ERYTHROCYTE OSMOTIC FRAGILITY IN HYPERThERMIA-SUSCEPTIBLE SWINE

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SUMMARY
The observation is reported that hyperthermia-susceptible swine manifest an increased red cell osmotic fragility. The importance of this observation is discussed.

Anaesthetic-induced malignant hyperpyrexia in humans appears to result from some intrinsic abnormality of muscle (Satnick, 1969; Harrison et al., 1970; King, Denborough and Zapf, 1972). Evidence points to this defect being in the sarcoplasmic reticulum (Kalow et al., 1970). A certain strain of Landrace pigs manifests a similar condition and has been used as an animal experimental model for the investigation of various aspects of the disease and trials of therapeutic measures (Berman et al., 1970; Harrison, 1971).

While taking blood specimens for various investigations from such hyperthermia-susceptible pigs, we observed that more often than not these specimens were markedly haemolysed. This observation prompted us to investigate the erythrocyte osmotic fragility of these pigs.

METHODS
Hyperthermia-susceptible swine were initially chosen by observing the reaction of all pigs acquired for the Surgical Research Laboratory to a screening challenge of halothane inhalation (Harrison et al., 1969). Hyperthermia-susceptible swine react in an obvious and highly characteristic fashion by manifesting extreme muscle rigor within about 10 min of exposure to halothane and recover if the halothane is immediately discontinued. Susceptibility to hyperthermia was confirmed in positive reactors by estimation of serum c.p.k. levels, which in hyperthermia-susceptible swine remain persistently raised (Woolf et al., 1970).

The red cell fragility of three such pigs, aged 9-14 weeks, was investigated over a time some weeks after the original test exposure to halothane. Three specimens of blood—a week elapsing between successive specimens—were taken from each pig under brief thiopentone anaesthesia. This blood was drawn from one of the large veins in the thoracic inlet through a wide-bore needle (15 s.w.g.), care being taken to exert the minimum of suction. The fragility of blood drawn under similar conditions from nine non-reactor pigs, non-reactivity being confirmed by low serum c.p.k. levels, served as a control.

Osmotic fragility was tested by the standard method (Dacie and Lewis, 1968) of estimating colorometrically the degree of haemolysis achieved in serial dilutions of saline solutions. Differences between groups of mean percentage haemolysis at each concentration of saline were tested statistically by a standard Student t-test.

RESULTS
The results (table I and figs. 1 and 2) reveal that these hyperthermia-susceptible pigs manifest a greater erythrocyte osmotic fragility than normal. The median corpuscular fragility of the hyperthermia-susceptible swine lay between 0.55 and 0.50% saline, while that of the control pigs was between 0.50 and 0.45% saline. (The human value...
for comparison lies between 0.445 and 0.40% saline; Dacie and Lewis, 1968.) The increment haemolysis curve (fig. 2) demonstrates a difference of 0.05% saline between peaks of maximal haemolysis.

There is quite marked disparity in the few reported estimations of porcine red cell fragility (Schalm, 1965). As the pig populations on which these reported estimations were performed may well have inadvertently included hyperthermia-susceptible swine (Harrison, 1972), comparisons of fragility in this paper are made only with the screened controls described.

**DISCUSSION**

Abnormalities in red cell fragility depend to a large extent on the functional state of its surface membrane (Dacie and Lewis, 1968). The marked morphological similarity between this cell membrane and the membranes of cell organelles such as mitochondria, endoplasmic reticulum and Golgi apparatus led to Robertson's concept of these as "unit" membrane (Robertson, 1959). Though there are important functional differences between membranes which doubtless reside in the protein enzymes associated with the phospholipid skeleton, there is indeed a structural organization that is common to most cellular membranes (Fawcett, 1962; Giese, 1968).

It is this that confers relevance to the finding of increased red cell fragility in hyperthermia-susceptible swine reported here. There is evidence that anaesthetic-induced malignant hyperpyrexia results from some intrinsic abnormality in muscle, more specifi-
erythrocyte osmotic fragility in swine cally of the sarcoplasmic reticulum. Here is evidence that another "unit" membrane in animals susceptible to anaesthetic induced malignant hyperpyrexia is also defective.

Acknowledgements
We wish to thank Brian Sassman for the initial screening and subsequent anaesthesia of the pigs used and Dr J. Smith for technical assistance in obtaining blood samples. We wish to thank the Liver Research Group and the J. S. Marais Surgical Research Laboratory of the University of Cape Town for access to and supply of pigs. This project was financially supported by the Anglo-American and De Beers Anaesthetic Research Fund and the Joseph Stone Anaesthetic Research Foundation.

References


Fragilite osmotique erythrocytaire chez le porc susceptible a l'hypertermie

Sommaire
Les auteurs rapportent avoir observe que des porcs susceptibles a l'hyperthermie manifestent une fragilite osmotique accrue des globules rouges et discutent l'importance de cette observation.

Osmotische fragilität der erythrocyten bei hypertermie-empfindlichen schweinen

Zusammenfassung
Es wird über die Beobachtung berichtet, daß Hypertermie-empfindliche Schweine eine gesteigerte osmotische Fragilität ihrer roten Zellen aufweisen. Die Bedeutung dieser Beobachtung wird diskutiert.

Fragilidad osmotica eritrocitaria en cerdos susceptibles a la hipertermia

Resumen
Se informa sobre la observación de que los cerdos susceptibles a la hipertermia presentan un incremento en la fragilidad osmótica de sus glóbulos rojos. Se discute la importancia de esta observación.