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Studies of Pectin Administration to Patients Not in Shock.*

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Pectin solution as a plasma substitute has been recommended by Hartman *et al.*[1,2] They demonstrated its effectiveness in experimental shock and in the prevention and treatment of shock in man. It was furthermore shown that pectin raises the plasma volume.[3]

To evaluate the usefulness of pectin solution as a plasma substitute, we studied its ability to cause hemodilution, which is a basic requirement of a plasma substitute; in addition, any untoward results following its administration were looked for, especially pseudo-agglutination of the erythrocytes. The latter has been considered an important contra-indication to the use of plasma substitutes.[4,5]

For better comparison, this study was made on 20 convalescent patients not in shock. Eight patients received a 0.75% and 12 a 1.5% solution of pectin‡ in approximately 90 minutes. The following were determined before and after the administration of pectin: (1) Arterial and venous pressure, and (2)—on venous blood drawn without tourniquet and placed into test tubes containing heparin§—hemoglobin, hematocrit, total protein (by the falling drop method), albumin and globulin (by Nesslerization), non-protein nitrogen, and sedimentation rate. Furthermore, complete hematologic data were obtained from 6 patients before and after pectin administration.

For comparison with pectin, 12 patients received a few days before or after the pectin administration, 1,000 cc of 2.5% dextrose in 0.4% saline intravenously in a period of 90 minutes.

As seen in Table I, after pectin administration the hematocrit, hemoglobin, and the total protein concentration and N.P.N. of the plasma decreased consistently, hemoglobin to a lesser degree. An increase of the mean corpuscular hemoglobin concentration was found in many instances. The albumin-globulin ratio did not change significantly. Systolic and diastolic arterial pressure and venous pressure rose in most instances. The sedimentation rate which was not at a normal level in a number of cases at the beginning of the experiment, because of the underlying disease, rose invariably. All reported constants usually returned to normal within 24 hours, in a few instances in 48 hours. The sedimentation rate, however, was sometimes found markedly elevated, even after 48 hours. Hematologic examinations revealed rouleau formation in 5 out of 6 patients and was present up to 72 hours. No other significant hematological changes were found.

Fifteen of the patients had received, prior to and following the pectin administration,

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1 Hartman, F. W., Schelling, V., Harkins, H. N., and Brush, B., *Ann. Surg.*, 1941, **114**, 212.

2 Hartman, F. W., Schelling, V., Harkins, H. N., Brush, B., and Warren, K. W., Scientific Exhibit, A.M.A., Atlantic City, 1942.

3 Jacobson, S. D., and Smyth, C. J., PROC. SOC. EXP. BIOL. AND MED., 1942, **50**, 218.

4 Hanzlik, P. G., and Karsner, H. T., *J. Pharm. and Exp. Therap.*, 1920, **14**, 379.

5 Ivy, A. C., Greengard, H., Stein, I. F., Jr., Grodins, F. S., and Dutton, D. F., *Surg., Gynec. and Obst.*, 1943, **76**, 1.

‡ The pectin solution was obtained from Frederick Stearns and Company and is described as having a molecular weight of between 40-60,000, the 1.5% solution in Ringers' having an oncotic pressure slightly greater than that of human plasma and a viscosity less than that of whole blood. Before administration, the acid solution was buffered with sodium phosphate or sodium lactate to a pH of 7.2.

§ The heparin used was provided by Hoffman, LaRoche Company (Liquaemin).

TABLE I.
Results of Intravenous Administration of Pectin (20 Patients) and of Dextrose and Saline (12 Patients).

Determination	Preliminary (avg)	% of change following administration of 1000 cc of pectin	% of change following administration of 1000 cc dextrose (2.5%) and saline (0.4%)
Total protein (g %)*	7.18	—12.9	— 5.1
A/G ratio	1.41	0	0
Hematocrit, %	43.8	— 9.8	— 4.2
Hemoglobin, g	14.0	— 5.0	
Red cell count	4.45		+ 1.7
Sedimentation rate, mm/hr	53.2	+46.6	+ 6.1
Venous pressure, cm	12.2	+22.1	+15.5
Arterial blood pressure:			
Systolic	123	+14.8	
Diastolic	78.8	+19.6	

* Determined by Barbour-Hamilton Falling Drop Apparatus.

Evans Blue (T-1824) in total doses of as much as 90 mg intravenously without demonstrating the hemorrhagic diathesis reported by others.[3] Hematologic studies failed to reveal such complications.

In none of the cases were reactions observed following the intravenous pectin injections. There was no rise of temperature, no significant change in pulse rate, fever or chills.

The urine output during the pectin (1.5%) administration increased in 8 cases by 500 to 600 cc without a consistent change in protein or nitrogen excretion.

In the patients receiving dextrose and saline solution the total protein and hematocrit were only slightly reduced at the end of 90 minutes; the sedimentation rate rose slightly and the venous pressure moderately.

Discussion. From these studies it appears that pectin solution in the form given is an effective hemodiluting agent in patients not in shock, producing slight rise of arterial and venous pressures. Its hemodiluting effect is much more marked and prolonged than that of dextrose and saline solution and is more marked in the hematocrit than in the hemoglobin determination, which suggests the possibility that part of the reduction of the hematocrit is not true hemodilution but shrinkage of the red cells. The increase in the sedimentation rate due to rouleau formation caused by pectin solution is marked but the resulting sedimentation velocity is not in excess of that commonly found in infections. Whether that represents a contraindication to the use of pectin in the form given must be decided by further studies. Other untoward results were not encountered.

Similar studies using pectin solution in patients in shock are in progress and will be reported separately.

Conclusion. Pectin solution is an effective hemodiluting agent in patients not in shock. It lowers total plasma protein, hematocrit, hemoglobin, and plasma non-protein-nitrogen. It raises the venous and arterial pressure slightly and the sedimentation rate of the erythrocytes markedly.