In this letter to the Editor of the *Tri-State Medical Journal*, Dr. Klenner states that ascorbic acid given intravenously is the "treatment of choice in carbon monoxide poisoning." He offers a biochemical model that might help explain ascorbic acid's effectiveness. He also suggests intravenous ascorbic acid is effective in treating barbiturate poisoning and puerperal sepsis caused by abortion.—*R.D.M.*

The Role of Ascorbic Acid in Therapeutics

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Ascorbic acid continues to play an important role in therapeutics. We have found ascorbic acid to be the treatment of choice in carbon monoxide poisoning, acute and chronic. A paper dealing with this, using dogs, will be sent for your consideration within the next several months. Since lives might be saved through this knowledge in the interim, a brief summary of the chemistry is in order. Hydrogen transport is of considerable importance in oxidative processes. Ascorbic acid serves well in this capacity. "Perfectly dry carbon monoxide and oxygen cannot unite to form carbon dioxide, but carbon monoxide and water may give rise to carbon dioxide in the complete absence of oxygen. The reactions which take place are: $CO+H_2O \rightarrow HCOOH \rightarrow CO_2+H_2$ (Wright)." It is obvious that the oxygen of the water has been used to oxidize carbon monoxide to carbon dioxide with the liberation of hydrogen. It is true that hydrogen and oxygen remain tenaciously united, but if a *hydrogen acceptor* is available to take up the hydrogen, the oxygen becomes available for oxidative purposes. Glutathione, a tripeptide composed of cystine, glycine and glutamic acid, is available and "may facilitate cellular oxidation by acting as a hydrogen acceptor (Hopkins)," thus serving in the role of a catalyst to speed up the break-down of water.

Whenever ascorbic acid is given intravenously there is an immediate, spontaneous reaction in which it *drops* two molecules of water to form dehydroascorbic acid. Ascorbic acid further serves to make all cellular membranes more permeable. This *released* water is utilized in the reaction described above. The oxygen from this reaction not only joins up with the carbon monoxide, but also acts to increase the oxygen pressure. This increase in oxygen pressure is *assisted* by the accumulation of the 'newly and rapidly formed carbon dioxide,' which, in turn, tends to stimulate the respiratory center. This mass action displaces the carbon monoxide from its union with haemoglobin, restoring a normal state of the blood. The rapid formation of carbon dioxide and oxygen serves the same purpose as if the patient were given 7% carbon dioxide with 93% oxygen to breathe. The concentration of carbon dioxide never becomes pathological, since in the presence of a trace of alkali some of the carbon dioxide will combine to form carbonate, thus being displaced from solution. Blood *does* contain *alkali*, assuring this reaction. Some

of the released oxygen also becomes available for tissue utilization, counteracting the depressing action of CO-Hgb. on the dissociation curve of the functioning haemoglobin which is still present.

Another valuable use for ascorbic acid is in barbiturate poisoning. In our experience with a patient weighing 134 pounds, who had taken a lethal dose of a barbiturate, it apparently was the difference in the patient living. He was awake in 40 hours and fully recovered in 72 hours. 900 mg. of ascorbic acid per Kg. of body weight was given intravenously, in divided doses, the first 24 hours. 500 mg. per Kg. body weight was used in subsequent 24-hour periods, also given in divided doses. In this case ascorbic acid was used in conjunction with strychnine sulfate and metrazole given intra-muscularly and picrotoxin in isotonic salin given as a continuous drip (In this instance 64 mg. was given. All in the first 18 hours of treatment).

In another case, using 1200 mg. per Kg. of body weight the first 12 hours, in divided doses, and 600 mg. per Kg. body weight in subsequent 24-hour periods, in divided doses, a patient with advanced puerperal sepsis following a criminal abortion was *returned* to normal in 9 hours. Penicillin, sulfadiazine and I.V. Achromycin were also employed. The rapidity in which the pathology was reversed can hardly be attributed to these other antibiotics alone. This patient entered the hospital with 105.4° F. and in 9 hours it was 98.6° F. and remained so throughout the uneventful hospital stay.