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Regional right ventricular wall motion in patients with obstruction of the right coronary artery due to the mucocutaneous lymph node syndrome

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Summary

The present study quantitatively analyzed the shortening fraction of regional wall motion (RWM) of the right ventricle (RV) in 18 patients with obstruction of the right coronary artery due to the mucocutaneous lymph node syndrome (MCLS). None of the patients had any apparent lesion of the left coronary artery by selective coronary angiography. The radial approach was used except for the right ventricular outflow tract in the lateral view, using the Siemens AVD system. There was no correlation between the occlusion and segmental stenosis, nor was there any correlation between dysfunction of the RWM of the RV and the posterior wall of the left ventricle (LVPW). The second cineangiography one year later showed that shortening of three segments (II III, and VIII) of the RV was significantly reduced, as compared with that during the first study. We believe that dysfunction of the LVPW may not be contributory in diagnosing RV infarction. Not only LV-graphy, but RV-graphy as well, are recommended for patients with RV dysfunction due to obstruction of the right coronary artery in the MCLS.

Key words
Regional wall motion　Right ventricle　Mucocutaneous lymph node syndrome

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The mucocutaneous lymph node syndrome (MCLS)[1~3] is widely known to induce an ischemic condition in children who have contracted the disease. However, there have been no reports concerning the right and left ventricular wall motions in this disease. Numerous studies of adults with coronary heart disease due to atherosclerosis have shown correlations between segmental left ventricular contraction abnormalities and myocardial ischemia or infarction[4~10]. For this reason, regional abnormalities of left ventricular wall motion are associated with acute and chronic coronary artery disease in adults. Although right ventricular (RV) wall infarction secondary to coronary arterial narrowing or obstruction has recently received attention from hemodynamic, radioisotopic and morphologic standpoints[11~20], it has received little attention from the standpoint of regional wall motion (RWM) of the right ventricle. Segmental right ventricular function has been demonstrated in patients with acute myocardial infarction, but no quantitative analysis of regional wall motion has been reported. However, the identification of such abnormalities may constitute an important clue for establishing prognoses. It is especially important that children with coronary lesions due to the MCLS are to be observed for regional wall motion of the right ventricle, because the etiology of coronary lesions due to the MCLS has been considered different from that of coronary heart disease in adults. This report described a quantitative analysis of regional wall motion of the right ventricle in patients with the MCLS with obstructive lesions of the right coronary artery (RCA) using angiographic techniques.

Materials and Methods

We studied 18 patients admitted to the National Cardiovascular Center with the diagnosis of right ventricular infarction due to the MCLS established by selective coronary angiography. In the present study, the following criteria were used to identify patients diagnosed as having right ventricular infarction due to the MCLS: (1) occlusion or segmental stenosis of the RCA according to selective coronary angiography; (2) perfusion defects in the area dominated by the RCA according to radioisotopic (RI) angiography; and (3) no lesions of the left main coronary artery (LCA). A complete obstruction of a coronary artery according to selective coronary angiography is termed "occlusion"[2,3]. A coronary artery with long stenosis is termed "segmental stenosis"[2,3]. Patients with the history of lung disease or valvular disease were excluded. There were 10 boys and eight girls, whose age ranged from one year to three years and two months with a mean age of one and one half years. All patients had a second angiography one year after the first. Six of the 18 patients had no obstructive lesion of the LCA in either the first or second coronary angiography. The control group consisted of 33 patients who had history of the MCLS without coronary lesions by selective coronary angiography. Group A consisted of six patients whose shortening of the left ventricular posterior wall (LVPW) decreased significantly compared with that of the control group. Group B consisted of 12 patients without decreased shortening of the left ventricular posterior wall.

Analysis of the regional wall motion: Ventriculography was performed for all patients. Biplane cine ventriculograms [antero-posterior (A-P) and lateral (LAT) views] were made at a speed of 90 frames per sec. One observer traced frame contours of the ventriculographic silhouettes at end-systole (ES) and end-diastole (ED). A radial coordinate system was superimposed on each ventriculographic contour using a Siemens AVD system. End-systolic ventricular volumes (ESV) and end-diastolic ventricular volumes (EDV) were calculated by applying Simpson's rule[21]. The midpoint of the long axis of the end-diastolic ventricular silhouette was superimposed on that of the ES ventricular silhouette, parallel with each long axis of the end-systolic and end-diastolic silhouettes, correcting for thoracic cage motion, descent of the pulmonary valve, and rotation of the cardiac apex[28]. A reference point was defined as the midpoint of the long axis from the apex to the

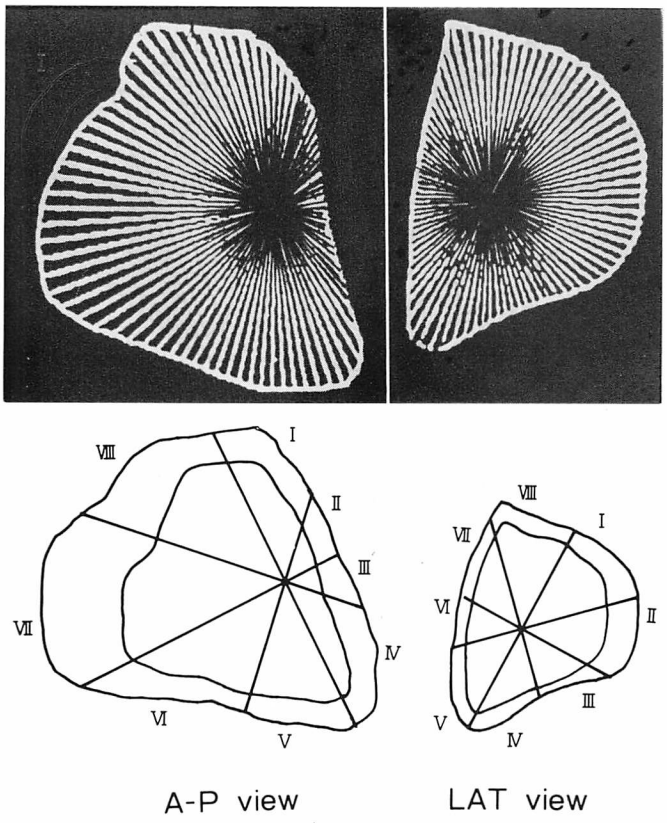

Fig. 1. Radial reference system for the right ventricle.

Radial reference system is used to identify endocardial segments at 4° increments on a right ventricular silhouette in the anteroposterior (A-P) and lateral (LAT) views. Eight regions generated by averaging eleven contiguous radii are shown. The regions are expressed clockwisely as " segment I–VIII ".

midpoint of the pulmonary valve plane on the A-P view and the edge beside the tricuspid valve on the lateral view. Radii were drawn from this reference point to the endocardial border at 4° increments around the contour. The distance along each radial line from the end-diastolic position of the ventricle to its end-systolic position was measured and expressed as a percentage of the distance from the end-diastolic position. The average of 11 radial lines was expressed as percent shortening of the segmental region (**Fig. 1**). The outflow tract of the right ventricle in the lateral view was excluded from the analysis of regional wall motion. To analyze regional wall motion of the left ventricle from a reference point defined as the center of gravity, radii were drawn to the endocardial border at 4° increments around the contour. We analyzed in the same way as for the right ventricle (**Fig. 2**).

Results

The mean±2 standard deviations for the shortening fraction of each regional wall motion is shown as a shaded area (**Figs. 3, 4 & 5**). At the first angiography, there was no significant correlation between shortening of regional wall motion in cases with segmental stenosis and that

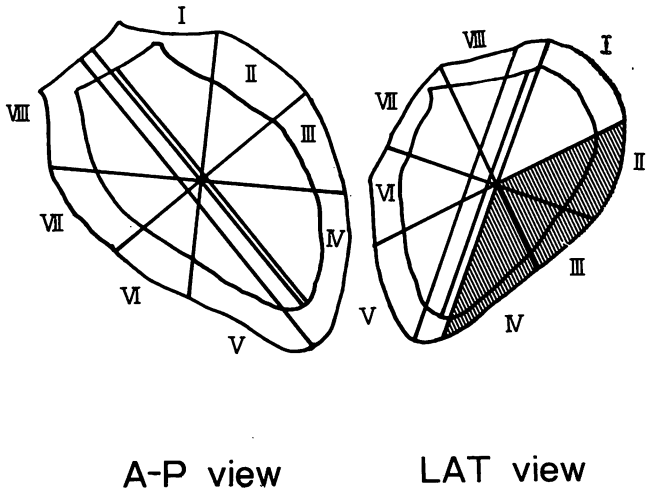

Fig. 2. Radial reference system for the left ventricle.

Radial reference system is used to identify endocardial segments at 4° increments on a left ventricular silhouette in the A-P and lateral views. Eight regions generated by averaging eleven contiguous radii are shown. The regions are expressed as " segment I–VIII " in clockwise direction.

of cases with occlusion by right coronary arteriography (**Fig. 3**). As shown in **Fig. 4**, three of the six patients in Group A (decreased shortening of the left ventricular posterior wall) had decreased shortening rates of regional wall motion of the right ventricle. The first case had six segments; the second case, 3 segments, with decreased shortening rates in both the A-P and lateral views. The third case had one segment decreased in rate in the lateral view. Six of the 12 patients in Group B had decreased shortening rates in regional wall motion of the right ventricle. Briefly, three of them had three segments in the A-P view, two of them had two segments, and the sixth had one segment with decreased rates in the A-P and lateral views. On segments I, II in the A-P view, shortening of regional wall motion in Group A decreased significantly as compared with those of the control group. Comparing Groups A and B, there was a significantly lower rate of shortening of regional wall motion in Group A than in Group B in segments IV, VI and VII in the lateral view. In six patients who showed neither occlusion nor segmental stenosis of the LCA in both the first and second selective coronary angiographies, shortening of regional wall motion were analyzed at the second angiography. On segments II, III and VIII in the A-P view, shortening of regional wall motion at the second angiography had decreased significantly compared with that at the first study (**Fig. 5**). However, there was no correlation between regional wall motion at the first and second angiographies on the lateral view. At the second angiography, left ventricular ejection fraction (LVEF), right ventricular ejection fraction (RVEF), left ventricular end-diastolic volume (LVEDV), and right ventricular end-diastolic volume (RVEDV) did not change significantly compared to those of the first angiography.

Discussion

Assessment of regional ventricular shortening is important, especially in cases with coronary disease, because this is a segmental disease which attacks some parts of the ventricle, leaving other parts undisturbed. Measurements of ventricular volumes and ejection fractions are useful but do not adequately evaluate regional changes in wall

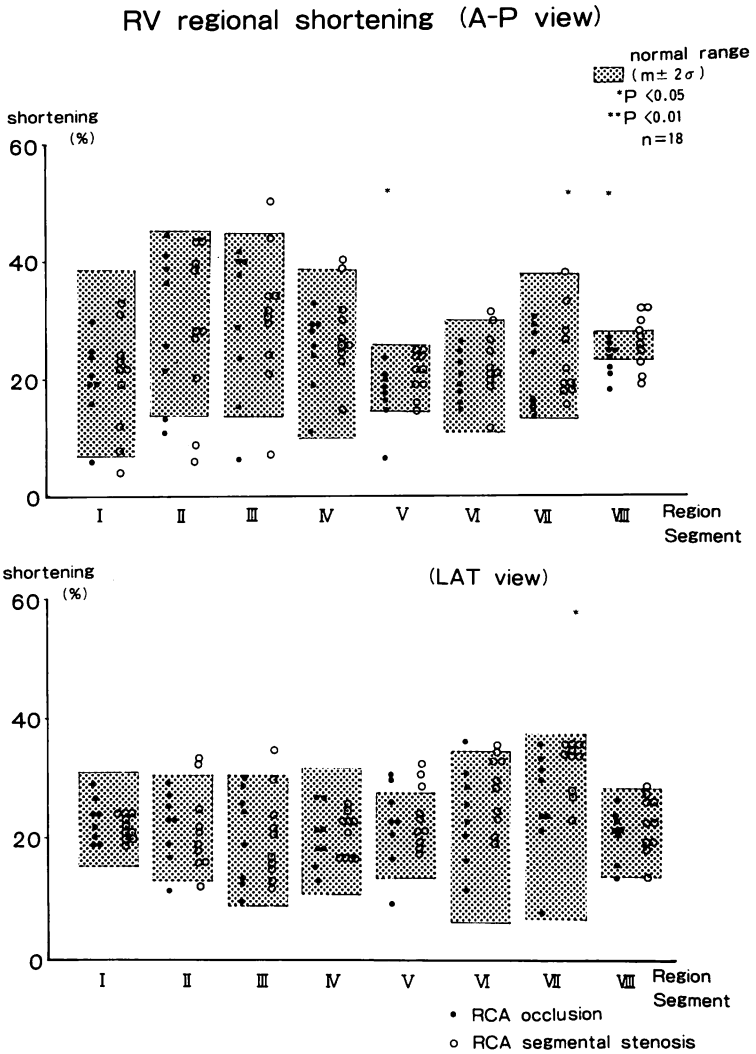

Fig. 3. Right ventricular regional shortening in each segment.

The range of mean±two standard deviations for shortening fraction of each regional wall motion is shown as a shaded area. The cases with right coronary arterial occlusion are expressed as closed circles and those with segmental stenosis of the right coronary artery as open circles.

motion occurring in patients with coronary artery disease[27]. Moreover, regional function may change even if global function does not[22~24]. Baxley et al[25] quantitatively studied patients with chronic heart failure after myocardial infarction and demonstrated hemodynamic derangements related to anatomic abnormalities of the left ventricle. In the computer system (Siemens AVD system) we used, numerous parameters including regional shortening can be calculated. One problem, however, involves the meaning of " shortening ". If each point of the contour is identified by means of a mathematical procedure, it remains questionable whether

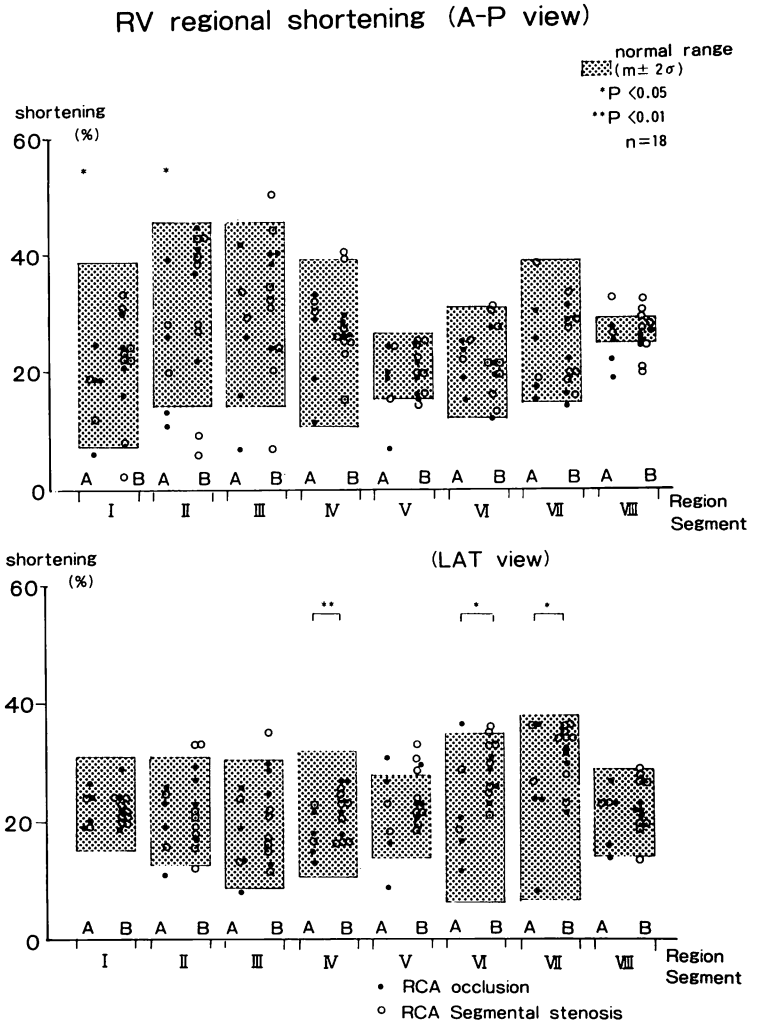

Fig. 4. Right ventricular regional shortening in each segment in Groups A and B.

The range of mean±two standard deviations for shortening fraction of each regional wall motion is shown as a shaded area. Group A consists of patients whose shortening in the left ventricular posterior wall decreased. Group B consists of patients without decreased shortening in that wall.

these points are identical to anatomic ones. A second important issue is the reference system. Various reference systems in use roughly fall into two categories; that using a long axis and perpendicularly-oriented axes, and that using radial axes[26~28]. We used the latter type as shown in **Fig. 1**. For analyzing the left ventricle, we chose the center of gravity of the end-diastolic contour as the starting point for the radii. However, we chose the midpoint of the long axis as the starting point for radii for analyzing the right ventricle. Our reason for this is that, during contraction, the right ventricular wall is assumed to move symmetrically toward the approximate midpoint of the long axis, while the left ventricular wall moves to-

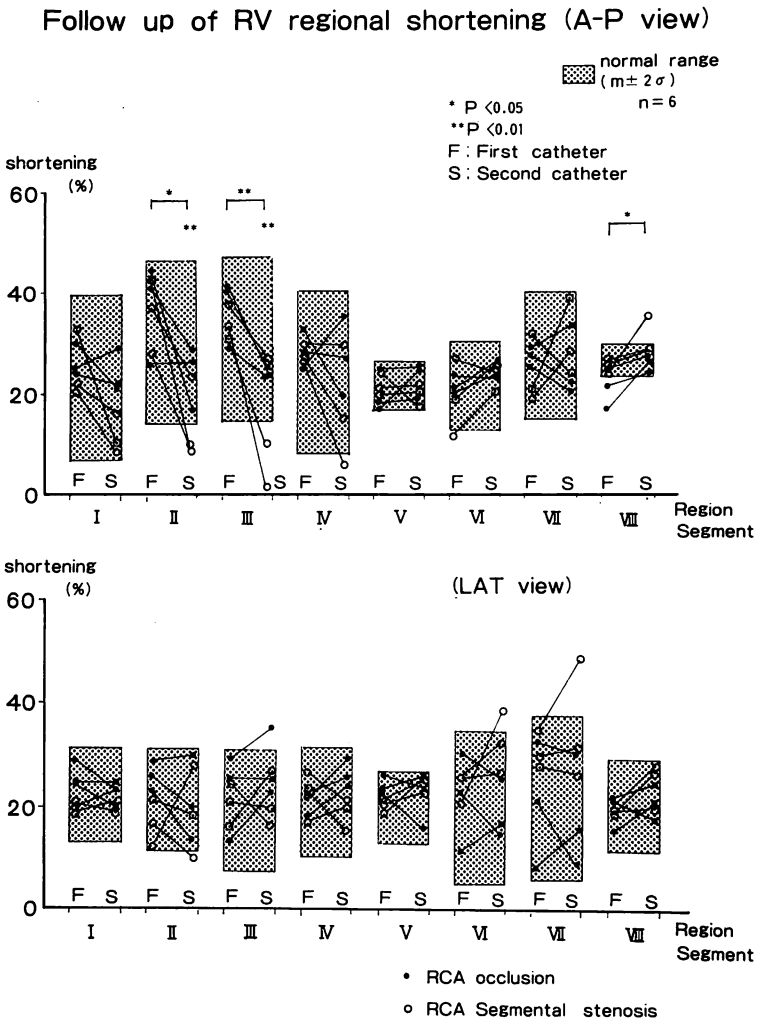

Fig. 5. Follow-up data of right ventricular regional shortening.

The area of mean±two standard deviations for shortening fraction of each regional wall motion is shown as a shaded area. Connecting lines mean the follow-up of the same case.

ward the approximate center of gravity. In addition, in left ventricular analysis, the radial system from the center of gravity of the end-diastolic contour showed the smallest variable coefficient, and in right ventricular analysis, the radial system from the midpoint of the long axis of the end-diastolic contour showed the smallest one. To analyze shortening of the right ventricle, we excluded the right ventricular outflow because the type of contraction affecting the right ventricular outflow may differ from that of the remainder of the right ventricle, especially in the lateral projection. The bulk of the right ventricular myocardium is consistently supplied by numerous branches of the coronary artery which also usually supplies the posterior wall of the left ventricle (usually in 90 percent[29]). Therefore, in a patient with RCA obstruction, it is im-

portant to examine regional wall motion of the right ventricle. Previous reports[14~16] state that right ventricular damage may be present in cases with acute inferior and inferoposterior myocardial infarctions. In this study, we analyzed the relationships between abnormality of the right ventricular wall and that of the inferoposterior wall of the left ventricle. Three of six patients with dysfunction of the left ventricular posterior wall showed abnormality of the right ventricular wall. However, six of 12 patients without dysfunction of the left ventricular posterior wall showed abnormality of the right ventricular wall. Therefore, we believe that dysfunction of the left ventricular posterior wall may not be sufficient to diagnose right ventricular infarction, and we recommend not only analysis of left ventricular wall motion but also that of right ventricular wall motion in patients with the history of the MCLS. Six of 18 patients were studied by repeating cineangiography one year after the first examination. In three segments (II, III and VIII) of the right ventricular wall in the lateral projection, there was a significant reduction of regional wall motion compared to that in the first study. As for the cause, there are two possibilities. The first is rotation of the ventricle or compensation for dysfunction of the right ventricle; the second is myocarditis due to the MCLS. At least, in our opinion, patients with RCA occlusion due to the MCLS must be followed up concerning the regional wall motion of the right ventricle.

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川崎病による右冠動脈閉塞例の右室局所運動

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川崎病における心室の局所壁運動に関する報告はない．本報では右冠動脈閉塞をきたし，右室梗塞に陥ったと判断された川崎病症例の右室局所壁運動 (RWM) を検討した．

対象は川崎病既往を有し，選択的冠動脈造影上，右冠動脈の閉塞 (occlusion あるいは，segmental stenosis) を認め，かつ心筋イメージング上，その支配領域に灌流欠損を認めた 18 例で，左冠動脈閉塞を伴うものは除外した．RWM 解析は，正，側二方向シネアンジオ上，流出路を除いた体部で，Siemens AVD system を用いて行った．同時に左室局所壁運動解析，心室容量計測を行った．

Occlusion を示した群と segmental stenosis を示した群との間では，有意な RWM の差は認められなかった．左室後下壁の運動低下と右室の RWM との間には，有意な関係は認めなかった．1 年後に行った 2 回目の心血管造影では，右室造影の正面像の 3 区画 (II, III, VIII) において，初回の造影に比し，RWM の有意な低下を認めた．

以上のことから，川崎病罹患によって右冠動脈閉塞をきたしたと考えられる症例では，左室造影による左室後下壁の壁運動から右室壁の機能を評価するのは不十分であり，右室造影検査が必要と考えられる．また，このような症例では，右室壁運動に関する長期の経過観察が必要である．

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