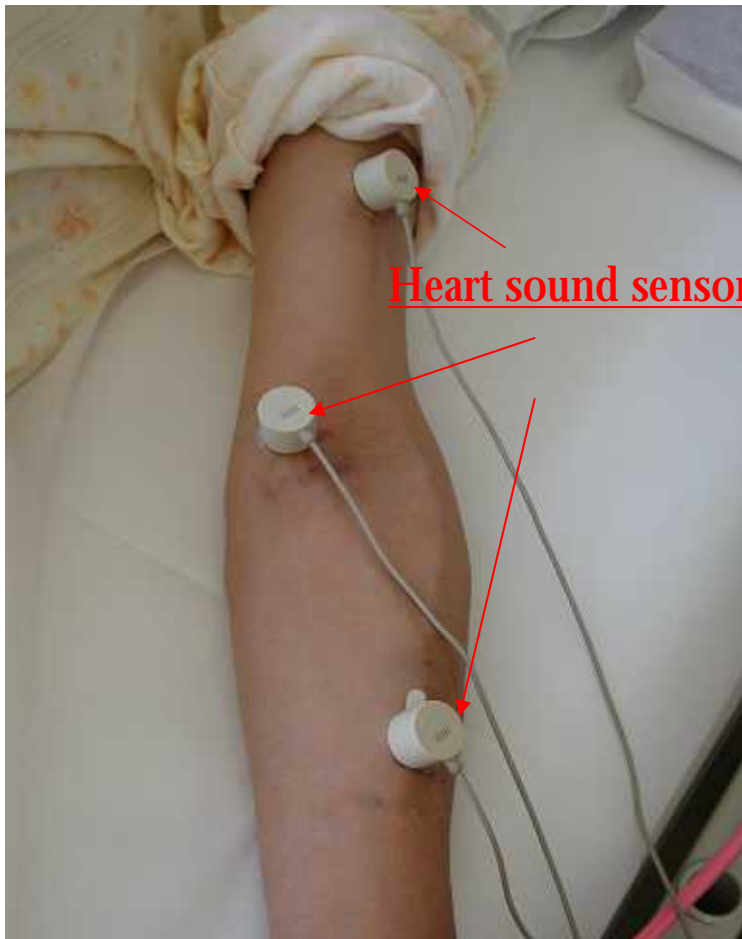
Purpose

In order to solve the above-mentioned problems, sounds of the vascular accesses, collected by a cardiac phonometer, are analyzed and expressed in a time-wise wave frequency via a wavelet transformation by a personal computer.

(4)

Method

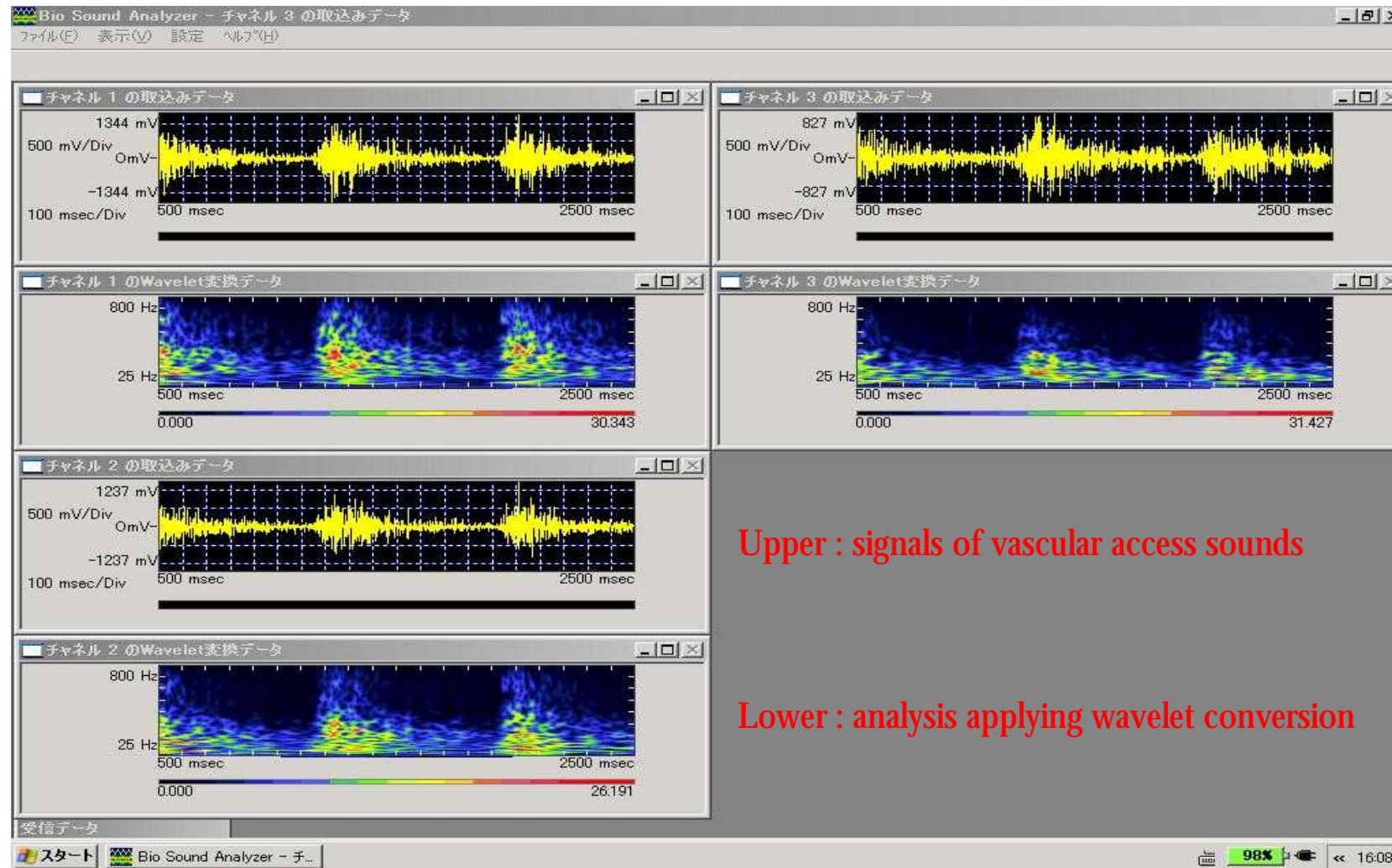
Analysis of the time-wise wave frequency of vascular access sounds using Bio Sound Analyzer (Chuo Denshi, Co., Japan)



Bio Sound Analyzer

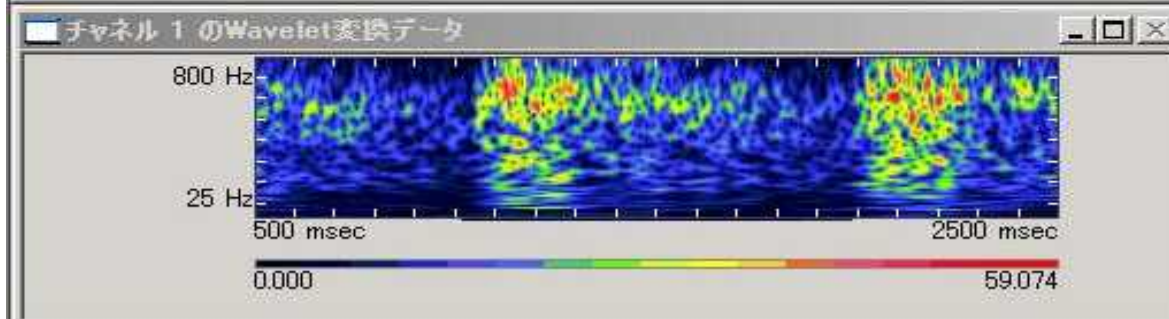
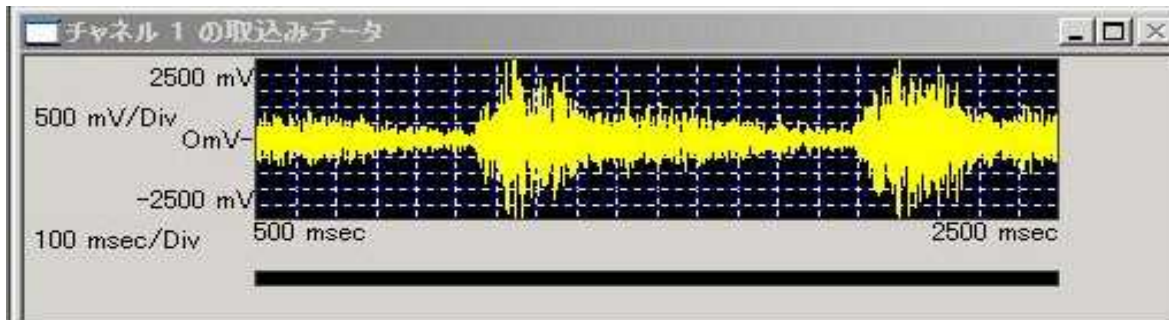
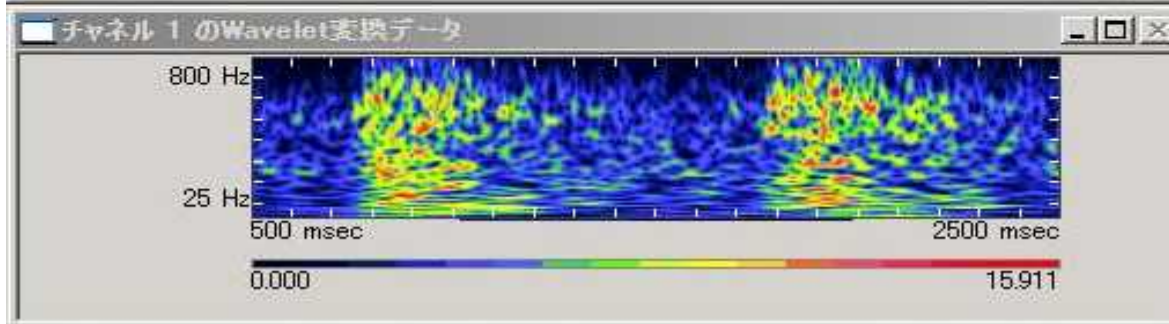
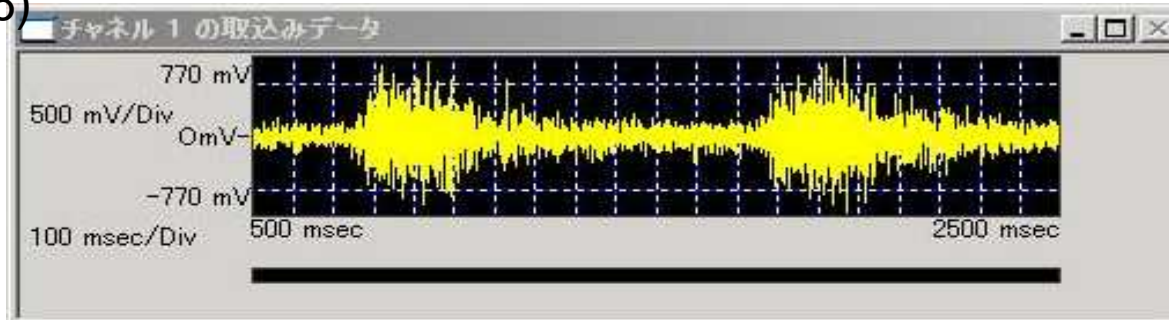
Portable time-wise wave frequency analyzer

(5) time-wise wave frequency analysis



Amplitude of wave frequency components
Blue = small ~ red = large

(6)



Case 1 : primary internal shunt
3 weeks before PTA



2 weeks before PTA

(7)

case 1 : angiography

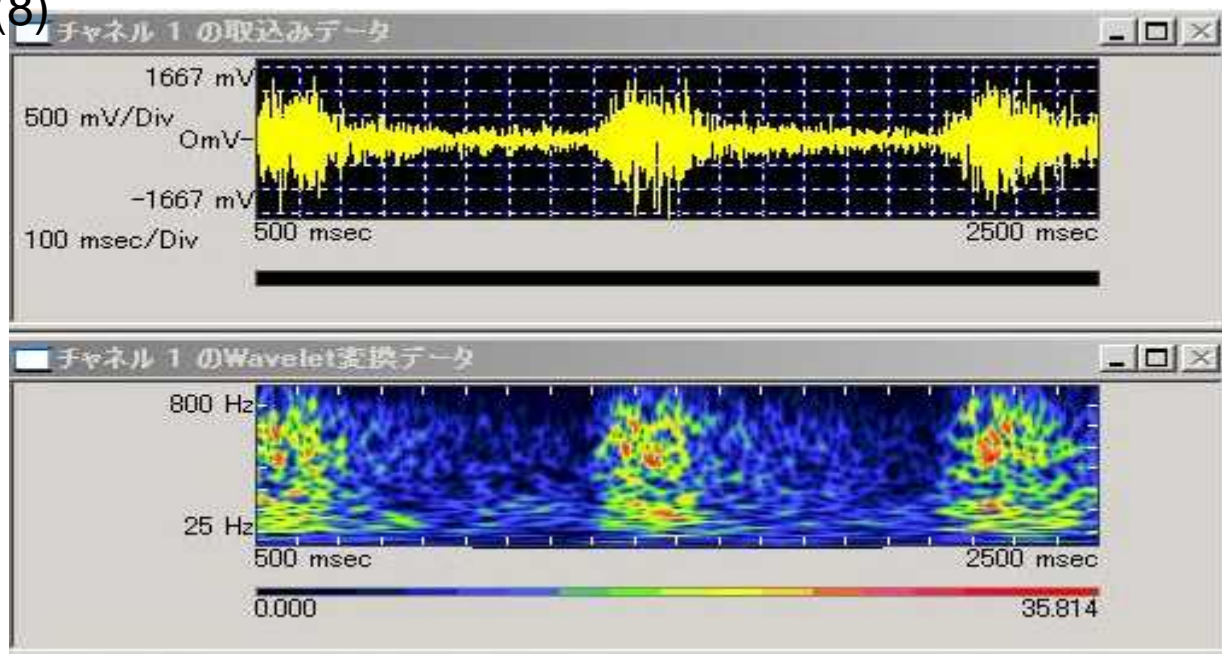


immediately before PTA

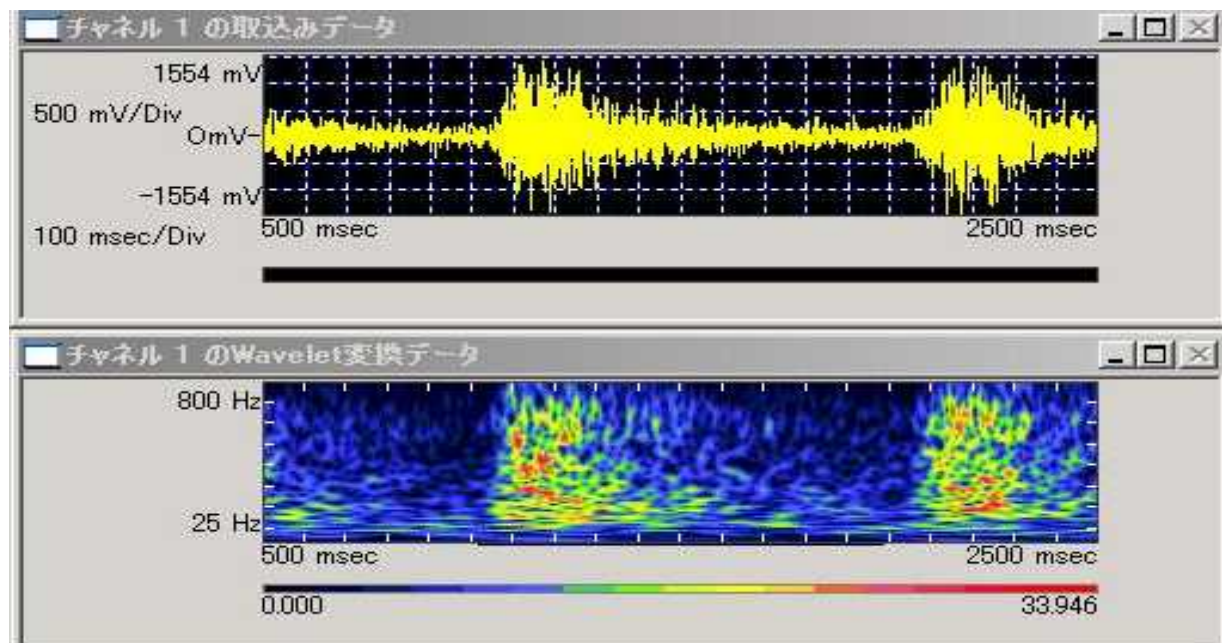


immediately after PTA

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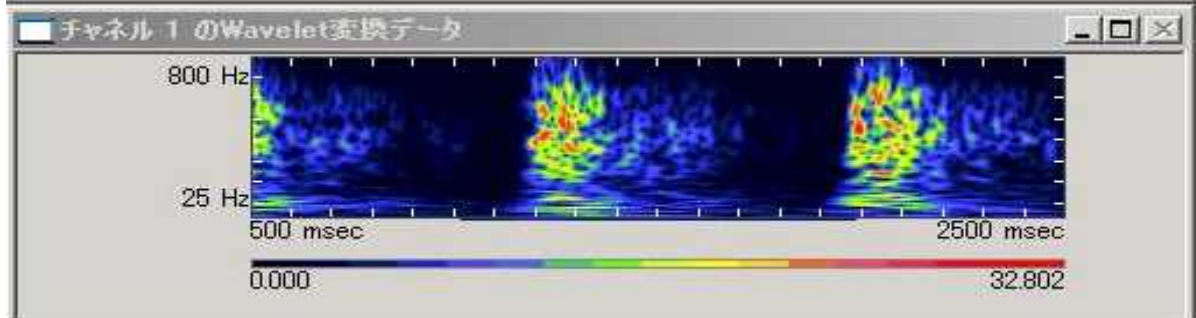
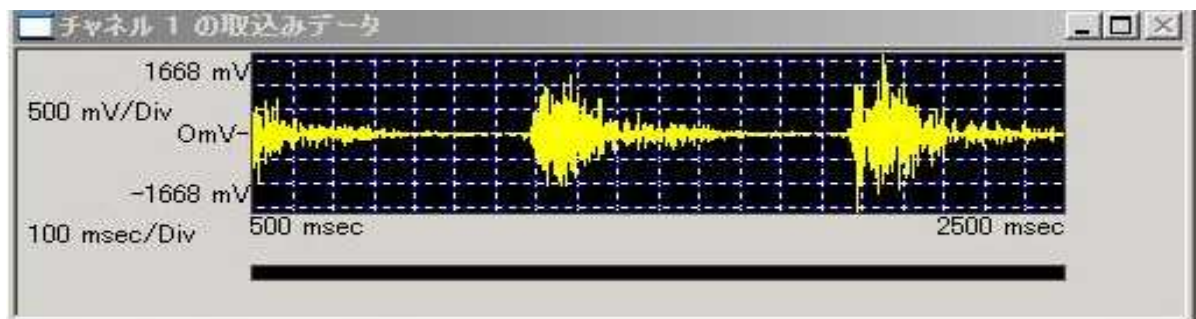
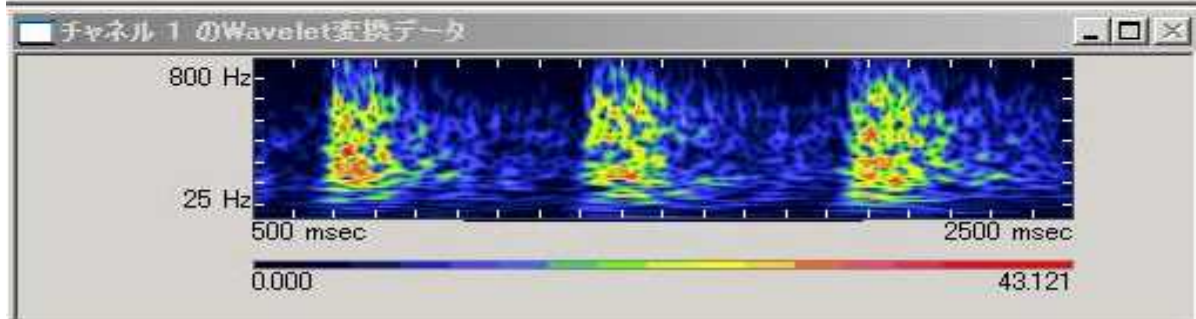
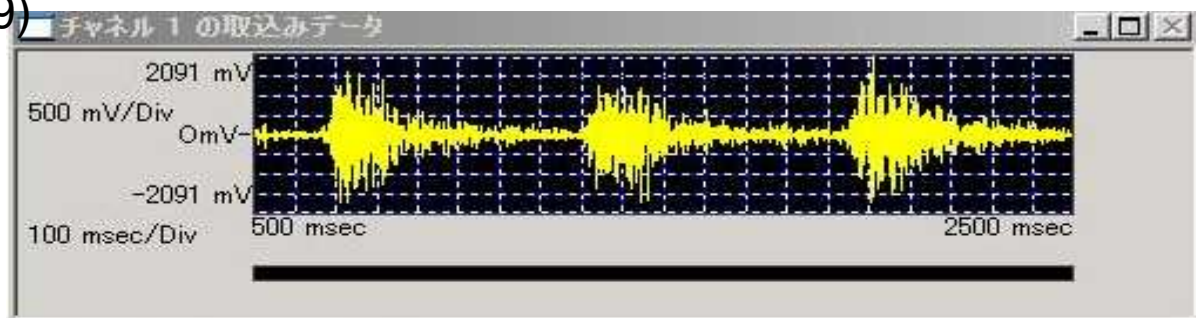


Case 1 : immediately before PTA



Case 1 : immediately after PTA

(9)



Case 2: artificial vascular graft

3 weeks before PTA



2 weeks before PTA

(10)

case 2 : angiography

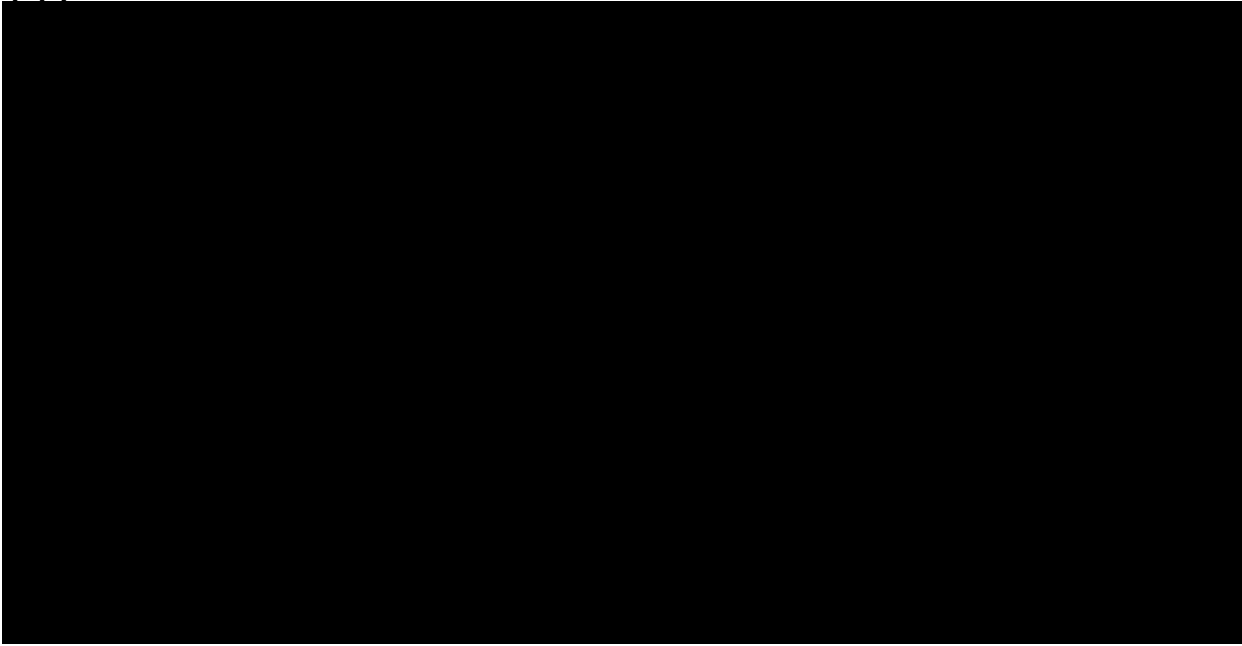


before PTA
Upper : close to
arterial anastomosis
Lower : close to
venous anastomosis



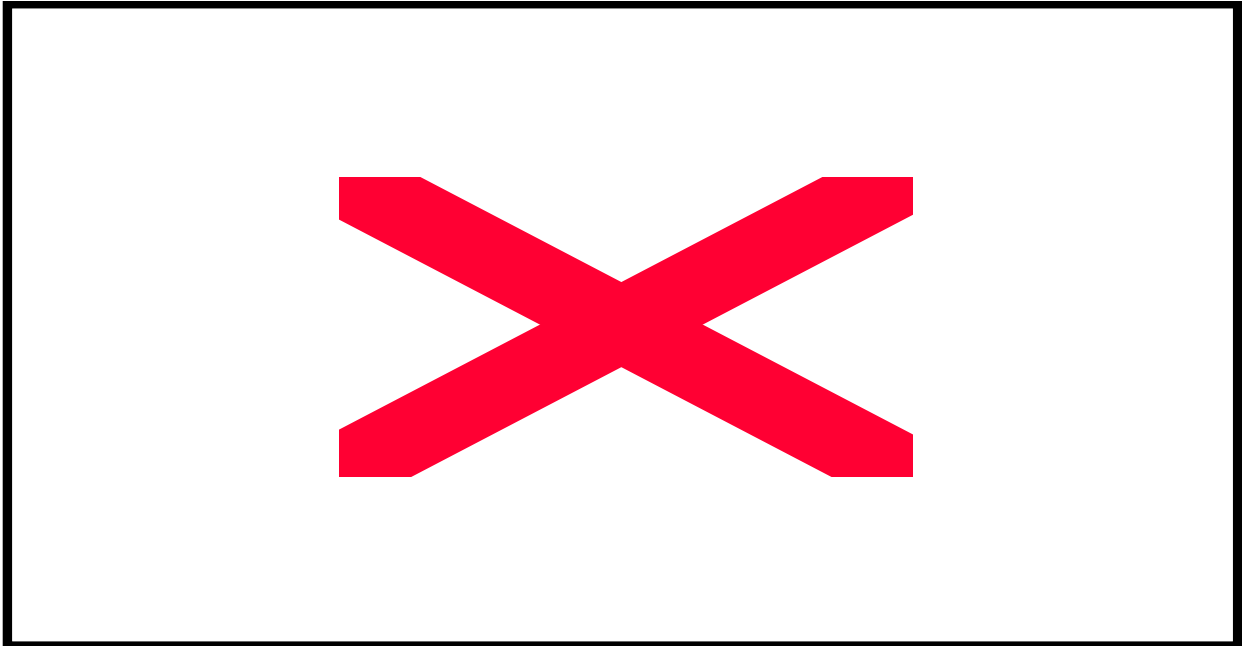
after PTA
Upper : close to
arterial anastomosis
Lower : close to
venous anastomosis

(11)



Case 2

Immediately before PTA



Immediately after PTA

(12)

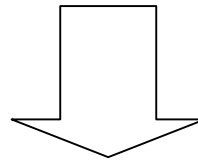
Results

Dominant Findings of Vascular Sounds

Stenosis :

high in wave frequency

short in duration of waves



Correction of stenosis :

low in wave frequency

long in duration of waves

Conclusions

Acoustological analysis of sounds of the vascular accesses is a novel prospective tool to detect their abnormalities. The information data is expected to be 1) representable, 2) storable, 3) objective, 4) universal, and 5) transferable to others, i.e. “scientific” and will be developed in mathematical models. A new medical field of acoustology is going to be developed.