Histochemical fibre types in striated muscle from the guinea-pig oesophagus

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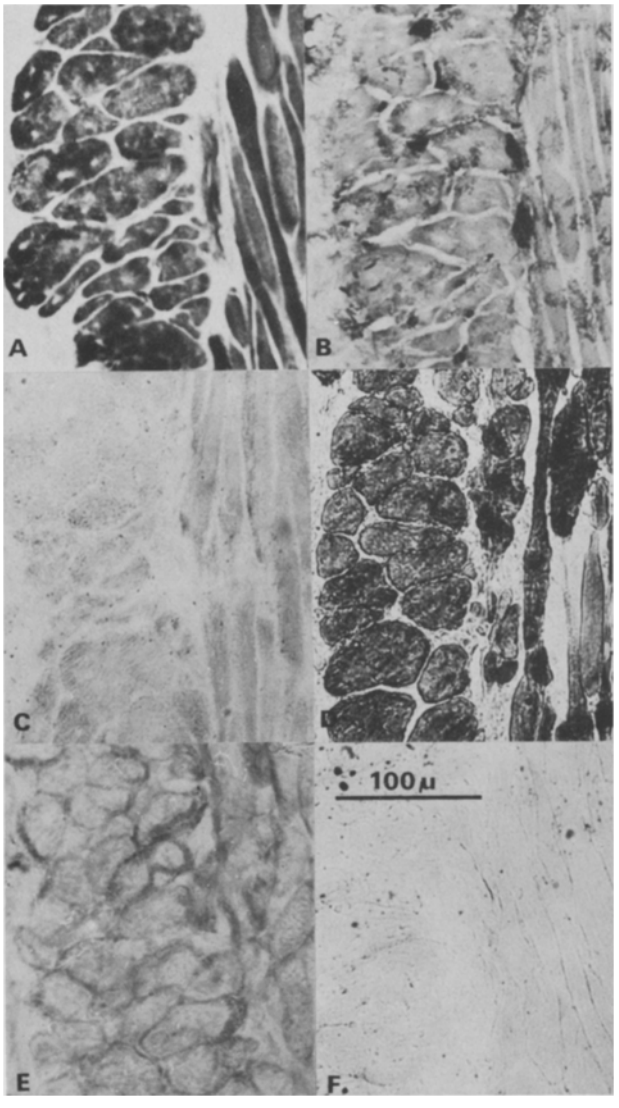
Summary. Histochemical techniques have been used to classify the striated muscle fibres found in the guinea-pig oesophagus. The functional significance of these results is discussed.

In previous studies histochemical techniques have been used to differentiate between different fibre types found in a variety of striated muscles. Correlation between speed of contraction and content of alkaline-stable myosin adenosine triphosphatase has been established by several workers[1-3]. Similarly the presence of succinate dehydrogenase and phosphorylase has been related to the type of metabolism found in striated muscle fibres[4-6].

As part of an ongoing study into the functional anatomy of striated muscle in the oesophagus in a variety of species, the present paper reports the histochemical fibre types in oesophageal striated muscle from the guinea-pig.



Sections of guinea-pig oesophagus showing striated muscle stained: *A* for myosin ATPase at pH 10.4, *B* for myosin ATPase at pH 4.35, *C* for succinate dehydrogenase, *D* for phosphorylase, *E* with periodic acid Schiff method, *F* with Sudan black B.

Materials and methods. 6 young adult guinea-pigs were killed with an overdose of pentobarbitone. Portions of the oesophagus and of the diaphragm were mounted on cryostat chucks, placed in melting difluorodichloromethane (Arcton − 12) cooled in liquid nitrogen, and serially sectioned in a cryostat. Adjacent sections were then processed by one of the following histochemical methods: a) A myosin adenosine triphosphatase technique[7] with preincubation at pH 4.35 and 10.4. b) A modification of a succinate dehydrogenase method[4] in which the slides are incubated in a medium containing 10 ml 0.1 M sodium succinate, 10 ml 0.1 M phosphate buffer (pH 7.6), 10 ml N,N, dimethylformamide and 20 mg of nitro blue tetrazolium overnight. c) A modification of Takeuchi's method[8] for phosphorylase in which sections were incubated for 15 min in 30 ml of 0.1 N acetate buffer (pH 5.6) containing 120 mg D-glucose-1-phosphate, 60 mg EDTA and 48 mg sodium fluoride. After rinsing, the tissue was stained with dilute Gram's iodine and immediately photographed. d) A periodic acid Schiff stain was used to demonstrate glycogen. e) Sudan black B was used to demonstrate lipids.

In all cases control sections of diaphragm, mounted on the same slide, demonstrated differentiation between the fibre types present in the diaphragm.

Results and discussion. Using the myosin ATPase technique all striated muscle fibres from the guinea-pig oesophagus stained darkly with alkaline preincubation but lightly with acid preincubation (figures A and B). Thus these fibres may be said to be of the fast twitch type[1-3].

Staining for SDH revealed only a very sparse homogeneous granular appearance, with no aggregation of granules at the periphery of fibres (figure C). However, phosphorylase activity, as shown by blue colouration, was noted in all fibres (figure D). This indicated that guinea-pig oesophageal muscle is glycolytic in action although the PAS method revealed no accumulation of pink-red granules which would have indicated the presence of glycogen. There was no intrafibrillar staining with Sudan black B, suggesting an absence of intracellular lipid storage (figures E and F).

Thus oesophageal striated muscle from the guinea-pig is composed of one fibre type, which is fast twitch, and glycolytic, but has no demonstrable lipid or glycogen storage.

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