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New approach to visualize the left coronary artery using two-dimensional echocardiography

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Summary

A new approach for visualizing left anterior descending coronary artery (LAD) and left circumflex coronary artery (LCX) by two-dimensional echocardiography (2DE) was described, and the clinical utility of this technique was examined in 47 patients with mucocutaneous lymph node syndrome (MCLS) comparing with the results obtained by a standard parasternal approach.

In the standard approach, the LAD and LCX were examined with the short-axis view of the aorta by placing the transducer over the left third or fourth intercostal space. In the new approach, the transducer was placed just over the left of the sternum in either the first or second intercostal space. To image the LAD, the echo section was shifted to the left after the long-axis view of the left ventricle was recorded. The LCX was also examined from the same acoustic window when imaging the short-axis view of the aorta.

With the use of a new approach, the detectable ranges of the LAD and LCX were extended more than an usual methodology, i.e., 22 mm and 4 mm by the standard approach to 26 mm and 7 mm by the new approach and these differences were statistically significant ($p<0.01$ and $p<0.001$, respectively). The successful recording rate of the LAD was 100% using either the standard or new approach. The overall rate for successful imaging of the LCX was 42.6% using the standard approach and 85.1% using the new approach ($p<0.05$).

It is our conclusion that the LAD and LCX are visualized more widely and more accurately by a new approach than a standard approach. The new technique is recommended for the routine use when evaluating the pathological change in the coronary artery in patients with MCLS.

Key words

Two-dimensional echocardiography　Left coronary artery　Mucocutaneous lymph node syndrome
Coronary aneurysm

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The left coronary artery (LC) has been examined by two-dimensional echocardiography (2DE) since Weyman and his co-workers reported the methodology[1]. The technique to detect LC is much easier than that for the right coronary artery[2], however, the detectable range of the LC is almost limited to the left main coronary artery (LMC). The imaging of both the left circumflex coronary artery (LCX) and left anterior descending artery (LAD) appears to be technically difficult[2].

We have reported a new approach for detecting the proximal, mid and distal portions of the right coronary artery and posterior descending artery in patients with mucocutaneous lymph node syndrome (MCLS)[3]. The purpose of the present paper is to introduce a further new approach to image the LAD and LCX, and to determine whether these techniques are practical comparing with the usual approach.

Materials and Methods

The patients consisted of 47 children with MCLS (19 females and 28 males). Ages ranged from three months to 12 years and four months (average: one year and 6 months). The diagnosis of MCLS was made on the basis of the guideline proposed by the Japanese Mucocutaneous Lymph Node Syndrome Research Committee in 1978.

2DE was performed in all 47 patients using Mark III Real Time Echocardiographic System (Advanced Technology Laboratories, Inc.) with three-elements, 3 MHz rotating scan head. Still frames were recorded using line scan recorder. Coronary arteriography was performed in 40 patients.

Methods used in this study were as follows:

1) Usual approach for LC[1]

The transducer was placed over the standard echocardiographic window along the left sternal border in either the third or fourth intercostal space. With an appropriate setting of the examination plane to cut across the aorta, the LMC and the proximal portion of the LAD were detected in the mass of echoes originated from the atrio-pulmonic sulcus[4]. This technique was the parasternal approach. The LMC was imaged as two thin relatively bright echoes originating from the aorta.

2) New approach for the LAD (**Fig. 1**)

The transducer was placed just leftward to the sternum in either the first or second intercostal space. The plane of examination was initially set to visualize a sagittal cross-section of the aorta. Then the transducer was shifted to the left with minor rotary movement until the linear echo-free space, which was corresponding to the LAD, was imaged along the anterior wall of the left ventricle. This cross-section provided simultaneous visualization of the aorta, pulmonary artery and left ventricle. We named this view as the " high-parasternal long-axis view " of the LAD.

3) New approach for the LCX (**Fig. 2**)

The location of transducer was the same as in the case of the LAD. The plane of examination was set to cut across the aorta. With appropriate angulation of the transducer, the LMC, LAD and LCX were visualized in the mass of echoes on the left of the aorta. We named this view as the " high-parasternal short-axis view " of the LCX.

To testify the usefulness of the new approach, the detectable length and the success rate for visualizing the LAD and LCX were measured. The detectable length of the individual artery was defined as its maximum recorded adequately in the echogram. For the detectable length of the LAD, we measured the length including the LMC because the bifurcation was often equivocal especially when recorded using the usual approach in the majority of the patients. The length of the LCX was measured by the distance between the bifurcation and the end of this artery recorded in the echogram. The success rate of imaging was calculated as the proportion of the number of the cases, in which the recorded length of the artery was more than 5 mm, to the number of ex amined cases.

Results

The representative recording of the LAD by a high-parasternal approach is shown in **Fig. 3.**

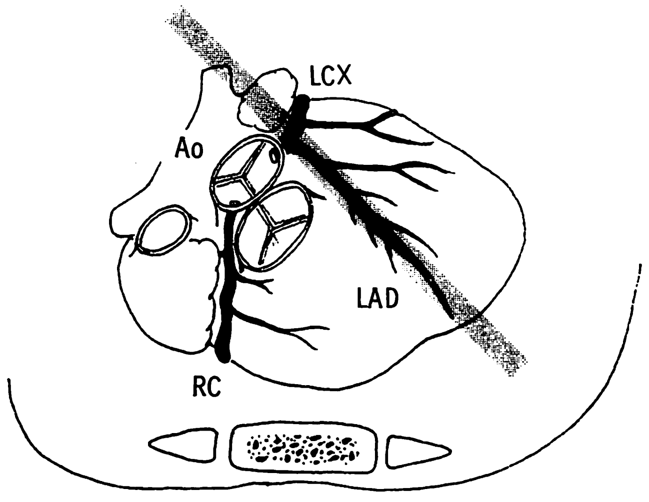

Fig. 1. Diagram of the examination of the left anterior descending artery (LAD).
Shaded area indicates the plane of examination.
Ao = aorta; RC = right coronary artery; LAD = left anterior descending artery; LCX = left circumflex artery.

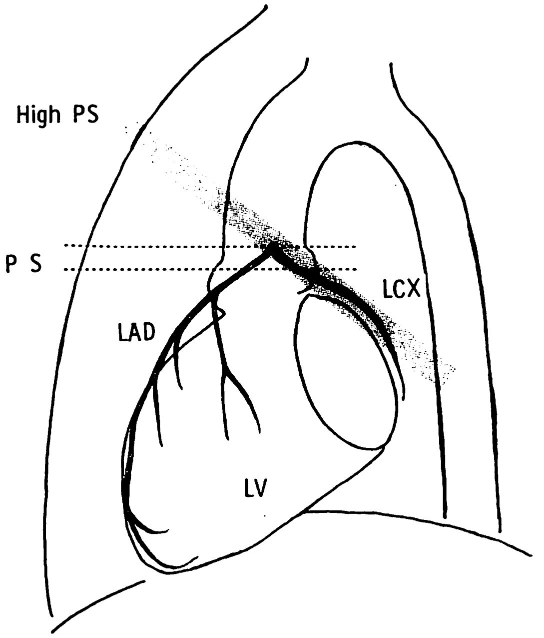

Fig. 2. Diagram of the examination plane of the left circumflex artery (LCX).
Shaded area and dotted line indicate the plane of examination.
High PS = high-parasternal approach; PS = parasternal approach; LAD = left anterior descending artery; LCX = left circumflex artery; LV = left ventricle.

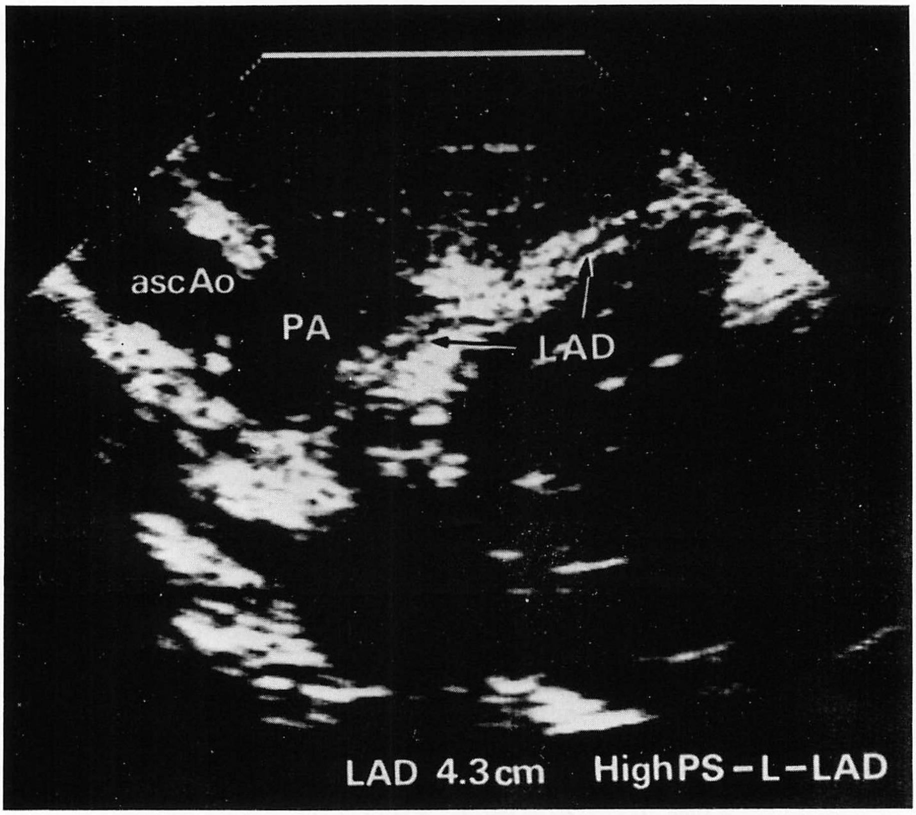

Fig. 3. Representative echogram of the LAD recorded by the high-parasternal approach.
ascAo=ascending aorta; PA=pulmonary artery; LAD=left anterior descending artery.

This patient was a three years and six months old boy, and the LAD was imaged as a linear echo-free space running along the anterior wall of the left ventricle.

The echogram obtained using a new approach in a male patient aged one year and one month is shown in **Fig. 4** with the frontal view of the selective left coronary arteriogram. In this echogram, an aneurysmal dilatation of the LAD at its distal portion was clearly imaged which could not be visualized by the usual parasternal approach.

The comparison of the recorded length of the LAD obtained by the parasternal and high-parasternal approaches is illustrated in **Fig. 5.** Using each approach, the adequate echograms were obtained in all. The averages of the lengths by parasternal and high-parasternal approaches were 22 and 26 mm, respectively, and this difference was statistically significant ($p<0.01$).

Fig. 6 shows a high-parasternal short-axis view of the LCX in a male patient aged three years. A frontal view of the left coronary arteriogram is also illustrated. The LMC and the proximal portion of the LAD are moderately dilated, and this finding is well demonstrated by 2DE. The LCX is also visualized clearly. Although the imaged length of this artery is not enough for the clinical practice, the anatomical detail of the bifurcation is shown distinctly.

Fig. 7 shows the comparison of the recorded length of the LCX using parasternal and high-parasternal approaches. The average length obtained by parasternal approach was 4 mm

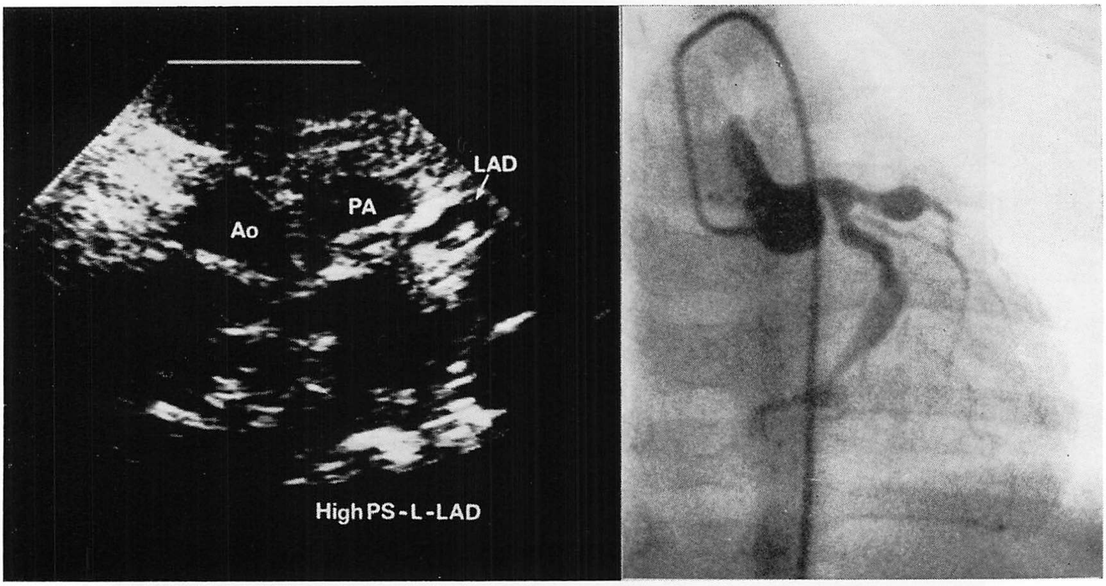

Fig. 4. Echogram of a coronary aneurysm in the LAD and corresponding coronary arteriogram.
Ao=aorta; PA=pulmonary artery; LAD=left anterior descending artery.

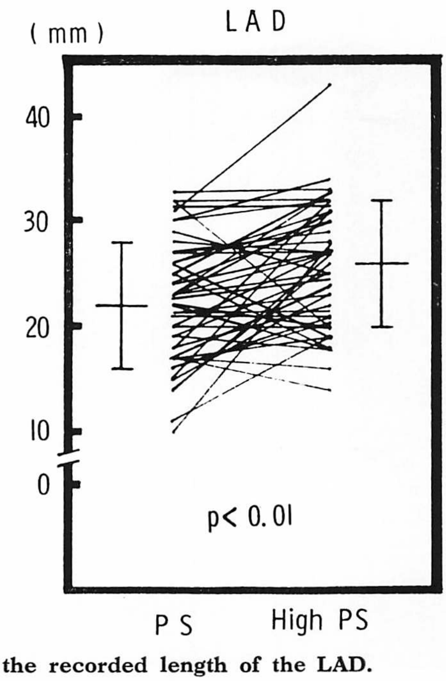

Fig. 5. Comparison of the recorded length of the LAD.
High PS=high-parasternal approach; PS=parasternal approach; LAD=left anterior descending artery.

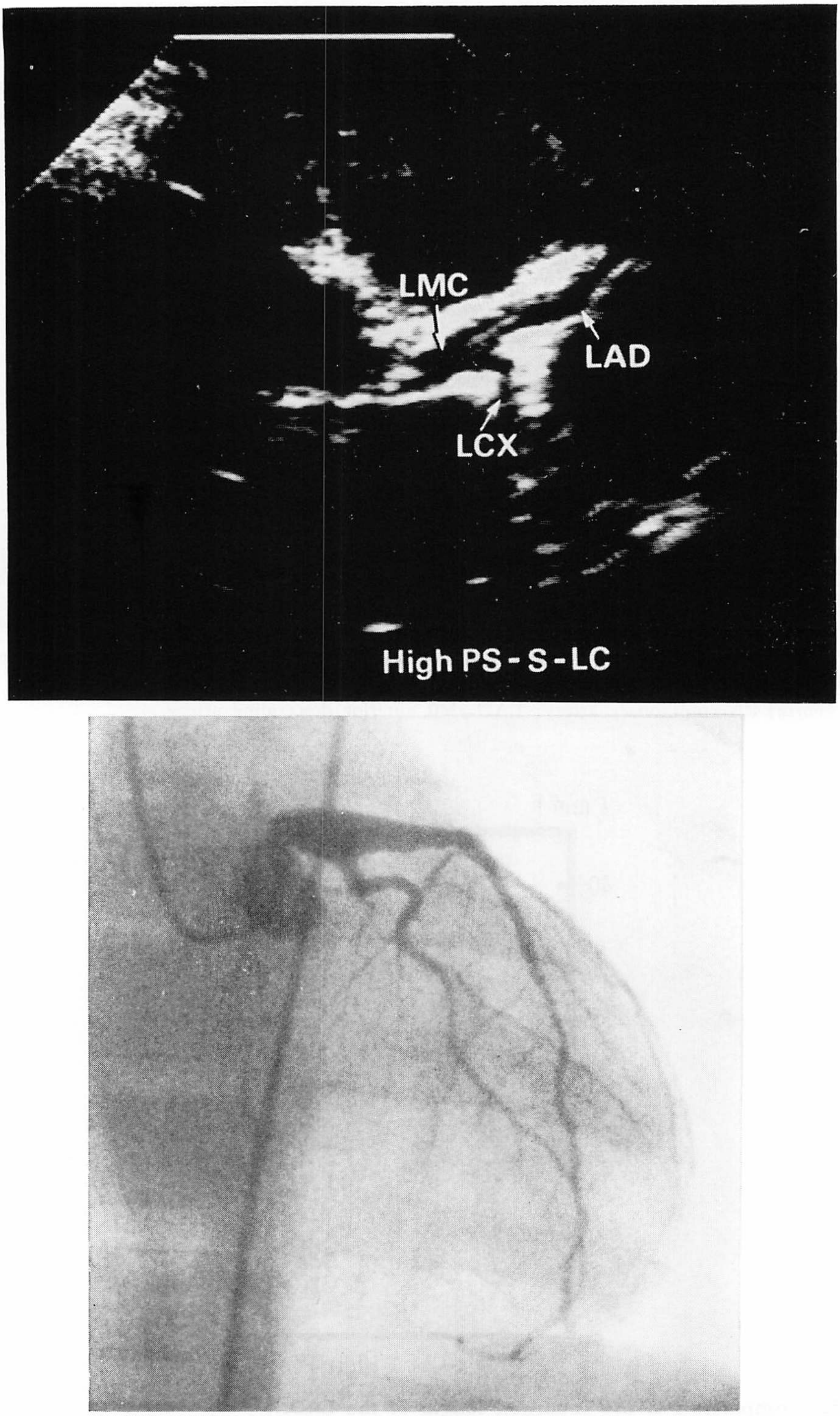

Fig. 6. Representative echogram of the LCX recorded by high-parasternal approach and the corresponding coronary arteriogram.

LMC=left main coronary artery; LCX=left circumflex artery; LAD=left anterior descending artery.

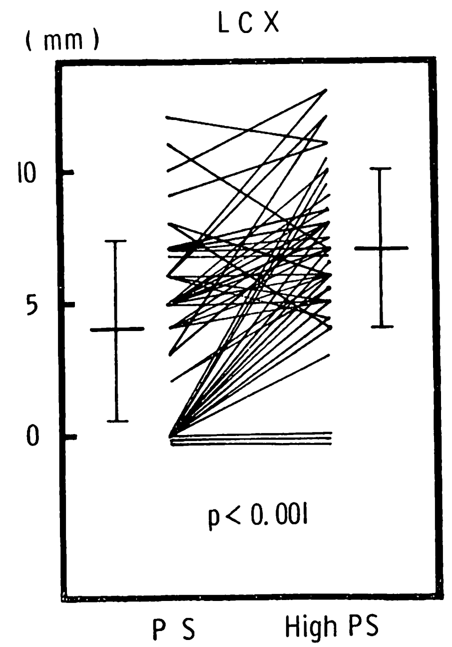

Fig. 7. Comparison of the recorded length of LCX.

High PS=high-parasternal approach; PS=parasternal approach; LCX=left circumflex artery.

and that by high-parasternal approach was 7 mm, and this difference was statistically significant ($p<0.001$). The overall success rate for imaging the LCX by a parasternal approach was 42.6% (20/47) and that by high-parasternal approach was 85.1% (40/47). This difference was significant ($p<0.05$) by chi-square test.

Fig. 8 gives the echograms of the LC in a male patient aged three years. There are three different views; parasternal short-axis, high-parasternal short-axis and high-parasternal long-axis views. As can be seen, the LCX is most clearly visualized in the high-parasternal short-axis view, and the LAD in the high-parasternal long-axis view.

Discussion

A new approach described in this paper was proved to be useful in the examination of the LC. The success rate of recording the LCX was improved by the introduction of high-parasternal approach. However, the detectable length of the artery was somewhat long, and still remained unsatisfactory in the clinical practice. Another advantage of this approach was the ability to show the detail of anatomy of the bifurcation. The high-parasternal approach also enabled us to examine the LAD more extensively than the usual parasternal approach. These new approaches were not technically difficult comparing with the usual approach.

Many investigators reported the techniques to evaluate the LC using 2DE[5,6], but the detectable length of this artery was limited to the LMC. This is because the optimal alignment of the ultrasonic beam parallel to the LAD could not be obtained by the previously reported approaches. The LMC runs leftward after arising from the aorta. On the contrary, the LAD runs more anteriorly and inferiorly after branching off from the LMC. Therefore, these two arteries lie in the different cross-sectional planes. Locating the transducer higher than the usual acoustic window and setting the ultrasonic beam paralell to the LAD, we could visualize this artery more extensively.

The same may be applied to the examination of the LCX. This artery runs posteriorly and inferiorly from the bifurcation. For this reason, the parasternal short-axis view, where the plane of examination is almost parallel to the horizontal plane of the trunk, can not obtain an extensive visualization of this artery. We set the plane of examination paralell to the course of the LCX placing the transducer over the high-parasternal acoustic window, and succeeded in visualizing this artery more extensively and easily.

Limitation of the new method was inevitable. For examining the LCX, we could not satisfy with the new approach described in this paper. Although this approach enabled us to image the LCX with more certainty, there were many limitations. The detectable length of the artery was not enough for the clinical use. The pathological change in the distal portion of the LCX may be missed. Further studies are mandatory

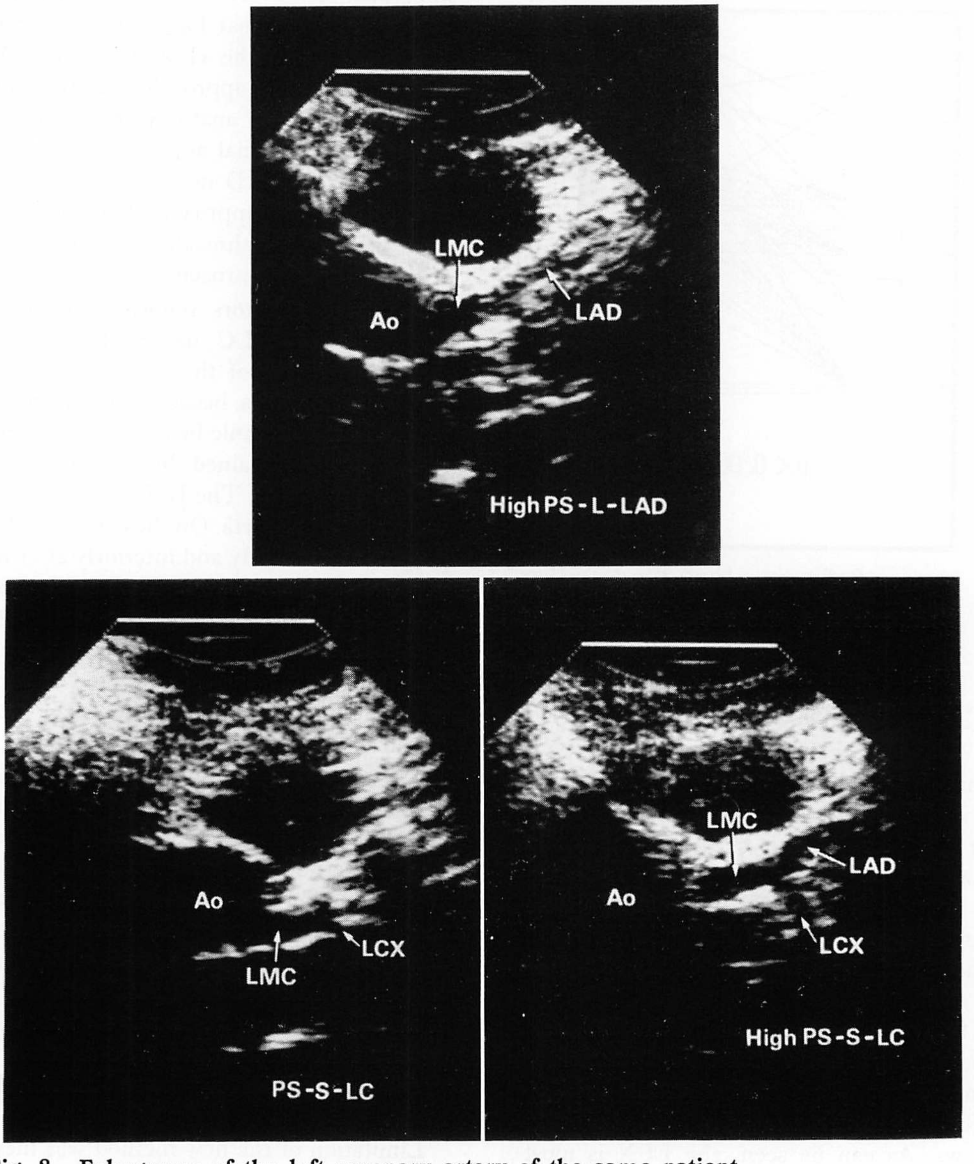

Fig. 8. Echograms of the left coronary artery of the same patient.
Upper: high-parasternal long-axis view of the left anterior descending artery.
Lower left: parasternal short-axis view of the left coronary artery.
Lower right: high-parasternal short-axis view of the left coronary artery.
Ao=aorta; LMC=left main coronary artery; LCX=left circumflex artery; LAD=left anterior descending artery.

before the extensive visualization of the LCX becomes technically feasible.

Clinical implication is worthy to mention. With the use of these new approaches, the LC could be imaged more extensively and the pathological change of this artery could be assessed more accurately than using only the usual approach in examining the coronary involvement of the patients with MCLS. Combining these techniques with the approach for the right coronary artery, main branches of the coronary artery can be detected noninvasively by 2DE.

超音波断層法による左冠動脈の新しい検索法

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左冠動脈前下行枝と回旋枝に対し超音波断層法を用いた新しい検索法について述べ，47名の川崎病患児において，従来の方法と比較しながら，新しい方法の臨床的有用性を検討した．

従来は前下行枝，回旋枝ともに通常の胸骨左縁より大動脈の短軸断面において検索していたのに対し，新しい方法では，探触子を第一または第二肋間に置き，左室長軸断面を得た後左方に断面を移行することにより前下行枝を，大動脈根部の短軸断面にて回旋枝をそれぞれ検出した．

新しい方法を用いると前下行枝の検出範囲は平均22mmから26mmに，回旋枝は4mmから7mmにそれぞれ延長した．この差はいずれも統計学的に有意であった．前下行枝ではどちらの方法でも全例で検出可能であったが，回旋枝は従来の方法の42.6%から，新しい方法では85.1%と有意に上昇した．

前下行枝，回旋枝の新しい検出法は臨床的に有用であり，川崎病の冠動脈病変の検索には常に試みられるべき方法と思われた．

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