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The Rat-Pull Test Procedure: A Method for Assessing the Strength of Rats

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GIARDINA, W. J. AND C. T. WISMER. *The rat-pull test procedure: A method for assessing the strength of rats.* PHARMACOL BIOCHEM BEHAV 50(4) 517-519, 1995.—A novel method for the measurement of rat strength is described. The method makes use of a rat's natural inclination to move forcibly and rapidly toward an enclosed, darkened compartment. Acrylamide (200.0 mg/kg, IP), gentamicin (30.0 mg/kg, IP), *d*-tubocurarine (0.1 mg/kg, IP), and diazepam (3.0, 10.0, and 30.0 mg/kg, PO) significantly decreased strength. The rat-pull test procedure provides a sensitive, reliable, and valid method for the measurement of strength in rats.

Strength Muscle dysfunction Grip strength

IN OUR pharmacology laboratory, we developed a method for the measurement of rat strength for a specific project application in which sensitivity and precision of measurement were required. Our method makes use of a rat's natural inclination to move forcibly and rapidly toward cover. The method can be used along with the other well-known test procedures (grip strength, rotating treadmill, inclined plane) to assess the potential of drugs and toxins to cause muscular dysfunction (1-3). We are calling our method the rat-pull test procedure.

METHOD

Apparatus

The apparatus consists of a wooden runway (42 cm length, 15 cm wall height, 10 cm width), which is open at one end; all surfaces are painted dark gray. The runway is divided into two equal length sections by a full height wall with a central portal (8 cm wide, 10 cm height). The closed portion of the runway is covered to the divider to provide a dark compartment that is accessible only through the portal. The uncovered portion of the runway is illuminated with ambient room light. The full length of the runway floor is covered with wire cloth (0.25 inch mesh) fastened to the floor to provide better traction. A strain gauge (Chatillon Model DPP-1 kg) is

attached to a metal stand, and the attachment arm is positioned approximately 27 cm (the final distance is determined by the size of the rats) from the open end of the runway. A tether (24 cm) is fastened securely to a rat shoulder harness and attached at the other end by a hook to the strain gauge attachment arm.

Procedure

The runway is placed on a pedestal 16 cm above the table surface. The strain gauge attachment arm is placed 22 cm above the table surface squarely facing the open end of the runway. The strain gauge is zeroed and set to measure and retain a pulling force in grams. The rat is placed in the harness and the harness attached to the strain gauge via the tether with full slack. The rat is then placed in the open end of the runway and allowed to move toward the portal. The narrow runway prevents the rat from pulling obliquely on the strain gauge. The tether is fully extended and exerting tension on the strain gauge when the rat's ears are past the portal. The distance of the strain gauge from the runway is adjusted so that only the rat's head enters the dark compartment. No further adjustment is required, as rats are selected to be nearly of the same weight and size in an experiment. The rat is allowed to pull hard against the gauge. Once the strain gauge is maximally

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TABLE 1
AN EXAMPLE OF STRENGTH MEASUREMENTS OBTAINED FROM THREE SUCCESSIVE PULLS
AT 0.5, 1.0, AND 2.0 HOURS AFTER VEHICLE ADMINISTRATION

	Rat Weight (g)	Strain Gauge Measurement (g)								
		0.5 h			1.0 h			2.0 h		
		1	2	3	1	2	3	1	2	3
1	300	530	570	500	640	690	640	560	580	620
2	290	690	520	570	630	680	650	620	590	650
3	310	670	710	690	640	670	650	630	610	540
4	300	680	730	666	620	610	680	540	510	510
5	330	430	470	450	500	460	460	480	500	450
6	320	550	580	590	510	530	600	490	530	510
7	320	590	540	510	530	610	530	570	710	610
8	300	660	490	500	430	570	520	540	540	550
9	310	850	600	480	520	570	590	460	590	580
10	310	550	500	470	430	480	540	440	490	470
Mean		620	570	550	550	590	580	530	570	550
SEM		40	30	20	30	30	20	20	20	20

loaded, the force is recorded and the procedure repeated. The measurement of strength is taken as the mean of three successive trials. In the experiments described here, strength was measured at 0.5, 1.0, and 2.0 h after dosing.

Male, Sprague-Dawley rats weighing at least 250 g were used. Four compounds were tested for their effects on strength: acrylamide (200.0 mg/kg, IP), gentamicin (30.0 mg/kg, IP), *d*-tubocurarine (0.1 mg/kg, IP), and diazepam (3.0, 10.0, and 30.0 mg/kg, PO). Each drug was tested in a separate experiment that included a group administered a volume dose of vehicle. Ten animals were tested in each group. One-way analysis of variance with Duncan's multiple-range test for comparison among treatment groups was used to determine significant differences among vehicle and dose groups within each time point.

RESULTS AND DISCUSSION

Table 1 shows the reliability of the strength measurement in vehicle-treated rats. Data are shown for the three successive

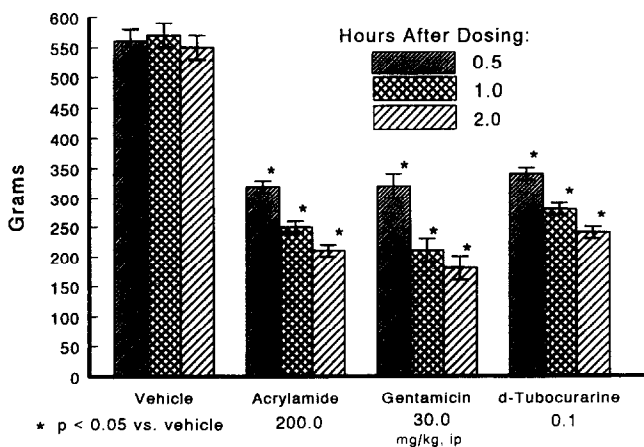


FIG. 1. The effects of acrylamide, gentamicin, and *d*-tubocurarine on strength as measured using the rat-pull test procedure.

trials within the 0.5-, 1.0-, and 2.0-h test sessions after vehicle administration. Acrylamide (a monomer used in the plastics industry), gentamicin (an amino glycoside antibiotic), and *d*-tubocurarine (a neuromuscular blocking agent) produced significant decreases in strength, as shown in Fig. 1. Diazepam (an anxiolytic and muscle relaxant) produced a dose-related decrease in strength, as shown in Fig. 2. These compounds were selected to validate the test method because they produce muscle weakness without paralysis at the doses administered and work by different mechanisms.

The rat-pull test makes use of a rat's natural inclination to seek immediately a dark enclosure when placed in a lighted field. The animal pulls hard on the strain gauge in an effort to enter the dark compartment. The wire cloth floor provides a no-slip, sure-grip surface. When the animal stops pulling, the strain gauge holds its maximum reading. If the animal makes a second effort during the trial, the strain gauge will reflect any increase in effort. The most consistent averaged strength measurements are obtained by using rats of nearly the same weight, which was 290 to 330 g in the example shown in Table

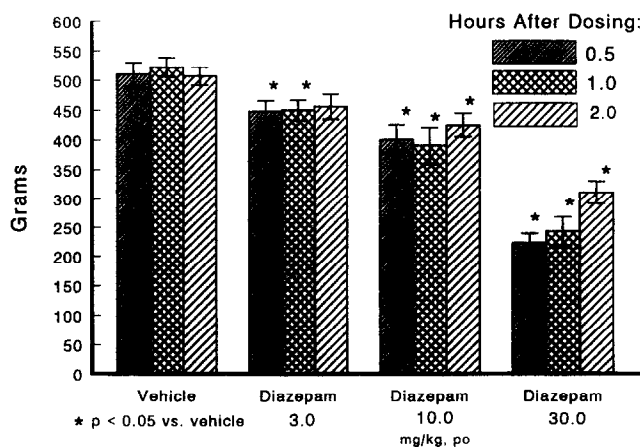


FIG. 2. The effects of diazepam at three doses on strength as measured using the rat-pull test procedure.

1. The best results are obtained using rats that weigh at least 250 g. No one is holding or pulling the animals to determine grip strength, which can introduce experimental error. No training of the rats or experimenter is required. The animal is not in an awkward, uncomfortable, or unnatural position dur-

ing the testing. The method allows for repeated daily or weekly strength measurements, different experimental designs, and parametric statistics. The rat-pull test provides a sensitive, reliable, and valid method for the assessment of the potential for drug or toxin-induced neuromuscular dysfunction.

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