2000 Vinyl chloride

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ANESTHESIA XXVII. NARCOSIS WITH VINYL CHLORIDE *†

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IN our studies on various volatile organic compounds available as inhalation anesthetics, our attention was directed to vinyl chloride. Vinyl chloride is an industrial chemical used in the synthesis of many organic compounds. The substance is a gas which boils at −18 C. It is soluble in the etherial solvents and its vapors are combustible.

Vinyl chloride was suggested as an anesthetic by Patty, et al. (1) and tried on human subjects by Schaumann (2). Patty's experiments on guinea pigs revealed that the action of vinyl chloride was similar to that of ethyl chloride and less harmful than either chloroform or carbon tetrachloride. According to Schaumann the narcotic limiting concentration for man is 7 to 10 per cent; 12 per cent is dangerous. In our studies, planned to give a first approximation of the anesthetic syndrome of vinyl chloride, we suggest that this compound not be used as an anesthetic in man.

Chemotherapeutic Considerations: There is a dictum in pharmacology (3) that potency and unsaturation parallel each other among analogous organic compounds. This holds for ethane and its more potent analogue, ethylene. It is also true for ethyl ether and its more potent analogue, divinyl ether. Therefore, one might expect that vinyl chloride would be a more potent anesthetic than its analogue, ethyl chloride. This relationship, however, appears not to obtain between these two chlorinated hydrocarbons. With ethyl chloride, 3.6 to 4.5 volumes per cent (4) are required for anesthesia with 20 mg. per cent in the blood. Schaumann (2) used 7 to 10 volumes per cent of vinyl chloride to produce anesthesia and found 17 to 20 mg. per cent in the blood. Our observations in dogs conform well to the indication of these data, namely, that there is little difference in potency between the saturated and the unsaturated analogues, and actually ethyl chloride appears to be the more potent.

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Observation Anesthesias in Dogs: Two dogs were anesthetized with vinyl chloride * using mixtures of the gas and oxygen. For induction the concentration of the gas momentarily was allowed to run to 50 volumes per cent and then reduced to 7 volumes per cent. Induction was rapid. There was continuous "crowing" even under deep anesthesia. There was much salivation. Abdominal relaxation was good, but the legs showed rigidity and incoordinated leg movements throughout the anesthesia. The recovery period was prompt but accompanied by violent excitation.

In a third dog anesthesia was produced using 25 volumes per cent momentarily, and a similar syndrome ensued.

Blood Pressure in Dogs: Four dogs were prepared for blood pressure tracings by cannulating the femoral artery. The operation was performed under monocaine hydrochloride local anesthesia. After a normal blood pressure tracing had been obtained, the animals were anesthetized with vinyl chloride-oxygen mixtures, using 10 volumes per cent of the former. In all 4 cases the magnitude of the blood pressure remained within normal limits during anesthesia. There was definite evidence of cardiac irregularity, however, such as intermittent tachycardia, extraventricular systoles and vagal beats. These irregularities disappeared upon changing the anesthetic to ethyl ether. These cardiac disturbances confirmed our stethoscopic observations on the unoperated dogs.

Electrocardiographic Studies in Dogs: Six dogs were anesthetized with vinyl chloride-oxygen mixtures, using 10 volumes per cent of the former. Electrocardiographic records, lead II, were made at light surgical anesthesia, surgical anesthesia and threatened respiratory collapse. All of the animals manifested marked changes in cardiac rhythm in surgical anesthesia. Marked tachycardia followed by bradycardia was typical. In 2 of the 6 animals the R-spike was inverted during surgical anesthesia and in 1, evidence of incipient ventricular fibrillation obtained. Inversion of the R-spike with bradycardia is shown in the record from dog 6, lead II, chart 1.

Abnormalities in the QRS complex were found in all 6 dogs varying from sinus arrhythmia and transitory extreme left axis deviation to very serious conditions including auriculoventricular block, ventricular

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* The vinyl chloride used in these studies was prepared for us especially purified by H. B. Smith of Petroleum Chemicals, Inc., Baltimore, Md. It was stabilized with 0.5 per cent of p-tertiary butyl catechol. The compound was purified as follows:

"Vinyl chloride of 97.4% by weight purity containing 2.6% by weight trichlorethylene, 3.5 ppm. of acetylene, and no free acidity was carefully distilled to remove trichlorethylene. The distilled vinyl chloride was washed with cuprous ammonium chloride, phosphoric acid, and dried over pelleted potassium hydroxide. The purified vinyl chloride was found to have the following specifications:

Acetylene: None by cuprous ammonium chloride test.
Free Acidity: None.
Ammonia: None.
Trichlorethylene: Trace."

tachycardia, ventricular multifocal extra systoles, and inversion of the T-wave with elevated ST segments in lead II. As anesthesia progressed toward respiratory failure, most of the QRS abnormalities disappeared but the R amplitude was greatly reduced.

Normal
Lead II

Vinyl Chloride Anesthesia
Lead II

CHART 1

Two dogs under ethyl chloride anesthesia and the same experimental conditions showed a lowering of blood pressure and progressive bradycardia without arrhythmias. In 1 animal a brief period of left axis deviation appeared during the induction phase.

SUMMARY AND CONCLUSIONS

1. Vinyl chloride has been studied as an anesthetic in the dog.
2. The anesthetic syndrome is marked by incoordinated muscular activity in the extremities.
3. In 6 dogs cardiac arrhythmias of a serious nature were observed.

It is our opinion that, as an anesthetic in the dog, vinyl chloride is unsafe and that its use in man is unwarranted.

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