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The Influence of Poly-Vinyl-Chloride Tubing on the Isolated Perfused Rat's Heart

Preliminary Communication

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Poly-vinyl-chloride (P.V.C.) tubing may decrease cardiac performance within a few minutes. A simple method for testing P.V.C. tubing utilizes the isolated rat's heart perfused by the *Langendorff* technique.

Over a period of several years, we have performed hundreds of experiments on the perfused isolated rat's heart [1] and encountered no difficulty [4]. In 20 experiments, contraction height and frequency of the preparation reflected by the "inducto-cardiogram" [3] were

unchanged over six hours or more. Owing to circumstances it was necessary to rebuild our set up and in the rebuilding we used P.V.C. tubing instead of glass.

After the reconstruction, over 50 experiments were unsuccessful. Premature cardiac arrest and ventricular fibrillation occurred. The first sign of deterioration of the heart was diminished height of contraction which occurred after 3 to 5 minutes of perfusion. Calcium, adrenaline, strophantine and aminophylline, added to the perfusion fluid, were ineffective in combatting the deterioration. A thorough investigation of the perfusion fluid did not reveal any change in composition. Perfusion pressure and temperature were kept constant throughout all experiments.

It seemed possible that the poly-vinyl-chloride tubing could be the responsible factor [2, 6, 5]. In experiments to test this possibility all factors were kept constant and provision was made for alternate perfusion through glass and P.V.C. While hearts were perfused through glass the contractions were constant and the electrocardiogram did not change. During perfusion through the P.V.C. tubes A (see table I) the mechanical activity diminished within 3 to 5 minutes in all hearts studied. If glass perfusion was restored, the contractions increased, but never reached the prepoly-vinyl-chloride perfusion level. In all cases with this kind of P.V.C. we could demonstrate a progressive deterioration of contraction. The effects of P.V.C. perfusion were partially additive. In most cases alternate glass - P.V.C. perfusion could be performed only three times; in these cases, after cessation of contractions the heart could not be restored.

TABLE I

Results of the Investigations of P.V.C. Tubing on Mechanical Activity of the Isolated Rat's Heart

Kind of P.V.C. investigated:	A	B	C	D	E	Total
Number of hearts:	7	2	2	2	4	17
Number of investigations:	14	4	4	4	6	
Cardiotoxic effect:						
positive within 15 minutes	14	0	0	3	5	

Different kinds of poly-vinyl-chloride tubing were investigated with this technique (table I). Before testing they were rinsed with

distilled water. Till now we used 17 hearts to investigate five different kinds of poly-vinyl-chloride tubing. There are kinds of poly-vinyl-chloride tubing which have *no toxic* effect on the isolated rat's heart perfused according to *Langendorff*.

The poly-vinyl-chloride tubing A, D and E however, have been used in heart-lung machines and biological set-ups. They were sold and declared safe for medical purposes.

The poly-vinyl-chloride tubing B and C came from transfusion-systems, as used in our hospital.

In conclusion we can say that not all poly-vinyl-chlorides interfere with cardiac contraction to the same extent. It is our opinion that all types of poly-vinyl-chloride used in heart-lung machines, for intravenous therapy or other medical and biological applications, should be tested with this technique before they can be declared safe.

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Summary

There are types of poly-vinyl-chloride tubing sold and used for medical and biological purposes which deteriorate heart action in a few minutes. A simple method for testing P.V.C. tubing can be found in the isolated rat's heart perfused according to *Langendorff*.

Résumé

Il y a sur le marché certains types de tuyaux en polyvinylchloride employés en médecine et en biologie qui produisent en quelques minutes une détérioration de la fonction du cœur. Une méthode simple pour dépister cette propriété du P.C.V. est la perfusion du cœur isolé du rat d'après *Langendorff*.

Zusammenfassung

Gewisse Polyvinylchloridschläuche, welche für biologische und medizinische Zwecke im Handel sind, zeigen nach wenigen Minuten einen ausgesprochenen cardiotoxischen Effekt. Der Perfusionsversuch nach *Langendorff* am isolierten Rattenherzen eignet sich bestens zum Nachweis dieser Wirkung.

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