Excitation-contraction coupling characteristics in mechanically skinned muscle fibres of the rat vary with age and strain

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Previously, Lamb and Stephenson[1,2] determined the excitation-contraction (E-C) coupling characteristics of mechanically skinned fibre preparations from vertebrate skeletal muscle using ionic substitution for inducing T-system depolarization. Here, we used the same experimental strategy to examine whether these characteristics vary with animal age and strain in the rat.

Fibres were obtained from Long Evans (LE) rats aged 4 to 21-wks and from Sprague Dawley (SD), Wistar (Wr), Zucker Lean (ZL) and Wistar Kyoto (WKY) rats aged 21-wks. All rats were killed by halothane overdose in accordance with Victoria University Animal Experimentation Ethics Committee procedures, and EDL muscles and single fibres were isolated as previously described[3]. The E-C coupling characteristics determined for each fibre were the maximum depolarization-induced force response ($_{max}$DIFR), the number of force responses to 75% run-down ($_{75\%}$R-D)[4] and the number of consecutive responses within the range 80-100% of $_{max}$DIFR (#DIFR$_{80\text{-}100\%}$).

The major findings were that (i) in the LE rats, 4-wk and 8-wk fibres produced $_{max}$DIFR values that were significantly lower than those produced by fibres from all other age groups (no significant difference between 10-wk, 15-wk and 21-wk fibres), (ii) 21-wk LE fibres produced larger values for $_{75\%}$R-D and #DIFR$_{80\text{-}100\%}$ than those produced by fibres from all other age groups, and (iii) while there was no significant difference in the $_{max}$DIFR between the five rat strains examined, fibres from SD rats produced $_{75\%}$R-D values that were at least 5-fold higher than those for the other rat strains.

Taken together, these data indicate that the responsiveness of rat mechanically skinned fibres to T-system depolarization varies with age and strain in a parameter-dependent manner. Our results should be of particular interest for studies of E-C coupling in fibres from rat models of specific diseases, which involve the use of rats of different strains and/or different ages as controls.

(1) Lamb & Stephenson (1991) J Physiol 423: 495-517
(2) Lamb & Stephenson (1994) J Physiol 478: 331-339
(3) Bortolotto et al. (2000) Am J Physiol Cell Physiol 279:C1564-77
(4) Goodman et al. (2003) Am J Physiol Cell Physiol 284:C1448-59