

TABLE I. Papillomatous Growths in Soles Collected from Wakasa Bay Area.

Fish No.	Species	Standard length (mm)	Tumorous growth—		
			No.	Location	Size (mm)
F-1	<i>Limanda herzensteini</i>	212	1	pigmented side	43 × 77 × 1
F-5	<i>Hippoglossoides dubius</i>	181	1	unpigmented side	48 × 51 × 4
F-6	<i>Hippoglossoides dubius</i>	225	3	pigmented side	31 × 31 × 5
				pigmented and (unpigmented side)	43 × 25 × 2.5 (33 × 27 × 1.5)
				pigmented and (unpigmented side)	44 × 25 × 2.5 (36 × 13 × 1.0)
F-10	<i>Hippoglossoides dubius</i>	200	1	pigmented side	44 × 49 × 5
F-11	<i>Hippoglossoides dubius</i>	181	1	pigmented side	37 × 32 × 5

tive tissue. In addition marked increase of melanin-containing cells was observed in tissue sections of growth of *L. herzensteini* with darker appearance. The gross and microscopic findings of *H. dubius* resembled descriptions of the epithelial papillomas reported by other authors to occur among flathead sole populations near Friday Harbor, Washington.

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Direct Percutaneous Determination of Systemic Blood Pressure and Production of Renal Hypertension in the Cat.* (32042)

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In any study of persistent experimental hypertension it is desirable to be able to make repeated determinations of the blood pressure, for long periods, in the unanesthetized animal. Most previously published determinations of the blood pressure of the cat have been in the form of kymographic records of the direct mean pressure of anesthetized, heparinized animals usually subjected to various surgical procedures used in brief physiological experiments or pharmacological tests(1). These determinations are made intermittently, or continuously, during a brief experiment, and the method employed for determination of the blood pressure usually involves cannulation of a carotid, fem-

oral, or other artery in an anesthetized animal. In such experiments, the depth of anesthesia usually varies in different animals, and even in the same animal, with consequent effects on the blood pressure. The number of determinations which can be made in the same animal, by cannulation of an artery, at intervals of days, is limited. Liddell and Carleton(2) did make repeated determinations of the blood pressure in normal, unanesthetized cats, by use of the exteriorized artery implanted within a loop of skin, a technique described by van Leersum(3) for the dog, and used by Dominguez(4) for the rabbit. This method, however, gives values for only the systolic blood pressure, and the accuracy is questionable, because the endpoint is subjective, being determined by the palpation of the loop distal to the cuff, and greatly affected by the snugness with

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which the cuff is applied to the loop containing the artery. Recently, Guazzi and Zanchetti(5) reported measurement of the blood pressure of unanesthetized cats by means of polyethylene tubing implanted in the femoral artery. Blood clotting was prevented by daily intravenous injections of heparin. This is a useful procedure, but in our hands clotting could not be prevented for more than a few days, which limited the use of this technique also to short term experiments.

Percutaneous puncture of a femoral artery, for determination of the direct blood pressure, has been performed repeatedly, for long periods, in unanesthetized dogs(6), rabbits(7) sheep and goats(8). With a mercury manometer as the indicator, only direct, mean values are thus obtained, but with a strain-gauge manometer systolic and diastolic pressures are obtainable. We considered it worthwhile, therefore, to determine whether the percutaneous method could be used in the cat, and whether this usually excitable, uncooperative animal would permit repeated determinations, and give reasonably uniform values, without anesthesia.

Methods and materials. In the beginning, all 4 limbs were tied down, to insure the restraint of the animal, but it was soon found that the same technique employed previously for the rabbit(6) could be used for the cat. As in the rabbit, only the hind limbs were secured with narrow leather straps and the front limbs were held by an attendant. The only difference from the procedure used for the rabbit was that a leather muzzle was applied to the head, to prevent the attendant from being bitten. The determinations were made by means of a mercury manometer, as well as by a Statham strain-gauge transducer connected to a Grass polygraph.

As in the rabbit, a 22 gauge needle was inserted through the intact skin of the groin from which the fur had been clipped. The needle was guided into the femoral artery by palpation with the index and middle fingers of the opposite hand. The needle was connected by a glass adapter, through plastic tubing, to a mercury manometer, or to

the strain-gauge transducer. As soon as the needle had penetrated the femoral artery, pulsating, bright red, arterial blood appeared in the glass adapter. In the case of the mercury manometer, this occurred readily; with a strain-gauge manometer, however, displacement of the membrane was so slight that no blood appeared in the glass adapter. For this reason it became necessary to connect a side-arm from the strain-gauge manometer to a saline-filled pressure reservoir. Once the needle had penetrated the skin, but not the artery, the pressure in the reservoir was dropped to zero. When the needle entered the artery, blood appeared in the glass adapter and the tubing leading from the manometer to the reservoir was then clamped. This permitted the recording of the direct, mean blood pressure. No anticoagulant other than normal saline solution was necessary in the system during the brief procedure. Since the cat's blood clots rapidly, the time for the recording of blood pressure was usually limited to a few minutes, but, as in the dog and rabbit(6,7), the period of observation can be greatly lengthened by a simple device which enables frequent flushing of the cannula and needle with saline solution.

The cats were unselected and of different varieties. While all of them were docile when unrestrained, all objected at first with considerable vigor to having all 4 limbs, or even only their hind limbs, restrained, with the body in the supine position. Few of the cats ever did become completely reconciled to the procedure. Percutaneous puncture of the artery seemed to cause little or no discomfort or excitement, in contrast to the tying down of the hind limbs, but most of the animals, after the initial struggle against being restrained, did calm down for enough time to permit a reading during a quiet period.

Seven male and seven female cats were used in the study. In five cats of each sex, single determinations of the direct, femoral, arterial blood pressure were made in 3 days in every animal by means of: (1) a mercury manometer, without anesthesia, (2) a strain-gauge manometer, also without anesthesia, and (3) a strain-gauge manometer, with anes-

TABLE I. Single Determinations of Blood Pressure in Cats.

No.	Sex	Without anesthesia			Under anesthesia	
		Direct mean* blood pressure	Systolic B.P.	Diastolic B.P.	Systolic B.P.	Diastolic B.P.
		Mercury manometer	Statham strain-gauge transducer			
1	♂	165	180	125	190	130
2	♂	165	155	100	190	155
3	♂	170	160	120	170	130
4	♂	175	190	140	180	140
5	♂	170	200	145	160	115
6	♀	130	135	90	190	130
7	♀	130	183	135	150	105
8	♀	110	160	130	160	120
9	♀	130	200	130	125	85
10	♀	—	150	115	100	75

* The direct mean determinations were made on a different day from the systolic and diastolic pressures recorded by the strain-gauge and Grass polygraph.

TABLE II. Repeated Direct Mean Blood Pressure of Unanesthetized Cats (Mercury Manometer).

Cat #	Sex	July 8	July 13	July 20	July 27	Aug. 3	Aug. 10	Aug. 17	Aug. 24
11*	♂	165*	160	150	150	150	135	130	130
12	♂	170	175	160	150	150	145	145	140
13*	♀	170	160	160	155	145	135	140	125
14	♀	160	165	165	160	155	145	145	135

* For more values for these two cats, see Fig. 1.

thetia due to a single intraperitoneal injection (27 mg/kg) of sodium pentobarbital. The measurements of the blood pressure by means of the mercury manometer and the strain-gauge manometer were made on different days. Neither thrombosis of the artery nor infection at the site of puncture occurred in any of the animals, although no special precautions were taken to insure sterility, even in a later group of animals in which punctures were made repeatedly for many months.

In the first group of animals we were impressed by the frequent occurrence of high blood pressure, especially in the males. Although excitement due to restraint of the animal undoubtedly accounts for some or all of the blood pressure elevation in the unanesthetized, untrained animals, it cannot explain some of the high pressures obtained under anesthesia. This problem is being investigated at greater length by one of us (D.B.G.).

Results. Table I gives the values for the single determinations, obtained under 3 different conditions, in the 5 cats of each sex.

It shows that the values for single determinations tended to be high and varied considerably in both sexes. The blood pressure of the females, however, especially the direct mean pressure of the unanesthetized animals, was lower, on the average, than that of the males, although the females were about as uncooperative as the males.

In another group, 2 of each sex, only the direct mean pressure was determined, repeatedly, without anesthesia, at weekly intervals, for as long as 24 weeks. Table II gives the values for all 4 during the first 7 weeks. It is evident that, although the values were high initially in both males and females, they gradually decreased in both as the animals became accustomed to the handling and restraint of the procedure, and reached a fairly uniform level in about 4 weeks. Even then, however, if the animals became apprehensive, or excited, during a determination, the pressures rose abruptly. The values given in Table II were always obtained during a quiet period.

At the end of the 7th week, the left main renal artery of 2 of the cats, one male (#11)

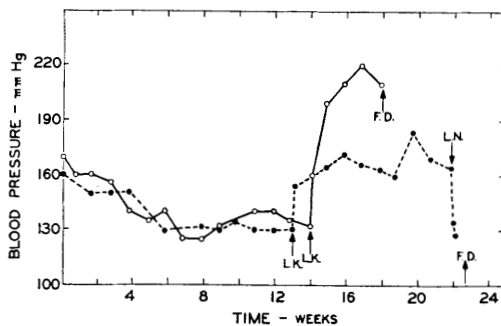


FIG. 1. ● --- ● Blood pressure, Cat #11, male. ○ — ○ Blood pressure, Cat #13, female. L. K. Left main renal artery moderately constricted. L. N. Left nephrectomy. F. D. Found dead.

and one female (#13) was moderately constricted by means of a silver clip similar to that used for rabbits(7).

Fig. 1 illustrates the elevation of the direct, mean blood pressure which occurred promptly and persisted as a result of this procedure. In Cat #13, a female, the blood pressure reached a higher level than in Cat #11, a male, but the animal was found dead, at the end of 4 weeks, without an obvious cause determined at autopsy. In Cat #11, the blood pressure remained moderately elevated for 9 weeks after the operation, at which time the ischemic left kidney was removed. The blood pressure fell to normal in 24 hours, but the animal was found dead at the end of 72 hours. The autopsy failed to reveal an obvious cause of death.

Summary. The percutaneous, direct method for determination of the blood pressure was applied in the cat, without and with anesthesia. In one group of 5 males and 5 females, single determinations were made,

to determine the feasibility of the method. In these animals the blood pressure was measured by 2 means—direct mean pressure with a mercury manometer, and systolic and diastolic pressures with a strain-gauge manometer. In this group the single pressures were generally high, and usually higher in the males. In another group, 2 males and 2 females, determinations were made weekly for 7 to 24 weeks. In these cats the initial pressures were also high, but similar in both sexes, but, in all the animals, gradually decreased and became stabilized at a lower level in about 4 weeks. In one male and in one female the production of unilateral renal ischemia, due to moderate constriction of the main renal artery, was followed by the development of hypertension, and, as in other species, the exclusion of the ischemic kidney of one of the hypertensive cats resulted in a prompt return of the blood pressure to the lowest prehypertensive level.

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