A RESTRAINING DEVICE AND PROCEDURE FOR CONTINUOUS BLOOD PRESSURE RECORDINGS IN MONKEYS¹

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Modifying a commercially available primate chair,² by adding a plexiglass middle plate and arm guards, allows up to 6 in. of space for the exit of intra-arterial and intravenous catheters or wires from the inguinal and lower thoracic region of the restrained monkey. Figure 1 shows the dimensions of this easily machined $\frac{1}{4}$ in. plexiglass restraining device. The monkeys thus restrained seem as comfortable and active as the normally restrained animals and have had no serious skin irritations or edema.

The $5\frac{1}{2}$ in. edge of the arm guard base is cemented (Plexiglass cement) or bolted at right angles to the bottom edge of each arm guard. The arm guard base is bolted into the

holes on the middle plate. In order to clean, one side of the chest plate connecting the two arm guards is hinged and the other side is bolted. The height of the chest plate and arm guard is determined by the cylinder height and will vary with the size of the monkey, but should be within 1 in. of the top plate of the chair to prevent turning. Monkeys weighing less than seven or eight pounds need smaller opening dimensions on the arm guards and middle plate.

The middle plate is supported by four plexiglass cylinders (4 to 6 in. high, $\frac{3}{8}$ in. outside diameter). Bolts run through the middle plate at each corner, through the cylinders, and are secured under the bottom plate of the chair. Edges of all sections touching the monkey should be beveled and sanded smooth.

The surgical approach for the intra-arterial catheterization used in this laboratory is similar to that described by Werdegar, Johnson and Mason (in press), except that we use the external rather than the common iliac artery. Siliconized³ polyvinyl tubing⁴ is inserted cephalad 6 or 7 cm through the external iliac artery, placing the beveled tip of the catheter in the descending aorta distal to the renal arteries. Several ligatures are made around the vessel and the catheter; the distal end of the external iliac artery is doubly ligated. The catheter is curved gently in an 180° turn, sutured onto fascia, and tunneled under the skin to the desired exit point near the umbilicus. An 18 or 20 gauge Luer stub adapter⁵ is inserted into the end of the catheter and con-

DIMENSIONS OF $\frac{1}{4}$ IN. PLEXIGLASS
RESTRAINING DEVICE

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²E. G. Foringer and Co., Rockville, Maryland. Sound controlled booths are necessary for obtaining pressures without unwanted environmental influences.

³Clay Adams, Inc., New York 10, N. Y.

⁴We have used both S-1 clear 027 $\times$ 055 (Surprenant Mfg. Co., Clinton, Mass.) and 034 $\times$ 066 Resinite Hi-Heat 105C Vinyl insulation sleeving (Borden Chemical Co., Compton, Calif.)

⁵Clay Adams Inc., New York 10, N.Y.

nected to a pressure transducer⁶ and flushing device⁷. (Fig. 2.)

The infusion pump automatically turns on once each hour for a 35-sec period during which time approximately 2 cc of heparinized saline (1500 USP units of heparin per liter normal saline) are infused through the one-way valve⁸ to prevent damping. One min after the end of each infusion, recording equipment⁹ is automatically turned on for a 2-min period. Figure 3 shows a sample of one such recording of a monkey working on a Sidman avoidance schedule.

To date, two *Macaca mulatta mulatta* monkeys have worked one year on reinforcement schedules without accident to the catheter while their blood pressures and heart rates were being monitored (Fig. 4). In one of these animals, the catheter failed six months after its insertion, probably because of clotting at the catheter tip. The catheter was removed and a new catheter was inserted into the opposite external iliac. There were no observable effects on the animal's circulation or health after six months. Modification of this procedure to include a venous catheter for dye dilutions analysis of cardiac output seems feasible.

⁶Model P23GB, Statham Transducers, Inc., Hato Rey, Puerto Rico.

⁷Harvard Apparatus Co., Inc., Dover, Mass.

⁸Becton Dickinson, Rutherford, New Jersey.

⁹Offner Polygraph, Beckman Instruments, Schiller Park, Ill.

REFERENCES

- Werdegard, D., Johnson, D. G., and Mason, J. W. A technique for continuous measurement of arterial blood pressure in unanesthetized monkeys. *J. Appl. Physiol.*, in press.