Refer to: Wright HT Jr, Parker CE, Mavalwala J: Unusual dermatoglyphic findings associated with cytomegalic inclusion disease of infancy—A first report and practical review. Calif Med 116:14-20, Mar 1972

Unusual Dermatoglyphic Findings Associated With Cytomegalic Inclusion Disease of Infancy

A First Report and Practical Review

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■ *Infection with the human cytomegalovirus has a teratogenic effect on the fetus during the first trimester of gestation as does rubella. Since unusual dermatoglyphic findings have been observed in infants with congenital rubella infection, the present study was designed to determine whether or not unusual dermatoglyphics occur in patients with cytomegalic inclusion disease of infancy. Analysis of dermatoglyphics in 15 infants with cytomegalic inclusion disease revealed unusual features in all infants. These features are reported here for the first time and are compared with dermatoglyphic findings in a normal population as well as with those of available parents of the infants.*

DERMATOGLYPHICS, literally "skin carvings," is the term given to the configurations formed by the furrows and epidermal ridges in the skin of the digital tips, palms and soles of all primates.[1] Cummins and Midlo's comprehensive treatise on the significance, description, methods and biologic aspects of dermatoglyphics is used as the basis for modern studies.[2] By the sixteenth week of gestation the epidermal ridges are well developed, but the process is probably not complete before 24 weeks.[3] Once complete, the epidermal ridges remain unchanged for life, except for growth in size. Hence the patterns which remain stable and characterize an individual are present at birth.[3]

Unusual dermatoglyphics were first observed in patients with Down's syndrome by Cummins.[4] In 1966, Alter summarized the unusual dermatoglyphics observed in 68 clinical disorders including not only chromosomal aberrations and single gene disorders but also diseases of uncertain genetic transmission, such as congenital heart disease and psoriasis, and diseases due to toxic or environmental factors, such as thalidomide and rubella.[3]

Like rubella, the cytomegalovirus has a teratogenic effect during the first trimester of gestation and one might speculate that alterations in der-

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Supported by Public Health Service Research Grant Nos. AI-03079 from the National Institute of Allergy and Infectious Diseases and FR-00086 from the Division of Research Facilities and Resources.

Submitted May 27, 1971.

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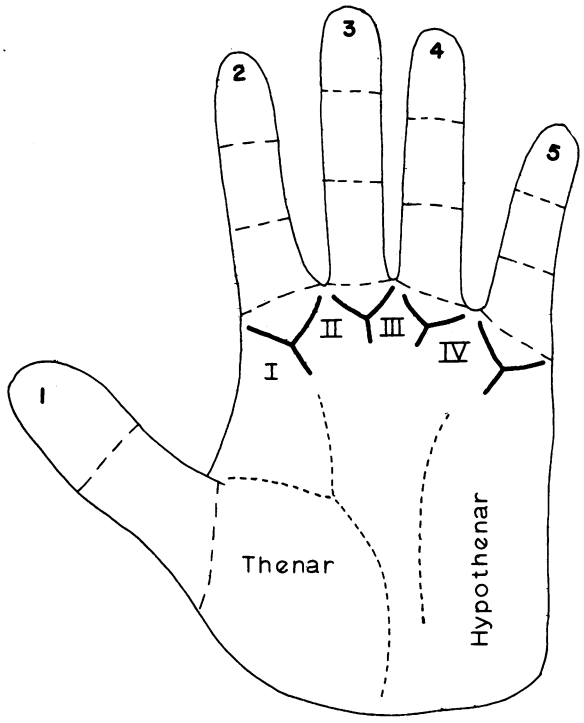

Figure 1.—Areas of the hand having dermatoglyphic patterns.

matoglyphics would be present in infants with cytomegalic inclusion disease since alterations occur in infants with congenital rubella infection.[5,6]

Analysis of dermatoglyphics in 15 infants with cytomegalic inclusion disease of infancy revealed unusual features in all 15. These features are reported here for the first time and are compared with dermatoglyphic findings in a normal population as well as with those of available parents.

Methods

Dermatoglyphics can be cleanly and permanently recorded by several techniques.[3] In the present study dermatoglyphic prints were obtained by use of inkless kits supplied by Faurot and Hollister. The advantages of the inkless methods are tidiness and relative cleanliness for the subject tested. The digits, palms and soles were covered with the appropriate fluid and then an impression was made on special sensitized paper. Prints on some patients were obtained by the photographic method utilizing an optical means of enhancing the contrast of surface reliefs as described by Harrick.[7]

The normal hand has 11 significant areas where sulci, or furrows, and ridges form distinct patterns (Figure 1). The areas are the five tips of the fingers, the four interdigital areas, the thenar eminence and the hypothenar eminence of the palm. Usually flexion crease lines are discussed with dermatoglyphics, although they are quite different in origin.

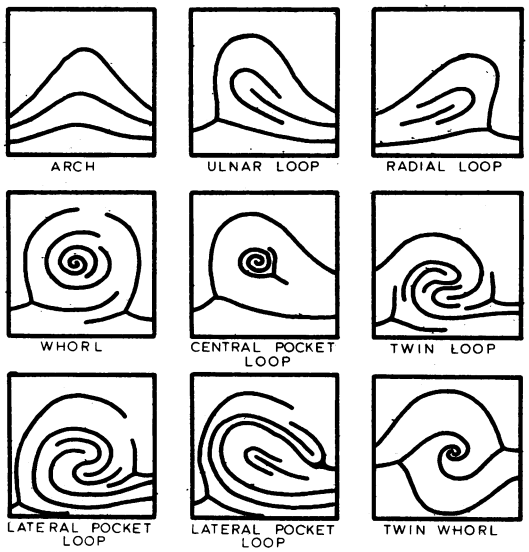

Figure 2.—Illustration of various dermatoglyphic digital patterns.

Subjects

Since 1960, 30 infants with cytomegalic inclusion disease have been studied at the Childrens Hospital of Los Angeles to determine clinical manifestations and sequelae of this disease. Fifteen of these patients have been admitted to the Clinical Research Center on one or more occasions for extensive studies to determine the long-term effects of a transplacental viral infection.

In all cases, the diagnosis was based on the presence of clinical manifestations of the disease as well as the repeated isolation of human cytomegalovirus from urine specimens and throat swabbings. This virus was identified by the classical cytopathic effect observed when specimens were inoculated into human fetal fibroblasts, and by subsequent cytochemical studies which demonstrated appropriate intranuclear and cytoplasmic inclusion bodies.[8]

In the present study dermatoglyphics on the patients are compared with those of their parents, or frequencies are quoted from large studies from Europe, since the patients are primarily of European descent.

TABLE 1.—*Digital Dermatoglyphic Patterns of 15 Patients with Cytomegalic Inclusion Disease*

	Right Hand					Left Hand					Total Ridge Count
	1	2	3	4	5	1	2	3	4	5	
B.B.	+	+	−	+	+	+	+	+	+	+	151
P.C.	+	−	−	−	−	+	−	−	−	−	68
W.E.	+	+	+	+	+	−	+	+	+	−	162
B.K.	−	−	−	−	−	−	−	−	−	−	0
J.M.	−	+	−	+	+	−	+	+	+	−	170
D.M.	+	+	+	+	−	+	+	+	+	−	208
D.P.	−	+	+	+	−	−	−	+	+	−	162
G.R.	+	+	−	+	−	+	−	−	−	−	192
E.S.	+	−	−	−	−	+	−	−	−	−	73
J.A.	−	−	−	−	−	−	−	−	+	+	76
E.M.	+	+	+	+	+	+	+	+	+	+	198
T.P.	−	−	−	−	−	−	−	−	−	−	not available low
M.R.	−	−	−	+	−	−	−	−	−	−	56
D.G.	−	−	−	−	+	−	−	+	+	−	196
J.J.	−	+	−	+	+	−	+	−	+	−	not available medium

− Arches and Loops
+ Whorls and Complex Patterns

TABLE 2.—*Digital Patterns of Parents of Children with Cytomegalic Inclusion Disease*

	Right Hand					Left Hand					Total Ridge Count
	1	2	3	4	5	1	2	3	4	5	
Mother											
D.M.	−	−	−	+	−	+	+	−	+	−	162
G.R.	+	−	−	−	−	+	−	−	−	−	196
E.S.	−	−	−	−	−	−	−	−	−	−	21
J.A.	−	−	−	−	+	−	−	−	−	+	49
E.M.	+	+	+	+	+	+	+	+	+	+	169
T.P.	−	−	−	−	−	−	−	−	−	−	70
D.G.	−	−	−	−	−	−	−	−	−	−	128
J.J.	+	+	−	−	−	−	−	−	−	−	149
Father											
E.S.	+	−	+	+	−	+	−	−	−	−	178
J.A.	+	+	+	+	+	+	+	+	+	+	190
E.M.	+	−	−	+	+	+	+	−	+	+	181
T.P.	−	−	−	+	−	+	−	−	−	−	112
D.G.	+	+	+	+	+	+	+	+	+	+	226

− Arches and Loops
+ Whorls and Complex Patterns

Definitions and Results

Fingers

Tips. The skin ridges on the fingers form various patterns ranging from the geometrically simple arch to loops and to more complex patterns such as whorls, central pocket loops, twin loops, lateral pocket loops and twin whorls (Figure 2). In Scotland Yard data[3] on 5,000 normal individuals, the incidence of complex patterns on the fingers was 25 percent, whereas the general trend observed in our patients was an increase of complex patterns to 43 percent. Two of our patients, B.K. and T.P., had extremely simple patterns on all ten fingers (Table 1). They most probably inherited their remarkably high frequency of arches. Analysis of the dermatoglyphics of B.K.'s parents, necessary for comparison, is not obtainable; however, analysis of the dermatoglyphics of T.P.'s parents confirms this assumption, since they have a high frequency of simple patterns (Table 2).

Usually, certain fingers will more frequently show complex patterns than other fingers.[2] In our patients, it would appear that the distribution of the complex patterns on individual fingers was different from that normally expected. For example, the fourth and fifth digits on each hand ordinarily have smaller and less complex patterns; however, among our patients this trend was not observed and complex patterns frequently were present on the fourth digit (Table 1).

Ridge Count. The ridge count of each finger is obtained by counting the number of ridges that lie between a point on the outer edge of the pattern, the triradius (designated "y" in Figure 3), and a central, or core, ridge of the pattern (designated "x" in Figure 3). The total count is obtained by adding together the higher ridge count from each of the ten fingers. Holt[9] has reported an average total ridge count of 145 in a study of 825 British males. The average total ridge count of the nine males in the present series (B.B., W.E., J.M., D.M., D.P., G.R., E.S., J.A. and E.M.) on whom a total ridge count could be made was 155.

Palms

Flexion Creases. Usually flexion crease lines are discussed with dermatoglyphics although anatomically they are quite different in origin (Figure 4). These are large deep grooves which generally overlie the flexural aspect of joints of the fingers and the rest of the hand. Two distinct, comparatively long, transverse flexion creases overlie the metacarpophalangeal joint (Figure 4, lines 1 and 2). When the two creases are fused into a single horizontal fold, they are referred to as a simian line. This occurs with high frequency in Down's syndrome.[10] Transitional forms occur when two creases are joined

Figure 3.—Method of dermatoglyphic ridge counting.

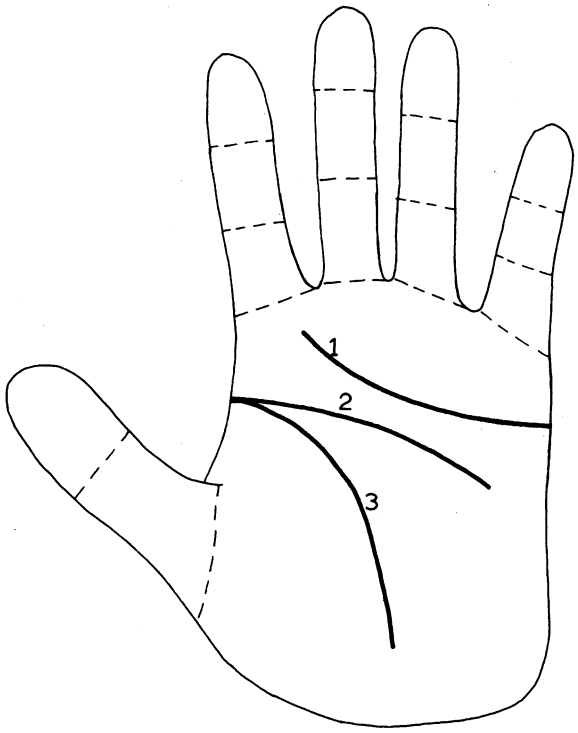

Figure 4.—Position of palmar flexion creases.

by a bridge. Although transitional transverse flexion creases occasionally occur in the normal population, they were observed on both hands of eight of our patients and another patient had a classical simian line on one hand.

Triradii. Another important element of patterns on the palm is the triradius, which is a Y-shaped junction where three ridges, sometimes referred to as radiants, meet. The normal hand has at least five triradii which are dermatoglyphic landmarks (Figure 5). Four are located at the base of the index, middle, ring and fifth fingers and are termed *a, b, c,* and *d.* At least one medial triradius is present on the palm between the hypothenar and thenar areas. The proximal medial triradius (pmt), termed *t* and commonly called the axial triradius, occurs normally close to the carpal creases. However, other distal medial triradii (dmt) may be present, invariably associated with patterns on the hypothenar area. Such distal medial triradii, termed *t′* and *t″*, must not be confused with an elevated proximal medial triradius which occurs when no triradius is present near the carpal creases. Proximal medial triradii were not elevated in our patients, but distal medial triradii occured in association with hypothenar patterns.

a-b ridge count. One measure of ridge breadth on the palm is obtained by counting the number of ridges that are cut by a line drawn between triradii *a* and *b* (Figure 5). Counting both hands, Fang[11] reported a mean a-b ridge count of 85 in a normal Ontario population of British extraction and a mean total ridge count of 84 in a study of normal British students. The mean total a-b ridge count on our patients was 80.

Main Lines. The proximal ridge radiant that emerges from each of the triradii *a, b, c,* and *d* is termed a main line. The four main lines usually cross the palm in a transverse fashion except for line A, which frequently is longitudinal. In our patients all main lines tended to be transverse, as in Figure 5.

Palmar Patterns. As far as the hypothenar area is concerned, Cummins and Midlo[2] found that 34.3 percent of 1,281 normal German males had patterns of varying complexity on the hypothenar area. Seven of our 15 patients (46.7 percent) had complex hypothenar patterns on both palms, and another had a complex pattern on the right palm only (Table 3). This suggests an increased frequency of complex hypothenar patterns among these patients.

In a normal population, the thenar-first inter-

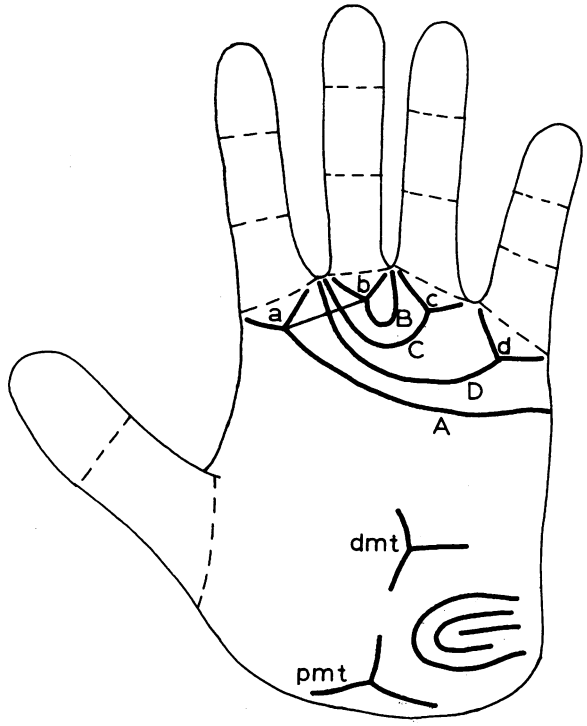

Figure 5.—Position of various triradii of the hand.

digital area is usually patternless. The frequency of patterns in interdigital area II was found to be 11.8 percent by Cummins and Midlo,[2] and the frequency of patterns in interdigital areas III and IV was 53.6 percent and 60.5 percent, respectively. In our patients, the thenar-first interdigital area was patternless except for the left palms of two patients; one patient had an interdigital area II pattern on the right palm and another had an interdigital area II pattern on both palms. The frequency of interdigital areas III and IV patterns among our patients was 53.3 percent (16 of 30) and 77 percent (23 of 30), respectively, suggesting an increase in frequency from the normal in the fourth interdigital area (Table 3).

Soles

Sole prints were obtained for ten patients. All of them had patterns in the hallucal area of both feet, except one patient who had an arch tibial on the left sole. Of the 19 hallucal patterns observed, five were complex patterns such as spiral whorls or lateral pocket loops, suggesting an increased frequency of complex patterns. The remainder were all distal loops. Very few studies are available on dermatoglyphics of soles and further analysis is necessary.

TABLE 3.—*Interdigital Palmar Patterns of Patients*

	Hypothenar		*Th/I*		*II*		*III*		*IV*		*a-b ridge count*
	R	L	R	L	R	L	R	L	R	L	
B.B.	+	+	−	−	−	−	+	+	+	+	80
P.C.	+	+	−	+	−	−	+	+	+	+	82
W.E.	+	+	−	−	−	−	+	+	+	+	85
B.K.	+	+	−	−	−	−	+	+	−	+	81
J.M.	+	+	−	−	−	−	−	−	+	+	79
D.M.	+	+	−	−	−	−	+	−	−	+	75
D.P.	−	−	−	−	+	−	−	−	−	+	65
G.R.	−	−	−	−	−	−	−	−	+	+	89
E.S.	+	−	−	−	−	−	−	−	+	+	86
J.A.	−	−	−	−	+	+	+	+	+	+	46
E.M.	−	−	−	−	−	−	+	−	−	+	73
T.P.	+	+	−	−	−	−	+	+	+	+	76
M.R.	−	−	−	−	−	−	+	−	−	−	93
D.G.	−	−	−	−	−	−	−	−	+	+	113
J.J.	−	−	−	+	−	−	+	−	−	+	74

R Right Hand
L Left Hand
\+ Present
− Absent

Dermatoglyphics on Parents

Dermatoglyphics were performed on parents of eight of the 15 children. Prints were obtained from eight mothers and five fathers. Comparative data on the parents is tabulated in Tables 2 and 4. It is of interest to note that in the case of the three patients, E.S., J.A., and T.P., all of whom had a low incidence of complex patterns and a concomitant low total ridge count, it was the mothers who also showed a low frequency of complex patterns and a low total ridge count. All three fathers had complex patterns and high total ridge counts.

While two of eight mothers (D.M. and E.M.) had complex patterns on the fourth digit of both hands, three of five fathers had complex patterns on the fourth digit of both hands and the other two fathers had this feature on the right hand only. Eleven of 15 patients tested had this trait on one or both hands.

A single transverse flexion crease was present on the right hand of the mother of D.G. only. Fifteen percent (4 of 26) of the palms of the parents had a transitional transverse flexion crease, whereas 53 percent (16 of 30) of the palms of the patients had transverse flexion creases.

Except for line A, the main lines on all the parents were transversely oriented. All main lines were transversely oriented in the children.

TABLE 4.—*Interdigital Palmar Patterns of Parents*

	Hypothenar		*Th/I*		*II*		*III*		*IV*		*a-b ridge count*
	R	L	R	L	R	L	R	L	R	L	
Mother											
D.M.	−	−	−	−	−	−	−	−	−	+	65
G.R.	−	−	−	−	−	−	−	−	+	+	117
E.S.	−	+	−	−	−	−	−	−	+	+	83
J.A.	−	−	−	−	+	−	−	+	+	+	74
E.M.	−	−	−	+	−	−	−	−	+	+	94
T.P.	−	−	−	−	−	−	+	+	−	−	92
D.G.	−	−	−	−	−	−	−	−	+	+	112
J.J.	−	−	−	−	−	−	+	+	+	+	79
Father											
E.S.	−	−	−	+	−	−	+	−	−	+	90
J.A.	−	−	−	−	−	−	+	+	+	+	91
E.M.	−	−	−	+	−	−	+	−	−	+	76
T.P.	−	−	+	+	−	−	+	+	−	−	illegible
D.G.	−	−	−	−	−	−	+	−	−	+	80

R Right Hand
L Left Hand
\+ Present
− Absent

Whereas 30 percent (3 of 10) of the palms of male children whose fathers were examined had hypothenar patterns, none of their fathers had this trait. Forty-five percent (9 of 20) of the palms of the male children in the study had hypothenar patterns.

Sole prints were available on four parents, and only the father of T.P. had complex hallucal patterns on both soles. The mother of T.P. had a complex hallucal pattern on the right sole. The other patterns were all loops or arches. Whereas, as was previously mentioned, all the ten infants tested had patterns in the hallucal area (except for one foot on one patient), only one of the four parents tested had patterns in the hallucal area of both soles.

Comment

Achs and associates[7] pointed out that children with major congenital malformations have unusual dermatoglyphic markings, most frequently represented by simian lines, bilateral distal axial triradii, single flexion creases and radial loops on other than the second digit.

Stough and Seely[12] suggested that 40 to 50 percent of infants with congenital rubella have unusual dermatoglyphic findings including simian lines, distal axial triradii, radial loops other than on digit 2, complex patterns on the digits and an increase in patterns in the third interdigital area.

Since these findings also occur in various syndromes, such as mongolism, D trisomy, 18 trisomy and rubella, they have been considered non-specific indicators of altered embryonic development and not specific for a given syndrome.[7]

Because cytomegalic inclusion disease of infancy, like rubella, is associated with major abnormalities, such as microcephaly, hearing loss, prematurity and growth retardation, this study was planned to investigate the presence of unusual dermatoglyphic findings in children with this disease.

As expected, unusual dermatoglyphic findings were found and it is believed most likely that they indicate abnormal influences in early gestation.

As far as controls are concerned, it is inappropriate to match controls for age and sex. Age does not matter because once dermatoglyphics are formed they do not change except for size; and there is a low bisexual variation. The frequency in patterns in one population changes from gene pool to gene pool. Appropriate controls are parents, siblings and relatives. It is also considered appropriate to use what is considered "normal" frequencies from large samples within the genetic population.

Until recently, it was generally agreed that ridge counts, patterns and flexion creases were primarily under genetic control. Mulvihill and Smith[13] speculated that dermatoglyphics are a direct consequence of the surface topography of the fetal hand during the period of dermal ridge development.

Attempts were made to apply statistical methods to the results obtained in this study. No significance was demonstrated. Unfortunately, extremely small numbers were available for evaluation but we speculate that if the trend continues with larger numbers, results would most likely acquire significance.

The present study supports the concept that environmental teratogens such as the cytomegalovirus may significantly alter dermatoglyphics, and it also supports the suggestion that dermatoglyphics may serve as a marker of a deleterious intra-uterine experience during early gestation.

Summary

This investigation of the dermatoglyphics in children with cytomegalic inclusion disease indicates that such children have: (1) a high frequency of complex patterns on the fingers, (2) a high frequency of transitional transverse flexion creases, (3) transversely oriented palmar main lines, (4) a high frequency of complex hypothenar patterns with distal medial triradii, (5) a high frequency of patterns in interdigital areas III and IV, and (6) a high frequency of complex hallucal patterns on the soles.

Since these findings occur in other syndromes and in children with major malformations, they most likely indicate an unusual influence in early gestation and are not diagnostic for any one disease.

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CORONARY CARE UNITS' EFFECT ON MORTALITY

Can we demonstrate that the introduction of specialized coronary care units does reduce mortality from acute myocardial infarction?

The answer is yes. There has not been a decisive study to indicate the value of coronary care. However, in several cities of the world, Melbourne, Australia, Toronto, Canada, New York City, and Philadelphia, people were admitted to coronary care units on the basis of bed availability. Some went to general care; some went to coronary care. Nobody made decisions. When you examine the statistics from the hospitals involved, there is an advantage to coronary care as against ordinary care, a reduction in mortality of about 30 percent. That is, mortality drops from 30 percent to 20 percent.

Would you like to put those figures into context? How many people get to the point where they could enter a coronary care unit?

The percentage of people dying before they can be admitted to a coronary care unit has consistently been about 60 percent. Sixty to 70 percent of patients die outside the purview of the hospital. Then taking the survivors, 30 percent of those who are not put into a coronary care unit will succumb while 20 percent of those reaching so-called "ideal" facilities will die. That's not 20 percent of the total population; that's 20 percent of those reaching this special environment.

—Discussion on New Trends in Treating Acute Myocardial Infarction

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