Thrombotic Thrombocytopenic Purpura
A Disseminated Disease of Arterioles

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SYNDROME, characterized by the occurrence of widely disseminated “hyalin thrombi” in the terminal arterioles and capillaries of many organs, was described by Moschcowitz. From the study of 4 patients, Baehr, Klemperer and Schiffin concluded that the syndrome was a clinical and pathologic entity characterized by endothelial proliferation and the occurrence of platelet thrombi in the terminal arterioles and capillaries, especially prominent in the renal cortex, adrenals, myocardium and pancreas. It has been established by several investigators that the clinical findings consist of an acute onset, pyrexia, hemolytic anemia, thrombocytopenic purpura, and by bizarre mental and neurologic manifestations which are the result of disseminated arteriolar occlusion. In all cases studied thus far, with 2 possible exceptions, the course has been steadily progressive and fatal. It has occurred more often in females, but has been observed in both sexes, from youth to old age.

The clinical and pathologic findings of 2 cases are presented in this report. One patient had a clinical course different from any other case reported.

Case Reports

Case Report No. 1: Negro female, age 54 years, was admitted to the University Hospitals of Cleveland on November 12, 1949, complaining of weakness and dizziness. Three weeks before admission she experienced gradual onset of nausea, especially in the morning, accompanied by transient attacks of “light-headedness.” Shortly after the evening meal on the day of admission she vomited undigested food with small particles of blood. There had been no drug ingestion. She had had discoid lupus of the scalp for the past ten years and hypertension for four years. The family and past history were otherwise noncontributory.

Examination revealed a blood pressure of 165/105 mm. Hg. There were irregular areas of alopecia areata and vitiligo over the scalp. The sclerae were slightly icteric. A left lateral strabismus, present for many years, was noted. There were scattered inspiratory rales at the right lung base.

Laboratory findings: Urine specific gravity 1.012, 3+ albuminuria, large numbers of erythrocytes per H.P.F. Bile test (Harrison), negative. Hemoglobin, 10.1 Gm. per 100 ml.; erythrocytes, 3,490,000 per cu. mm.; leukocytes, 13,000 per cu. mm. Hematocrit, 31. Differential count: 70 per cent neutrophils, 5 per cent unsegmented neutrophils, 22 per cent lymphocytes, 3 per cent monocytes. Icterus index, 18 units. Microprecipitation test, negative for syphilis. Guaiac test on stool negative. X-ray examinations of chest, abdomen, gall bladder and kidney (retrograde pyelograms) were negative.

The leukocytes varied between 13,500 and 23,700 per cu. mm. On the ninth hospital day the temperature rose to 39.2 C., the patient vomited and became aphasic, confused, and disoriented. The next day she had a convulsive seizure with tonic movements of the right arm of fifteen minutes’ duration. The spinal fluid was clear and colorless, with a pressure...
of 330 mm. of water, contained 5 neutrophils and 8 erythrocytes, and had a protein content of 29 mg. per 100 ml. The hemoglobin fell to 6.2 Gm. per 100 ml.; erythrocytes to 2,200,000 per cu. mm. and the hematocrit to 17. The leucocyte count was 29,200 per cu. mm. and the blood film showed 22 normoblasts per 100 leukocytes. Reticulocytes, 10.5 per cent. The tourniquet test was strongly positive. Bleeding time (Duke), 17 minutes; clotting time (Lee-White), 7 minutes. No clot retraction in twenty-four hours. Platelet count, 17,280 per cu. mm. Aspirated sternal marrow showed hyperactivity of the erythropoietic series. The megakaryocytes were increased in number and platelet formation could not be seen. The saline fragility test demonstrated increased fragility of the erythrocytes (patient 0.56 to 0.38 per cent saline, control 0.42 to 0.34 per cent saline). Two hour urinary urobilinogen, 2.4 Ehrlich units. Fecal urobilinogen, 560 Ehrlich units per 100 Gm. with a control of 192 Ehrlich units. Serum protein, 7.1 Gm. per 100 ml.; albumin, 4.0 Gm.; globulin, 3.1 Gm. Serum bilirubin, 1.22 mg. per 100 ml., of which 0.3 mg. was direct. The cephalin flocculation test, negative on admission, became 4+ positive. Blood urea nitrogen, 16.9 mg. per 100 ml.; urea clearance, high normal (Cs = 118 and 111 per cent). Prothrombin content, 65 per cent of normal (Quick). The Coombs developing test was negative.

Repeated blood transfusions were given. Repeat reticulocyte counts were 11.4 and 11.3 per cent. The temperature varied from 37.5 to 39 C. The aphasia improved, but she remained disoriented and intermittently hypomaniac and stuporous. On the thirteenth hospital day the urine became grossly bloody and the stools were guaiac positive. On the seventeenth hospital day, splenectomy was performed, but the patient died during the operation.

Autopsy: Gross examination disclosed focal hemorrhage in the epicardium, myocardium, endocardium, larynx, trachea, renal pelvis and mucosa of the urinary bladder. The spleen, removed surgically, weighed 175 Gm. and appeared normal. The heart weighed 400 Gm.

Microscopic examination revealed widespread occlusion of arterioles, most frequent in myocardium, adrenal, esophagus and lymph nodes, but also present in lung, skin, skeletal muscle, genital system and spleen. These consisted of amorphous and finely granular material which stained pink with hematoxylin and eosin. In every instance, the occlusive mass was adherent to and continuous with the arteriolar wall at some point (figs. 1 and 2). At the point of adherence, the arteriolar wall was abnormal, being composed of the same amorphous pink-staining material as that seen in the occlusive masses. The entire wall of the affected vessels was often extremely thin and so distorted that it was possible to identify the type of vessel only by examining serial sections and demonstrating continuity with a normal segment of arteriole at either end of the occluded segment. In some of the occluded vessels the lumen was represented by an endothelial-lined crescentic slit as a result of displacement by a mass projecting inward from the vessel wall (figs. 1 and 2). The absence of fibrin within the occlusive masses was demonstrated by a negative phosphotungstic acid-hematoxylin stain. The periodic acid-Schiff reaction not only gave a positive reaction in the occluding material, but also gave a similar staining reaction throughout the segment of vessel wall in continuity with the mass in the lumen. The loss of both elastic tissues and smooth muscle in the wall of the affected arterioles was demonstrated with the elastic and Van Giesen stains.

Case Report No. 2: This white woman was 43 years old when first admitted to the University Hospitals of Cleveland on August 6, 1947. She had experienced gradual onset of weakness and lethargy one month before, followed by intermittent "chilly sensations," and, on one occasion, fainting when arising from bed.

On admission the temperature was 38.1 C. She was acutely ill, dyspeptic, and pale. The liver extended 2 cm. and the spleen 1 cm. below the costal margins.

Laboratory findings: Urinalysis was within normal limits. Erythrocytes, 1,080,000 per cu. mm.; hemoglobin, 3.8 Gm. per 100 ml.; hematocrit, 13.5; leukocytes, 10,450 per cu. mm. Differential count: 67.5 per cent neutrophils, 0.5 per cent basophils, 7.5 per cent unsegmented neutrophils, 0.5 per cent metamyelocytes, 14.5 per cent lymphocytes, 7.0 per cent monocytes, 2.5 per cent unidentified mononuclears. There were 20 normoblasts per 200 leukocytes. The platelets were slightly decreased in number as estimated from survey of a blood film. Reticulocytes, 14.5 per cent. Bleeding (Duke) and clotting (Lee-White) times, normal. Aspirated sternal marrow revealed marked erythroid hyperplasia. The megakaryo-
erythrocytes were considered to be normal in number and appearance. The saline fragility test showed increased erythrocyte fragility (patient 0.50 to 0.40 per cent saline, control 0.42 to 0.32 per cent). Blood urea nitrogen, 35.3 mg. per 100 ml. Serum protein, 7.4 Gm. per 100 ml., with albumin 3.5 Gm., globulin 3.9 Gm. Serum bilirubin, 0.25 mg. per 100 ml. Cephalin flocculation test, 4+ positive. Guaiac test on feces, negative. Gastric analysis showed 30 units of free HCl after histamine.

There was sustained fever of 38.0 to 40.5 C. during the first twenty-four hospital days. Despite administration of 7000 ml. of whole blood, there was no improvement in erythrocyte or hemoglobin levels. Reticulocyte counts varied from 28 to 54 per cent. Splenectomy was performed on the twenty-fourth hospital day because of the spherocytic hemolytic anemia. The spleen weighed 500 Gm. Gross and microscopic examination revealed multiple recent and old infarcts, and hyperemia. An organized thrombus was found in a small artery.

The patient had a stormy, febrile course, but had recovered by the twenty-first postoperative day, at which time the blood findings were: erythrocytes, 3,100,000 per cu. mm.; hemoglobin, 9.0 Gm., per 100 ml.; leukocytes, 13,800 per cu. mm. She received 3,300 ml. of whole blood during the postoperative period.

During the next two years the erythrocytes varied between 3,000,000 and 4,080,000 per cu. mm. Three months after splenectomy the blood pressure was recorded at 190/130 mm. Hg. She remained asymptomatic.
She was re-admitted to the hospital on June 30, 1950, in a semi-stuporous condition. Six months before the admission there had been gradual and progressive diminution of intelligence, poor memory, slovenly habits, and slowness of speech with subsequent apathy and lethargy.

On admission she was unresponsive and dyspneic with Cheyne-Stokes respiration. The blood pressure was 215/125 mm. Hg, the pulse rate 100 per minute. Cyanosis was present. The liver was palpable 5 cm. below the costal margin. The right extremities were flaccid, but capable of small motion on stimulation. The deep tendon reflexes were hyperactive. A Babinski sign was present bilaterally. The right pupil was larger than the left and both responded sluggishly and incompletely to light. Funduscopic examination revealed blurring of the nasal margins of both discs, arterio-venous nicking, and a striate hemorrhage below the left disc. There was flattening of the right naso-labial fold and sagging of the angle of the right side of the mouth.

Gross hematuria and 3+ albuminuria were present. The hemoglobin was 13.3 Gm. per 100 ml.; erythrocytes, 3,900,000 per cu. mm.; leukocytes, 11,500 per cu. mm. The differential count showed a predominance of adult neutrophils. Blood urea nitrogen was 46 mg. per 100 ml. The spinal fluid had an initial pressure of 270 mm. of water, 26 cells per cu. mm., of which 24 were erythrocytes, and protein content of 176 mg. per 100 ml.

Therapy included digitalization and oxygen administration. Four days after admission the temperature rose to 39 C. On the fifth day blood studies showed: erythrocytes, 4,560,000
per cu. mm.; hemoglobin, 12.8 Gm. per 100 ml.; leucocytes, 25,450 per cu. mm. of which 83 per cent were neutrophils, 6 per cent unsegmented neutrophils, 6 per cent lymphocytes and 5 per cent monocytes. Reticulocytes, 6.9 per cent. Platelets, 59,000 per cu. mm. Bleeding time (Duke), 9 minutes. Clotting time (Lee-White), 10 minutes. There was no clot retraction in twenty-four hours. The Rumpel-Leed test was strongly positive. Sternal marrow obtained by aspiration was hypercellular, with a left shift of the granulocyte series and a granulocyte to nucleated red cell ratio of 7.5:1.0. The megakaryocytes were increased in number. The Coombs developing test was negative. Serum bilirubin was 0.56 mg. per 100 ml.; cephalin flocculation, ++; thymol turbidity 1.8 units.

Sections of the spleen, removed three years previously, were re-examined and multiple thromboses of arterioles, previously disregarded, were demonstrated (figs. 3 and 4).

On the sixth hospital day, when the patient was completely unresponsive, a twenty-three day course of ACTH (Armour) was begun, with a daily dose of 20 mg. During the first ten days the temperature became normal, she responded by nodding and smiling, and dyspnea and cyanosis disappeared, allowing the discontinuance of oxygen therapy.

The saline fragility test was normal at this time. Reticulocytes decreased to 2.2 per cent.
Relapse began on the thirteenth day of ACTH therapy, in spite of continued administration. Fever recurred. Gross hematuria reappeared. The hemoglobin fell to 8.3 Gm. per 100 ml., erythrocytes to 2,900,000 per cu. mm., and the leukocytes increased to 36,000 per cu. mm. The blood urea nitrogen fell to 44 mg. per 100 ml.

During the seven days following the twenty-three day course of ACTH the patient continued to be febrile and became semi-comatose. Anemia and leukocytosis persisted. The reticuloctyes remained at about 10 per cent and the platelet count diminished to 86,520 per cu. mm.

During the last seven weeks of her life, she remained stuporous and febrile with tempera-
ture ranging from 37 to 39.8 C. Nine days before death blood values were: erythrocytes, 3,960,000 per cu. mm.; hemoglobin, 12.7 Gm. per 100 ml. (no blood transfusions were given); leukocytes, 18,400 per cu. cm. Platelets, 97,000 per cu. mm. with normal bleeding, clotting and clot retraction times. Reticulocytes, 5.9 per cent. Death occurred on September 25, 1950, eighty-seven days after hospital admission.

Autopsy: Hemorrhage was a prominent gross feature, especially in the skin and brain. In the right frontal lobe a hemorrhagic area measured 2 x 2 x 1 cm. and in the left occipital lobe another measured 3 x 3 x 2 cm. Each was confined to the medulla, extending to the cortex. In the skin, hemorrhages were present as ecchymoses on the neck, trunk, and extremities, the largest measuring 3 x 5 cm. Petechiae and ecchymoses were visible in the cortex and pelvis of both kidneys and in the mucosa of the urinary bladder.

Old infarcts occupied large areas of the left parietal and right occipital lobe of the cerebrum. A more recent infarct of the upper lobe of the left lung had undergone liquefaction necrosis and appeared as an abscess 1.2 cm. in diameter. Another old infarct of the terminal ileum resulted in a chronic ulcer measuring 1 x 1.5 cm. Occluded vessels were identified by gross examination in the last two instances.

The spleen, removed three years previously, weighed 500 Gm. and contained old and
recent infarcts. The heart weighed 480 Gm. The anterior and posterior leaflets of the mitral valve both had firmly attached, pink, verrucous vegetations measuring 1.4 x 0.5 x 0.2 cm. An anatomically patent foramen ovale had a few small pink, firmly attached vegetations along the margin in the right atrium. In addition, there were hyperemia and edema of the lungs, hyperplasia of the femoral marrow, a small prepyloric gastric ulcer, irregular cortical atrophy of the kidneys and nodular cortical hyperplasia of the adrenals.

The significant microscopic finding was widespread occlusion of arterioles and small arteries involving nearly every tissue of the body. In some instances the occlusive material was eosinophilic, amorphous and finely granular and covered with endothelial cells. In many sites, it could be shown by serial sectioning that the material occluding the lumen was continuous with similar material located subendothelially in the vessel wall, as was true in the first case (fig. 6). The Van Giesen stain demonstrated the absence of both elastic and muscle fibers of the vessels in involved areas. The occlusive material and degenerated areas of the vessel stained identically with the periodic acid-Schiff reagent. In some instances, the occlusion contained numerous small mononuclear cells, but collagen formation was absent. The normal structure of the vessel wall was absent, frequently, at these sites, with...
marked thinning of the walls and dilatation of the vessel with formation of occluded aneurysms. There was no inflammatory reaction associated with these lesions.

The changes were especially prominent in the vessels of the cerebrum, leptomeninges (fig. 5), myocardium (fig. 6) and spleen (figs. 3 and 4). In the cerebrum, there were associated subcortical hemorrhages with cortical and medullary infarctions. Focal fibrosis was present in the myocardium. Occlusive vascular lesions were found in 4 of 6 groups of lymph nodes examined. Other sites with demonstrable lesions included the pancreas, adrenals, skin, mesentery, kidney, liver, femoral bone marrow and stomach. Only one lesion was found in the lungs and none could be demonstrated in skeletal muscle.

The vegetation on the mitral valve (figs. 7 and 8) consisted of hyalinized fibrous tissue with superimposed amorphous, granular, neutrophilic material. Bacteria were not present.

In addition to the occlusive lesions, there was a diffuse, moderate, interstitial nephritis, and moderate arteriolar nephrosclerosis. The islets of Langerhans were hyperplastic and the adrenal cortex was nodular and thicker than usual. Basophils were numerous in the pituitary and some were enlarged and had granular and vacuolated cytoplasm.

DISCUSSION

As pointed out by Singer et al., this syndrome and its clinical manifestations are the result of three distinct phenomena which do not occur together in any
other clinical entity: (1) hemolytic anemia, (2) thrombocytopenic purpura, (3) signs due to occlusion of small arterioles, usually manifested clinically by focal neurologic changes and mental aberrations.

In cases studied previously, the onset has been abrupt, and the course violent, short and fatal. The onset has occasionally been preceded by an upper respiratory infection. The first complaints, often vague, include malaise, weakness, nausea, vomiting, headache, dizziness, arthralgia and myalgia. Convulsions, stupor and coma appear as the condition becomes more fulminating. Low-grade fever and pallor are present early, followed by icterus, petechiae, ecchymoses and epistaxis. Moderate splenomegaly and hepatomegaly are usually present. Mental and neurologic signs are constant and develop as the fever increases. There may be signs of focal involvement such as hemiplegia, aphasia or cranial nerve paralysis, as well as those of generalized cerebral involvement with delirium, muttering and hypomanic activity. Some of these signs may be transitory, but their occurrence has been associated with the terminal stage of the disease.

Laboratory examination reveals the combination of hemolytic anemia and
thrombocytopenic purpura. The hemolytic anemia is accompanied by the usual findings of hemolysis, including reticulocytosis, nucleated red cells in the peripheral blood, erythroid hyperplasia of the marrow, and increased output of urobilinogen. It was not possible to demonstrate abnormal agglutinins in the blood nor was the Coombs test positive, findings in agreement with those of Singer. Similarly, while spherocytosis was demonstrated by the one fragility test performed on Case 1, it was variable from time to time in Case 2, a variation observed by others. The ultimate mechanism of the hemolytic process has not been delineated.

The thrombocytopenia is accompanied by the laboratory findings considered to be diagnostic of so-called idiopathic thrombocytopenic purpura. In these 2 patients, the numbers of megakaryocytes in the marrow were increased, immature forms were present, and, unlike the observations of Singer, platelet formation was inhibited. It is the authors' belief, in fact, that the thrombocytopenia is not the result of deposition of large numbers of platelets in the occluded vessels, but may be the result of a process similar to that producing idiopathic thrombocytopenic purpura. There is no universal agreement concerning the mechanism of this process, although there is little doubt that the spleen is involved in some manner. It seems likely to us that the abnormal splenic mechanism responsible for the production of idiopathic thrombocytopenic purpura was also operating in these patients.

Singer et al. have discussed the possible relationship of the syndrome to polyarteritis nodosa, lupus erythematosus and to certain clinical and experimental hypertensive states. From a study of 2 patients, Beigelman has also proposed that the platelet thrombosis syndrome be placed in the same category as the collagen diseases.

Our histologic observations on the present 2 cases support the concept that the degenerative lesion of vessels is primary and in this respect the syndrome is similar to the so-called collagen diseases. This raises the question of whether the occlusive material in the involved vessels actually consists of agglutinated platelets. Review of the evidence upon which such an impression is based reveals that the absence of erythrocytes, hemoglobin, leukocytes and fibrin in the lesions led to the conclusion that the material must consist of platelets, by exclusion. The presence of platelets at the margins of the occlusions and Gore's observation that both the occlusive material and platelets gave positive reactions with the periodic acid-Schiff test supported this impression further. Since this reaction is positive in many types of tissues involving degenerative changes in vessels, it cannot, however, be considered specific. Thus, there is no conclusive positive evidence that the occlusions are composed of platelets.

In an attempt to identify or exclude platelets specifically, comparative cytochemical reactions were performed on centrifuged platelets, the vascular occlusions of Case 1, and on certain degenerative vascular lesions (arteriolar necrosis, polyarteritis and amyloid in vessels). Since no specific reaction is known for platelets in tissues, these tests were performed to compare the reaction of platelets with that of other tissues. The Feulgen reaction and methyl green stain were negative in all of the tested tissues, indicating the absence of nucleic acids. The fast green stain, which identifies a basic substance, and the
periodic acid-Schiff reaction, which indicates the presence of a polysaccharide, were positive in all the tissues tested. The toluidine blue test, to demonstrate metachromasy, was positive in the case of the platelets, the vascular occlusions of Case 1 and amyloid in vessel walls, but was negative in arteriolar necrosis and polyarteritis. Thus, none of these tests are specific, and in themselves, do not prove or disprove that platelet material is present in the occlusive lesions. Nevertheless, it should be stated that, insofar as studied, platelets and the material in the vessels showed parallel reactions.

Evaluation of certain prominent histologic features of these 2 cases, however, make it seem unlikely that the occlusive lesions were composed only of platelets. The amorphous material present in these vessels was almost always covered by endothelium, suggesting that it was degenerated and swollen material enroaching upon the lumens from the vessel wall and not an intraluminal thrombus. Further support for this view is provided by the fact that the same material was seen frequently throughout all layers of the vessel wall and occasionally even in the surrounding connective tissue. At these sites, it replaced completely the normal structures. A unique, and perhaps pathognomonic, feature of the vascular lesions, which will be the subject of another report, was the finding of multiple aneurysms of the arterioles and precapillaries containing both the amorphous material and masses of proliferated endothelial cells. In no instance was an exudative reaction a feature of the lesions. The characteristic finding, therefore, was a nonexudative lesion which partially replaced the vessel wall and resulted in aneurysm formation. It is our opinion that these histologic changes can be explained only by a degenerative change in the vessel wall and that the presence of platelet thrombi alone would not be expected to produce such lesions. While platelets could not be specifically identified in, or excluded from, the lesions on the basis of staining, these studies present strong histologic evidence that much, if not all, of the material in question represents an intramural degeneration rather than an intraluminal coagulum.

Case 2 indicates that not all cases are rapidly and progressively fatal. There is little doubt that her course lasted at least three years, since re-examination of the spleen removed three years before death revealed characteristic lesions identical with those demonstrated at necropsy in other organs. Subsequent to splenectomy, the anemia was markedly alleviated and the patient maintained a remission for twenty-eight months, although hypertension developed during that time. Whether the remission was spontaneous or the direct result of the splenectomy can be proven only by further experience. Splenectomy has been performed in similar patients in only 3 other instances and, in each case, death occurred shortly after operation before any therapeutic effect could be evaluated. Muirhead et al. believe that splenectomy has not received a fair trial.

The effect of ACTH therapy is difficult to interpret. There was clinical and hematologic improvement during the first ten days of therapy with subsequent severe relapse while the drug was continued. The dose used was not large, however, and larger doses might have prolonged the remission. In this connection, the problem arises whether vigorous hormone therapy might cause rapid healing and fibrous obliteration of affected vessels as has been observed in cases of polyarteritis nodosa treated with cortisone, in which great numbers of small in-
farcts have occurred throughout the body. It is possible that both splenectomy and ACTH therapy induced remissions in Case 2.

This is an acute febrile syndrome involving primarily the vascular and hematopoietic systems. The triad of hemolytic anemia, thrombocytopenic purpura and clinical neurologic abnormalities resulting from small vessel occlusion should suggest the diagnosis. Lymph node biopsy might confirm the diagnosis, but enlarged lymph nodes, suitable for biopsy, were not present in these or other reported cases. The muscle has not shown characteristic histologic changes. In our second patient, on the other hand, vessels in the skin contained characteristic lesions so that skin biopsy might be of diagnostic value in subsequent cases.

The application of a suitable name which would include the hemolytic anemia, thrombocytopenia and the vascular phenomena becomes a problem, especially since we do not believe that the thrombocytopenia is the result of massive sequestration of platelets in the occlusive lesions, nor has the mechanism of the hemolytic process been delineated. The degenerative process in the walls of arterioles and capillaries appears to be the primary vascular lesion. The term thrombotic thrombocytopenic purpura has been suggested. This term does not describe the essential components of the syndrome and is, we believe, inaccurate, in that the occlusive lesions are not thrombi. Nevertheless, the term has already acquired some popularity, is short and alliterative. A term describing all the components of the syndrome would be unwieldy, and an alternative of applying a proper name is generally objectionable. We propose that the term, thrombotic thrombocytopenic purpura, be retained until a better understanding of the pathologic physiology of the condition permits the application of a more suitable name.

SUMMARY

1. Two patients with a syndrome of hemolytic anemia, thrombocytopenic purpura and arteriolar occlusions are described.
2. In one patient, a long remission followed splenectomy, and improvement for ten days followed the administration of ACTH. No claim is made that either form of therapy induced the remission, but trial of these procedures in other cases is indicated.
3. Evidence is presented that the primary vascular lesion is a degenerative process in the arteriolar and capillary walls rather than thrombus formation in the lumen of the vessel. The occurrence of aneurysms in arterioles and precapillaries was a striking observation.
4. The histologic changes suggest a relationship to the so-called collagen group of diseases.
5. It is suggested that the term, thrombotic thrombocytopenic purpura, be retained until further study of the conditions permits application of a more suitable name.

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