Regression of coronary aneurysms in patients with Kawasaki syndrome

MASATO TAKAHASHI, M.D., WILBERT MASON, M.D., AND ALAN B. LEWIS, M.D.

ABSTRACT  Coronary aneurysms were demonstrated echocardiographically in 34 of 186 patients who presented with Kawasaki syndrome between 1979 and 1983. The aneurysms were confirmed by selective coronary angiography in 27 patients and by postmortem examination in one. The 27 surviving patients with proven aneurysms were followed for 2 to 40 months (mean 15), during which they received low dose (5 to 10 mg/kg) aspirin daily. Progressive improvement and resolution of aneurysms were observed by serial echocardiography in 18 patients and confirmed by angiography in 14. Coronary aneurysms persisted, however, in nine other patients for 14 to 40 months (mean 25.7). The incidence of aneurysm resolution was higher in children less than 1 year of age at the onset of the illness than in patients older than 1 year (100% vs 50%; p < .001). Aneurysms were more likely to resolve in girls than in boys (100% vs 42%; p < .001). Fusiform aneurysms tended to resolve more frequently than saccular lesions (80% vs 18%; p < .025). Aneurysms located distally in the coronary arteries appear to regress more rapidly than proximal ones. We conclude that an age of less than 1 year at the onset of Kawasaki syndrome, female sex, and fusiform aneurysm morphology are significant factors that favor resolution of coronary artery aneurysms. However, important questions remain with regard to the long-term fate and functional capabilities of these healed lesions.


KAWASAKI SYNDROME, first described in Japan in 1967, has gained worldwide attention because of the development of coronary aneurysms in 15% to 20% of patients. Deaths have occurred primarily from myocardial infarction after thrombosis within the aneurysms. Originally mortality was reported as 1% to 2%. However, a recent nationwide survey in Japan showed that the mortality rate had decreased to 0.3%. Our own experience in Los Angeles (0.5% mortality) also underscores this trend toward decreased mortality. This decrease in death rate is attributed to early diagnosis and initiation of aspirin therapy. Furthermore, regression and/or resolution of coronary aneurysms have been reported by Glantz et al. in the United States and by Kato et al. in Japan. We have noted that rate and extent of regression of aneurysms varied considerably among patients. In some patients dramatic changes occur in a relatively short span of time, whereas in others angiographic and echocardiographic appearances change very little over years. In this study we attempted to identify various factors that may influence regression of coronary artery aneurysms.

Methods

Patients. A total of 186 patients with Kawasaki syndrome were seen at Childrens Hospital of Los Angeles from 1979 through August 1983. Their ages ranged from 3 months to 14 years, with a median of 2 years and 3 months. The male-to-female ratio was 1.6:1. The ethnic distribution of the patients is shown in table 1. For comparison, the ethnic distribution of patients admitted to Childrens Hospital of Los Angeles and that of the population in Los Angeles County according to 1980 census data are also shown. As can be seen, Asians are overrepresented in the Kawasaki syndrome group.

Diagnosis and treatment. The diagnosis was made using the clinical criteria established by the Center for Disease Control. Appropriate laboratory studies were done to exclude diseases of known etiology including group A streptococcal infection, leptospirosis, and Ebstein-Barr virus infection. A careful history was taken to exclude drug reactions and exposure to mercury. All patients diagnosed as having Kawasaki syndrome in the acute febrile phase were treated with aspirin (80 to 100 mg/kg/day) until fever, skin rash, and other systemic symptoms subsided. No other anti-inflammatory agent or gamma globulin was used in this group of patients. The dose of aspirin was then reduced to 5 to 10 mg/kg/day for inhibition of platelet aggregation. In patients with multiple large coronary artery aneurysms, dipyridamole (2 to 3 mg/kg/day) was added to the regimen. The duration of low-dose aspirin therapy depended on the condition of the patient's coronary arteries. In those patients who devel-
TABLE 1  
Ethnic distribution of patients with Kawasaki syndrome compared with all patients admitted to Children’s Hospital of Los Angeles (CHLA) and 1980 census in Los Angeles County

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>No. Kawasaki patients</th>
<th>Observed distribution (%)</th>
<th>Expected distribution CHLA admissions</th>
<th>1980 census (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>57</td>
<td>30.6</td>
<td>49.6</td>
<td>53.3</td>
</tr>
<tr>
<td>Asian</td>
<td>55</td>
<td>29.6</td>
<td>3.8</td>
<td>5.8</td>
</tr>
<tr>
<td>Hispanic</td>
<td>36</td>
<td>19.4</td>
<td>27.3</td>
<td>28.3</td>
</tr>
<tr>
<td>Black</td>
<td>30</td>
<td>16.1</td>
<td>19.3</td>
<td>12.6</td>
</tr>
<tr>
<td>Other</td>
<td>8</td>
<td>4.3</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Total</td>
<td>186</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

NA = not available.

*Four of eight are part Asian.

opened no echocardiographic evidence of aneurysms or in those who were judged to have false-positive echocardiographic results by angiographic verification, aspirin was terminated 2 to 6 months from the onset of illness. In every case, erythrocyte sedimentation rate and platelet count were verified as normal before treatment was stopped. In those patients who showed echocardiographic evidence of aneurysms with or without angiographic confirmation, aspirin was continued as long as there was evidence of aneurysms. In this group of patients, no other medical or surgical treatments were used.

**Echocardiography.** As soon as the diagnosis of Kawasaki syndrome was established, the coronary arteries were evaluated for aneurysms by two-dimensional echocardiography. A Toshiba SSH 10A Sonolayergraph model (2.4 MHz transducer) or Hewlett-Packard model 77020A ultrasound system (3.5 or 5 MHz transducer) was used. The right and left coronary arteries were visualized by means of variations of parasternal short axis and apical views of the aortic root with the patient in supine and left lateral positions. A coronary artery with a uniform lumen of 2 mm or less was judged to be normal. An artery was judged to be abnormal if its internal diameter was in excess of 3 mm and was frequently surrounded by bright echoes. When two observers could unequivocally agree on the interpretations of abnormality, the artery was judged as definitely abnormal. Patients with equivocal echocardiographic findings were not included in this study.

**Coronary arteriography.** Thirty of the 34 patients who showed echocardiographic evidence of abnormal coronary arteries during the early phase of illness underwent cardiac catheterization and angiography. The interval between the first echocardiographic examination and cardiac catheterization ranged from 10 to 186 days (mean 78). Selective coronary arteriography was performed in nearly all patients by means of specially formed pediatric coronary artery catheters. In patients in whom multiple coronary aneurysms were confirmed by the initial angiographic examination, repeat angiography was performed 1 to 2 years later. Except for two patients early in our series, those patients with solitary aneurysms clearly visible echocardiographically were not subjected to repeat angiography.

**Statistical analysis.** Persistence or resolution of aneurysms was analyzed by the life-table method. We computed the probability of persistence of coronary aneurysms (not to be confused with survival of the patients). Patient age and sex at onset of disease was examined as possible determinants of resolution by Fisher’s exact test, analysis of variance, and life-table methods. Aneurysm morphology was examined as a possible determinant of resolution by the chi-square test, Student’s t test, and analysis of variance. The incidence of resolution according to coronary arterial segments was analyzed by the chi-square test.

**Morphologic classification of aneurysms.** Angiographically defined aneurysms in 17 patients were classified into four morphologic types: fusiform, saccular, ectatic, and segmented (figure 1). The first two types were localized to any one arterial segment, whereas the latter two types involved large portions of coronary arteries. Fusiform (spindle-shaped) aneurysms were limited to a short segment and characteristically showed gradual transition in internal diameter from the normal to the dilated segment at both proximal and distal ends. Saccular aneurysms also were confined to a short segment but showed abrupt transition from the normal to the dilated state. Their profiles were spherical, dumbbell-shaped, triangular, or “sack-like.” An ectatic aneurysm encompassed a long arterial segment and was more or less uniformly dilated throughout its entire length. A segmented aneurysm also involved a long arterial segment. Unlike an ectatic aneurysm, it had multiple dilated segments joined by short normal or stenotic segments. At a branching point the aneurysm frequently assumed a lobulated pattern.

Aneurysms were identified in proximal, middle, and distal segments of major coronary arteries according to the nomenclature used by the National Heart, Lung, and Blood Institute Coronary Artery Surgery Study. Where an extensive aneurysm involved more than one segment, it was tabulated as multiple aneurysms equal to the number of involved segments. The incidence of resolution was analyzed according to whether aneurysms were located in proximal, middle, or distal arterial segments.

**FIGURE 1.** Morphologic classification of coronary artery aneurysms. Based on angiographic appearance, aneurysms were first divided into localized and extensive categories. Localized aneurysms are those confined to relatively short segments of coronary arteries, whereas extensive aneurysms involve almost entire lengths of arteries. Localized aneurysms were further classified as fusiform and saccular aneurysms. Extensive aneurysms were further classified as ectatic and segmented aneurysms. (See text for definition of each type.)
segments by the chi-square test in eight patients in whom serial angiographic examinations were available.

Results

Thirty-four of 186 patients (18.3%) fulfilled echocardiographic criteria for coronary artery aneurysms 19.4 ± 10.3 days (mean ± SD) (range 8 to 43) after onset of Kawasaki syndrome. One of these patients died of massive myocardial infarction caused by thrombosis of multiple coronary aneurysms during the acute phase of illness, making the mortality rate in our series of patients 0.5% (2.9% of the patients with positive echocardiographic findings). Three of the patients were subsequently lost to follow up. The echocardiograms of three other patients were abnormal, but coronary arteriograms obtained within 24 hr of the last echocardiographic examination were normal. These echocardiograms were therefore classified as “false positive.” Excluding these patients with false-positive results, the overall incidence of coronary artery aneurysms in our patients was 16.4%. The remaining 27 patients were followed for 2 to 40 months (mean 15) with serial echocardiograms.

Nine children (33% of these 27) who had angiographically proven coronary aneurysms continued to show echocardiographic and/or angiographic evidence of aneurysms for 14 to 40 months (mean duration 25.7 months). Five patients had subsequent follow up coronary angiographic examinations. Figure 2 shows an example of partial regression of an ectatic right coronary aneurysm over a period of 12 months.

In 18 other patients we observed progressive improvement in echocardiographic appearance of coronary arteries until the lumen diameters became normal. Resolution of aneurysms was confirmed by repeated angiography in 14 patients. Ten patients showed rapid echocardiographic normalization within 2 to 4.5 months from onset (mean 3) before performance of the initial angiographic study. Figure 3 shows an example of rapid echocardiographic improvement of a right coronary artery aneurysm in a 3-month-old girl. Figures 4 and 5 show examples of complete angiographic resolution of right and left coronary aneurysms.

Age of onset. Eleven of the 28 patients (39%) under 1 year of age at onset developed coronary aneurysms, whereas only 20 of 158 (13%) children older than 1 year developed aneurysms (p < .0014) (table 2). One infant girl died of massive myocardial infarction 20 days after onset. One infant and two children over 1 year of age with aneurysms were lost to follow up. Aneurysms in all nine of the remaining infants under 1 year of age resolved, whereas aneurysms resolved in only nine of the 18 remaining older patients (50%) (p < .001; table 3). Figure 6 shows the results of life-table analysis plotting probabilities of persistence of coronary aneurysms in the entire group as well as in younger and older cohorts of patients. The estimated probability of aneurysm resolution in the entire group at the end of 31 months was 80%. In the patients under 1 year of age there was a 100% probability of resolution within 18 months of onset of the disease. In the older patients there was a 68% probability of aneurysm resolution within 31 months from onset. The difference became significant after 7 months (p = .003).

Sex. Nineteen boys and 12 girls developed aneurysms. Follow-up data were available in 18 boys and
nine girls. Aneurysms resolved in nine of the 18 boys and in all nine girls (p < .001) (table 4). Figure 7 presents probabilities of persistence of aneurysms in boys and girls in a life-table format. In girls there was a 100% probability of resolution within 31 months from onset. In comparison, there was only a 42% probability of resolution in boys. The difference became significant after 7 months (p = .003).

We examined whether this sex difference in resolution resulted from age bias. The average ages of boys and girls with aneurysms were 2.37 ± 1.95 and 1.25 ± 1.30 years (mean ± SD), respectively. This difference failed to reach statistical significance. But when the boys and girls were subdivided into those who had had resolution and those who had not, the ages of the subgroups were significantly different (analysis of variance, p < .01). The ages of the boys who had had resolution were 1.11 ± 0.79 and 1.25 ± 1.30 years, respectively, and were not significantly different by multiple-comparison t test. The age of the boys whose aneurysms persisted was 3.64 ± 1.97 years (range 1.08 to 6.92), which was significantly greater than that of either the boys or the girls who had had resolution (p < .001 and p < .005, respectively). We examined the incidence of aneurysms in boys and girls with Kawasaki syndrome in different age brackets to further elucidate this problem. Age-specific incidences of aneurysms in boys and girls under 2 years of age were 17.6% and 22.6%, respectively. The difference was not significant. The incidence of aneurysms in boys older than 2 years was 15.9%, whereas that in girls in the same age bracket was only 4.9% (p < .05).

Aneurysm morphology. Table 5 shows the number of angiographically confirmed aneurysms by morphologic types. Eight of 10 fusiform aneurysms resolved as compared with only three of 17 saccular aneurysms (p < .025). There were too few ectatic and segmented aneurysms for statistical conclusion. The ages of onset in the three morphologic groups were similar: fusiform 2.64 ± 1.94 years, saccular 3.21 ± 2.62 years, and

FIGURE 3. Serial two-dimensional short-axis echo-cardiograms of a 3-month-old girl showing rapid resolution of a right coronary artery aneurysm over a period of 66 days. A = anterior; P = posterior; R = right; L = left; RCA AN = right coronary artery aneurysm; AO = aortic root; LCA = left coronary artery.

FIGURE 4. Left, Selective right coronary arteriogram in a 6-month-old boy showing an extensive segmented aneurysm involving the entire right coronary artery. The study was done 3 months after onset of Kawasaki syndrome. Right, Sixteen months later in the same patient the right coronary artery luminal configuration appears normal with no stenosis or obstruction of any segment or major branches.
extensive \(2.59 \pm 1.97\) years. Within each group the mean age of the patients whose aneurysms had resolved was significantly younger compared with that of patients with persistent aneurysms: fusiform \(1.23\) vs \(4.40\) years \((p < .02)\), saccular \(0.25\) vs \(3.80\) years \((p < .05)\), and extensive \(0.75\) vs \(3.21\) years \((\text{NS})\).

**Aneurysm location.** The proximal segment of left anterior descending branch was the most frequent site of aneurysms, followed by the proximal right coronary artery and the left main coronary artery. The left circumflex artery was the least frequently involved major artery. In the subset of patients who underwent coronary arteriography, aneurysms in the distal arterial segments were without exception associated with aneurysms in the proximal segments. Only one of the six aneurysms in the left main coronary artery resolved. Two of the four aneurysms in the left circumflex branch resolved. In both the right coronary artery and the anterior descending branch a greater proportion of more distally located aneurysms resolved compared with more proximal ones (table 6). Five patients with persistent coronary artery aneurysms underwent follow-up angiography. Although their coronary arteries remained abnormal in the second study, some of the more distally located aneurysms had undergone resolution (two patients) or distal portions of extensive aneurysms had become more normal in caliber (three patients).

**Discussion**

The demographic characteristics of our patients, including a male-to-female ratio of \(1.6:1\), a predominance of young patients under 4 years, and a relatively high prevalence of Asian ethnic groups, are all consistent with previously reported epidemiologic data.\(^4\) The 16% incidence of coronary artery aneurysms in our patients is also similar to that reported in previous studies.\(^7\) Echocardiography is widely recognized as a sensitive screening tool for coronary aneurysms in this syndrome,\(^9\,10\) with very high sensitivity and acceptable specificity recently documented by Capannari et al.\(^15\) However, false-positive interpretations of echocardiograms do occur occasionally. These are usually due to relatively large but otherwise normal coronary arteries as noted in our three patients.

The fact that coronary artery aneurysms may undergo regression or resolution has been reported previously.\(^6\,7\) Striking discrepancies exist among patients in the incidence, rapidity, and extent of regression. Our overall statistics indicate that two-thirds of those patients with initial echocardiographic evidence of coronary artery aneurysms subsequently undergo resolu-

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**TABLE 2**

<table>
<thead>
<tr>
<th>Presence or absence of coronary aneurysms according to age of onset</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onset at age less than 1 year</td>
</tr>
<tr>
<td>-------------------------------</td>
</tr>
<tr>
<td>Aneurysms</td>
</tr>
<tr>
<td>No aneurysms</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

Fisher’s exact test \(p < .0015\).

**TABLE 3**

<table>
<thead>
<tr>
<th>Resolution of coronary aneurysms according to age of onset</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onset at age less than 1 year</td>
</tr>
<tr>
<td>-------------------------------</td>
</tr>
<tr>
<td>Aneurysms</td>
</tr>
<tr>
<td>Resolved</td>
</tr>
<tr>
<td>Not resolved</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

Fisher’s exact test \(p < .001\).
tion. Patients under 1 year of age have a higher incidence of aneurysms. These may be the patients who in a previous era would have been diagnosed as having infantile polyarteritis nodosa. Pathologic descriptions of these two disease entities have been found to be indistinguishable.6,16 Causes for more consistent and rapid resolution of aneurysms in younger children are not clear and should be a subject for further investigation.

Sex differences in the resolution of aneurysms is partly explained by a significantly higher incidence of aneurysms in older boys. In other words, Kawasaki syndrome appears to take a milder form in older girls than in older boys, whereas the severity of disease as indicated by incidence of aneurysms seems to be equally high in both sexes in the younger age bracket.

The influence of aneurysm morphology on resolution is interesting. No age difference was noted among the three morphologic groups. Within each group, younger age of onset prevailed as a factor influencing resolution.

Fusiform aneurysms appear to resolve more frequently than saccular ones. In fusiform lesions there is more gradual transition from normal luminal diameter to the maximally dilated point. In comparison, saccular lesions represent more abrupt change from normal to abnormal, and these lesions may indeed represent more severe disruption of vascular wall architecture. An alternative hypothesis would be that fusiform lesions are partially healed lesions with intimal proliferation already in progress. This difference may be due to enhanced activity of platelet dependent growth factors in certain patients.19

Coronary aneurysms in Kawasaki syndrome occur in the proximal segments of the major coronary arteries in majority of cases.7 We observed that aneurysms in the distal segments were always associated with aneurysms in the proximal segments. In these cases, the regression process appeared to start in the distal segments of the coronary arteries and proceeded centrally. Certain mechanical factors may make proximal coronary artery segments more vulnerable to aneurysm formation and at the same time less amenable to healing. First, the proximal segments are larger. Loss of integrity of the vascular wall as a result of inflammation may increase the wall tension at any given intraluminal pressure than in middle and distal segments. Second, the proximal coronary artery segments are more ex-

TABLE 4
Resolution of coronary aneurysms according to sex

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aneurysms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resolved</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Not resolved</td>
<td>9</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>9</td>
</tr>
</tbody>
</table>

Fisher's exact test p < .001.

FIGURE 6. Persistence curves of coronary aneurysms in the total group of patients, those less than 1 year old, and those older than 1 year. The vertical lines indicate ±1 SE. The difference between the two age groups remained significant after 7 months of follow-up at p = .003 (two-tailed).

FIGURE 7. Persistence curves of coronary aneurysms in boys and girls. The vertical lines indicate ±1 SE. The difference between the two groups remained significant after 7 months of follow up at p < .05 (two-tailed).

TABLE 5
Resolution of angiographically proven coronary aneurysms according to morphologic classification

<table>
<thead>
<tr>
<th></th>
<th>Fusiform</th>
<th>Saccular</th>
<th>Extensive a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resolved</td>
<td>8 (80%)</td>
<td>3 (18%)</td>
<td>3 (43%)</td>
</tr>
<tr>
<td>Persistent</td>
<td>2 (20%)</td>
<td>14 (82%)</td>
<td>4 (57%)</td>
</tr>
<tr>
<td>Total</td>
<td>10</td>
<td>17</td>
<td>7</td>
</tr>
</tbody>
</table>

aIncludes ectatic and segmented types.

Chi-square for all three morphologic types = 10.12, p < .006. Fisher's exact test for fusiform and saccular types only, p < .003.
posed, being lifted off the myocardial surface with only a periarterial fat pad “protecting” them. Finally, the proximal coronary artery segments tend to distend during early ventricular systole because of rising aortic pressure and simultaneous cessation of intramural coronary flow.17 We have no data to show whether coronary arteritis of Kawasaki syndrome involves all coronary segments to an equal degree. Assuming that this is the case, i.e., that inflammatory reaction occurs all along the entire arterial length, it would be the proximal segment that must bear the brunt of stress and thus may lead to aneurysm formation. Furthermore, the right coronary artery and the circumflex branch of a dominant left coronary artery may be more prone to extensive aneurysms (ectatic or segmented varieties) because of their courses within the atrioventricular grooves where the walls are not embedded in the myocardium.

According to Fujiwara et al.18 almost all fatal cases of Kawasaki syndrome are associated with massive thrombosis and scarring of major coronary arteries. Kato et al.7 demonstrated by biopsy of an aneurysmal axillary artery that regression of aneurysms occurs by localized intimal proliferation. Aspirin therapy appears to prevent massive thrombosis and to permit more gradual restitution of normal lumen contour. A recently described platelet-dependent growth factor may play an important role in this process.19 It is not clear at this time whether this resolution of aneurysm represents true healing, i.e., reestablishment of normal vascular architecture, or permanent “filling-in” of the aneurysmal lumen with a proliferated intimal layer consisting of smooth muscle cells and fibroblasts. If the latter is the case, it is conceivable that the lumen may become stenotic because of the excessive intimal proliferation such as occurs in Eisenmenger reaction in the lung20 or in saphenous vein grafts after coronary bypass graft surgery in adults.21

From a clinical standpoint, there remains an unanswered question as to the functional capacity of such “healed” coronary arteries. Normal human coronary arteries may increase blood flow as much as twofold to threefold in response to stress.22 To what extent can these arteries meet the increased myocardial metabolic demands during exercise and stress? Equally uncertain is the risk of atherosclerotic process, all other known risk factors being equal. To answer these questions patients who have undergone aneurysm resolution should be kept under long-term surveillance. Stress tests combined with myocardial perfusion scanning and quantitative coronary arteriography with intervention with vasoreactive agents may elucidate the functional capacity of once diseased coronary arteries. New technology of noninvasive tissue characterization should be explored in addition to careful study of available coronary artery tissues to understand the true nature of aneurysm resolution.

We thank Kathrine Sivazlian and Karen Boot for performance of echocardiographic studies and Julie Buck for preparation of the manuscript.

References

Vol. 75, No. 2, February 1987

TABLE 6
Resolution of angiographically proven coronary aneurysms according to locations along the major coronary arteries

<table>
<thead>
<tr>
<th></th>
<th>Proximal</th>
<th>Middle</th>
<th>Distal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resolved</td>
<td>10 (50%)</td>
<td>7 (88%)</td>
<td>4 (100%)</td>
</tr>
<tr>
<td>Persistent</td>
<td>10 (50%)</td>
<td>1 (12%)</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
<td>8</td>
<td>4</td>
</tr>
</tbody>
</table>

*Coronary artery segment nomenclature used by NHBLI Coronary Artery Surgery Study. ^13
Chi-square 5.96, p < .05.

16. Landing BH, Larson EJ. Are infantile polyarteritis nodosa with coronary artery involvement and fatal mucocutaneous lymph node syndrome the same? Comparison of 20 patients from North America with patients from Hawaii and Japan. Pediatrics 59: 651, 1977


Erratum

The second paragraph of the above article was published in an incomplete form. The correct paragraph is as follows:

"The multicenter randomized trial conducted by the Netherlands Interuniversity Cardiology Institute demonstrated early recanalization in 79% of patients with angiographically proven obstruction, without major complications. The high patency rate after thrombolysis was associated with limitation of infarct size, higher left ventricular ejection fraction (LVEF), and improved survival in comparison with these variables in conventionally treated patients. The design of this study, clinical course in the hospital, complications of early catheterization, limitation of enzymatic infarct size, and improvement in left ventricular function and survival during the follow-up period have been described elsewhere."
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