The effect of the polycationic modified derivatives of polyglutamic acid was investigated on the viral resistance induced by poly I:C in primary human foetal cell cultures too; 10^6 cells were seeded in 1 ml of the above-mentioned medium and grown in stationary tubes at 37 °C for 4 to 5 days. The minimal protective doses of poly I:C, both in presence and absence of polycations, were determined as described above (Table).

Minimal protective doses of poly I:C against VSV infection in L-929 and human foetal cells in the presence and absence of polycations

Type of polycation[b]	Minimal protection doses[a] of poly I:C in μg/ml of media	
	L-cells	Human foetal cells
Poly-DMAE-glutamine[c]	1.10^{-4}	5.10^{-3}
Poly-DEAE-glutamine[c]	1.10^{-4}	5.10^{-3}
Poly-L-lysine (Sigma)	1.10^{-3}	1.10^{-2}
DEAE-dextran (Pharmacia)	5.10^{-4}	1.10^{-3}
Without polycation	1.10^{0}	–

[a] Determined as described in the text. [b] Polycations were used in concentrations of 20 μg/ml of media. [c] Polycationic modified derivatives of polyglutamic acid, with characteristic structural units as indicated in the formula.

Summary. Polycationic modified derivatives of polyglutamic acid are at least as good enhancers of poly I:C induced viral resistance in various cell cultures as are DEAE-dextran or poly-L-lysine[7].

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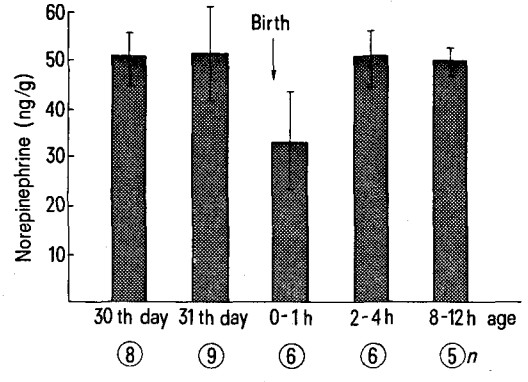
Norepinephrine in Fetal and Neonatal Rabbit Brain

In newborn mammals, such as the rat, mouse and rabbit, the amount of norepinephrine is relatively small, slowly increasing to adult values over a period of 4 to 6 weeks[1,2]. All these species are considered developmentally immature at birth. The newborn guinea-pig is comparatively well developed: its brain norepinephrine is at approximately the adult level. In the newborn rabbit (1-day-old) only half of this value is found[1]. Since we are interested in physiological modifications occurring in mammals during parturition and a few hours afterwards, we have undertaken this study to determine whether or not the brain norepinephrine store changes in fetus and newborn rabbits during this period.

Materials and methods. In our experiments we have used fetuses and newborn rabbits of the white New Zealand strain, in which the term of gestation is 31 days. At the stage of the 30th or 31st day, the female rabbits were killed by air embolism, laparotomy was performed and all the fetuses were taken out and decapitated at once. The brains were quickly removed, blotted on filter paper and frozen immediately. Since each brain contains low amounts of norepinephrine, it was necessary to pool 4 to 5 in each sample. The newborn rabbits were separated from their mother just after birth, during the 1st h or later on, within 2 to 4 or 8 to 12 h. As with the fetuses, the newborn animals from the same litter were divided into groups of 4 to 5 and killed by decapitation. Their brains were removed and the samples were prepared in the same way. The tissue was homogenized in ice-cold 0.4 *M* perchloric acid by using a Tri-R tissue homogenizer (Genelab International) provided with a glass pestle, and centrifuged at $9000 \times g$ at 0 °C for 30 min. The extraction was performed twice more and all 3 supernatants were pooled[3]. The pH was adjusted to 8.5 *M Tris* buffer[4] and the samples were adsorbed onto alumina[5]. We used active Merck aluminium oxide, acidic activity I, prepared by the method of ANTON and SAYRE[6]. The alumina containing the adsorbed norepinephrine was washed a few times with bi-distilled water. The elution was performed with 3×2 ml of 0.3 *N* acetic acid, the alumina being mixed thoroughly with the acid by a magnetic stirrer. All 3 eluates were pooled, centrifuged, adjusted to pH 6.5 and used for fluorometric assay[7]. An Amico-Bowman Spectro-fluorometer with ellipsoidal mirror



Norepinephrine level in fetal and neonatal rabbit brain (ng/g). Mean values and standard error for each group are given. *n* = number of samples.

[1] N. KARKI, R. KUNTZMAN and B. B. BRODIE, J. Neurochem. *9*, 53 (1962).
[2] H. C. AGRAWAL, S. N. GLISSON and W. A. HIMWICH, Int. J. Neuropharmac. *7*, 97 (1968).
[3] A. BERTLER, A. CARLSSON and E. ROSENGREN, Acta physiol. scand. *44*, 273 (1958).
[4] J. P. HANIG, J. M. MORRISON and S. KROP, Analyt. chim. Acta *59*, 363 (1972).
[5] V. RENZINI, C. A. BRUNORI and C. VALORI, Clin. chim. Acta *30*, 587 (1970).
[6] A. H. ANTON and D. F. SAYRE, J. Pharmac. exp. Ther. *138*, 360 (1962).
[7] U. S. VON EULER and F. LISHAJKO, Acta physiol. scand. *51*, 348 (1961).

was used for fluorimetric measurements. Readings were made at activation wave lengths of 380 and 430 nm and at fluorescence wave lengths of 490 and 540 nm. The mean values ± SEM are given in ng/g of tissue.

Results. In the fetuses of 30 days, the brain norepinephrine level is low, only 51 ± 4.9 ng/g. No changes occur the next day, the last one before birth (52 ± 9.7 ng/g), as can be seen in the Figure.

After parturition, within the 1st h, the newborn rabbit brain content falls to 34 ± 9.9 ng/g norepinephrine, about 37% less than that of the 31st day. Later on, within 2 to 4 h, the amount of norephinephrine returns to the prenatal level (52 ± 5.6 ng/g) and remains practically the same for 8 to 12 h (51 ± 2.4 ng/g) (see Figure).

Discussion. In the rat fetus, the enzymes involved in the biosynthesis of catecholamines are present in the brain at 15 days of gestation[8,9]; at this age, the norepinephrine is at only 2% of the adult level, whereas the biosynthetic enzymes have specific activities of about 10% of those in the adult brain[10]. At birth and thereafter, the biosynthetic enzymes and their products, dopamine and norepinephrine, increase in a parallel fashion[9,11]. Our results show that in the rabbit fetus on the 30th and 31st day of gestation, norepinephrine is present and the level remains unchanged, as is the case within 2 to 4 and 8 to 12 h after parturition. On the other hand, during the 1st h following parturition, a decrease of norepinephrine can be seen and the variability of the individual values is larger than in the other stages. Within 2 to 4 h, the amount of norepinephrine rises to the level measured in the fetuses, and remains the same for 8 to 12 h. Similar modifications of the amount of catecholamines have been observed in the newborn rabbit, in various tissues. For instance, during the first few hours following parturition, one can observe a decrease of the amount of catecholamines in the adrenals[12,13] and increase in the plasma[13,14] and in the heart[15]. These rapid and transitory variations of the amounts of catecholamines found in the newborn rabbit thus seem to be linked to birth. The fall of the norepinephrine level in the brain can be related to the fetal suffering special conditions during parturition, especially the hypoxia which occurs[16]. It has been established that in the adult cat, the asphyxia produced by rebreathing can decrease the norepinephrine level in the hypothalamus in less than 2 h[17]; in the adult rat, the hypoxia decreases in 1 h the norepinephrine in the brain[18]. In the fetus, asphyxia also introduces a decrease of the level of catecholamines in human[19], lamb[20], calf[21] and foal[22] adrenals and in human[19] and rabbit[23] paraganglia as well as in human[24] extra-adrenal tissue. In the adult rat, other severe stresses, such as prolonged muscular effort[25] and exposure to cold[26–28], are also known to reduce the endogenous level of catecholamines in tissues. Consequently, the spontaneous decrease of norepinephrine in the brain which we have found in the newborn rabbit can also be explained by stress conditions to which the animals are exposed during parturition. As has been suggested[29], norepinephrine, by its vasomotor action, could contribute to a better distribution of blood to the brain, thus increasing the brain's oxygen stock and facilitating the defense of the newborn animal against asphyxia. Therefore, this brain norepinephrine liberation during parturition could have an important role in a most critical period of the mammal's life[30].

Summary. In the first hour after parturition, the newborn rabbit brain norepinephrine content is about 37% less than that of the fetus of 30th or 31st day. Later on, within 2 to 4 h, the norepinephrine level returns to the prenatal value and remains unchanged between 8 to 12 h. This transitory fall of the brain norepinephrine seems to be linked to the stress conditions which occur during parturition.

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8 J. T. Coyle and J. Axelrod, J. Neurochem. *19*, 449 (1972).
9 F. Lamprecht and J. T. Coyle, Brain Res. *41*, 503 (1972).
10 J. T. Coyle and D. Henry, J. Neurochem. *21*, 61 (1973).
11 G. R. Breese and T. D. Traylor, Br. J. Pharmac. *44*, 210 (1972).
12 J. Roffi, J. L. Froger and M. F. Debray, C. r. Acad. Sci., Paris *277*, 595 (1973).
13 I. Motelica-Heino, M. F. Debray and J. Roffi, J. Physiol., Paris, in press.
14 K. Okyayuz and R. Ghambir, Experientia *29*, 1472 (1973).
15 J. Roffi and I. Motelica-Heino, Experientia *31*, 194 (1975).
16 G. S. Dawes, in *Foetal and Neonatal Physiology* (Year Book Medical Publ., Chicago 1969), p. 117.
17 M. Vogt, J. Physiol., Lond. *123*, 451 (1954).
18 M. Stupfel and J. Roffi, C. r. Soc. Biol., Paris *155*, 237 (1961).
19 A. Hervonen and O. Korkala, Acta obstet. gynec. scand. *51*, 17 (1972).
20 R. S. Comline and M. Silver, Nature, Lond. *181*, 283 (1953).
21 R. S. Comline and M. Silver, J. Physiol., Lond. *183*, 305 (1966).
22 R. S. Comline and M. Silver, J. Physiol., Lond. *216*, 659 (1971).
23 T. Brundin, Acta physiol. scand., suppl. *280*, 70 (1966).
24 A. Hervonen and O. Korkala, Scand. J. clin. Lab. Invest. *27*, suppl. *116*, 73 (1971).
25 J. Fugazza, J. Physiol. Paris, suppl. *5*, 55 (1963).
26 J. D. Barchas and D. X. Freedman, Biochem. Pharmac. *12*, 1232 (1963).
27 J. Leduc, Acta physiol. scand., suppl. *183*, 52 (1961).
28 I. Motelica, Acta physiol. scand. *76*, 393 (1969).
29 J. Boethius, T. Brundin and N. A. Persson, Acta physiol. scand. *78*, 269 (1970).
30 This work was supported by a grant from DGRST (Délégation Générale à la Recherche Scientifique et Technique, contrat No. 71 73219).

Comparative Study of the Electrical and Mechanical Behaviour of an Intact, Semi-Intact and Isolated Gastropode (*Helix pomatia*) Smooth Muscle Preparation

Under appropriate stimulation conditions, the isolated penis retractor muscle (PRM) of *Helix pomatia* L., a gastropode smooth muscle, can be made to perform a phasic contraction and a prolonged contraction known as 'catch' (Wabnitz[1,2]). Whether the two distinct types of contraction play a part in the normal behaviour of the penis retractor muscle in the intact animal is unknown.

The aim of the present experiments is to compare the normal electrical and mechanical behaviour of the intact penis retractor muscle-nerve-brain preparation with the properties of the muscle at different stages of surgical

1 R. W. Wabnitz, Dipl.-Arbeit Univ. Göttingen (1970).
2 R. W. Wabnitz, Cell Tiss. Res. *156*, 253 (1975).