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## Sclerosing Substances. Effect on Vascular Endothelium.

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Injection of varicose veins has become the most popular form of treatment in this condition. Different sclerosing substances have been used to produce endothelial injury and thus cause an obliteration of the vein by the production of an intravascular coagulum.

We attempted to compare the relative effects of a group of sclerosing substances which have been employed clinically. That the results obtained are not exactly comparable with those obtained in the clinic is obvious, as the changes occurring in a normal vein following the injection of an irritating substance will undoubtedly be less marked than those occurring in an already diseased vessel. Twenty different sclerosing agents were injected into the internal saphenous or the cephalic veins of normal dogs. Sections were removed after one-half, one, 3, 6, 12, 24, and 48 hours; 3, 4, 6, 10, and 14 days; 3, 4, 6, and 8 weeks. Each section was examined histologically, employing hematoxylin and eosin; Weigert, Mallory connective tissue, and Sudan III stains.

The amount of endothelial injury varied considerably from complete destruction to little or no change. Almost invariably, the greatest amount of destruction was noted within the first hour. Whereas most of the sections removed at one-half hour to 4 day intervals showed rather extensive change, those sections removed after 4 days showed relatively little change, indicating a marked tendency toward regeneration between the fourth and sixth days. In spite of extensive endothelial injury as evidenced within the first 4 days, the incidence of thrombus formation was relatively low as only 28 fibrinous coagula and 11 fibrous, or organized, coagula were found.

The average amount of destruction produced by the different sclerosing substances in order of their severity is shown in Chart I.

All except sodium salicylate, 15%, invertose, 50%, glucose, 66%, and phenol, 1%, produced fibrinous coagula. Glucose, 66%, invertose, 50%, mercuric iodide, 1%, phenol, 1%, invertose, 50%, and sodium salicylate, 10%, and invertose, 75%, and sodium salicylate, 20% developed fibrous coagula. The greatest number (3) of organized or fibrous coagula were caused by sodium salicylate, 40%. Sodium salicylate, 30%, and sodium chloride, 10%; quinine

CHART I.
Average Destruction of Endothelium.*

| Solution Used. | Average Destruction |
|---|---|
| | % |
| Sodium salicylate, 40% | 58.7 ± 2.33 |
| Quinine and Urethane | 58.1 ± 2.64 |
| Sodium salicylate, 30%, sodium chloride, 10% | 53 ± 2.28 |
| Sodium chloride, 25% | 48.4 ± 1.89 |
| Sodium salicylate, 30% | 41.8 ± 2.21 |
| Bichloride of mercury, 1% | 33.6 ± 2.34 |
| Sodium chloride, 20% | 33.4 ± 1.24 |
| Invertose, 75% | 31 ± 2.51 |
| Calorose | 28.6 ± 1.78 |
| Invertose, 75%, sodium salicylate, 20% | 28.5 ± 1.29 |
| Glucose, 66% | 27.6 ± 1.54 |
| Invertose, 50%, sodium salicylate, 10% | 27.1 ± 1.12 |
| Biniodide of mercury, 1% | 19.1 ± 0.96 |
| Iodine, 1%, potassium iodide, 1% | 13.1 ± 1.52 |
| Phenol, 1% | 12.1 ± 1.33 |
| Sodium salicylate, 20% | 9.8 ± 2.2 |
| Sodium salicylate, 15% | 8.7 ± 1.99 |
| Glucose, 50% | 8.1 ± 0.65 |
| Invertose, 50% | 6.2 ± 1.85 |
| Sodium chloride, 15% | 1.8 |

*The average in each instance is based on 16 observations each made one-half, one, 3, 6, 12, 24, and 48 hours; 3, 4, 6, 10, and 14 days; 4, 6, and 8 weeks after intravenous injection of sclerosing substances.

and urethane; mercuric chloride, 1%, each produced 2 fibrous coagula; whereas invertose, 75%, and calorose each was responsible for the production of an organized thrombus. Canalization occurred in all the fibrous coagula.

*Conclusions.* Whereas the destruction of endothelium is responsible for the development of sterile thrombi following injection of sclerosing substances, the extent of the destruction does not necessarily indicate the degree of thrombosis. In spite of extensive destruction of endothelium, coagulation occurs relatively infrequently, but usually between the fourth and sixth days a regeneration of the endothelium occurs so that the vessel again becomes lined with a normal endothelium. This and the fact that canalization invariably occurs in the artificially produced thrombi possibly account for recurrences following the injection treatment of varicose veins.