with the division lines of a blood cell counting chamber. The diameter scattering of the MS in the 4 compartments of all kidneys studied and that of a 863 MS sample from the stock suspension are compared with help of the χ^2 test at a significance level of 5%.

Results and discussion: In the table the number of MS in each area of the kidneys studied is shown. The MS from kidneys preserved by perfusion and by storage with HES are given together. The same is made with the Fluosol 43 preserved kidneys. For grafical presentation of the size scattering, the sum of all counted MS in each area is taken as 100 and the number of MS of different size in each zone is expressed in percent of this value. This size distribution in the 4 zones is compared with that of the MS sample from the stock solution. Between the diameter size scattering in the sample and that in the 4 areas there is no significant difference ($p < 0.5$). The figure 1 shows this distribution. It is asymmetrical with a maximum at 13 µm.

The size distribution in the 4 compartments investigated is identical with the diameter scattering of the injected MS suspension. This finding demonstrates that with the chosen size no preferential redistribution of MS exits that could be attributed to their different diameter.

The method presented permits additionally the study of the MS distribution by direct observation in the trapping vessel. Therefore a greater resolution than that obtained with the radioactive labelled MS method in the observation of the microcirculation can be achieved.

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Catecholamine levels in newborn human plasma in normal and abnormal conditions and in maternal plasma at delivery

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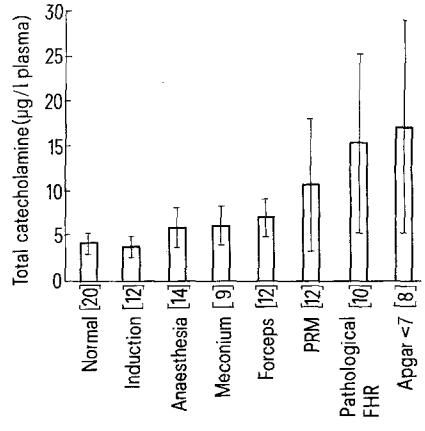
Summary. High levels of catecholamines have been found in plasma from the umbilical cord of newborn infants, suggesting a release of catecholamine from the fetus during parturition. Plasma catecholamine levels are also elevated in mothers at delivery.

It is well known that the adrenergic nervous system plays a central role in the adaptation mechanisms of the newborn to extrauterine life[1]. The adrenal stores of catecholamines have been found to decline at birth, in both rat and rabbit[2], while in rabbit the level of plasma norepinephrine increases[3]. Thus, birth is probably accompanied by an increased release of catecholamines from the newborn animal in these species. It is also known that hypoxia is a powerful stimulus for catecholamine secretion in the fetal sheep[4]. In view of these findings, the purpose of this study was to determine the epinephrine and norepinephrine concentrations in the plasma of the human newborn, in normal and in different abnormal conditions, and also in the plasma of the mother.

Materials and methods. This study was performed on 54 newborn infants and 26 mothers delivered at Maternité Baudelocque, Paris. The infants were divided into 2 groups, according to their clinical conditions, i.e. 'normal' and 'abnormal' infants. The group of 'normal infants' included babies born spontaneously at term, after a normal pregnancy. The group of 'abnormal infants' included seven clinical conditions: induction of labour by oxytocin, anaesthesia of the mother, presence of meconium stained fluid, use of forceps, premature rupture of membranes (PRM), pathological fetal heart rate (FHR) and an Apgar score < 7. All the infants showing one or more of these conditions were included in the 'abnormal' group. Maternal peripheral blood was obtained from healthy pregnant women, during normal spontaneous labour. Blood was collected from the umbilical cord of infants within 5 min following delivery. Blood samples (about 20 ml) were collected in heparinized tubes placed on ice and containing 10 mg of sodium metabisulfite in order to avoid oxidation of catecholamines[5]. The plasma was separated by centrifugation immediately after collection, and the proteins were removed after addition of 0.2 ml of perchloric acid and a further



Total catecholamines (epinephrine + norepinephrine) in plasma of the human newborn, in different abnormal conditions. Horizontal lines indicate the SEM.

Catecholamine levels in the human newborn plasma at delivery, under normal and abnormal conditions

	Number of cases	Total catecholamines (μg/l)	Epinephrine (μg/l)	Norepinephrine (μg/l)
Normal pattern	20	4.23±1.02	0.41±0.18	3.82±0.96
Abnormal pattern	34	8.58±3.02	0.42±0.30	8.16±3.00

Mean values are given with the SE.

centrifugation. The acidified and deproteinized plasma samples were stored at −18 °C until assay. Catecholamines were isolated according to the method of Euler and Lishajko[6].

The plasma was adjusted to pH 8.4 by addition of 0.1 N NaOH solution, under constant stirring. The plasma at pH 8.4 was passed over a glass column containing 0.7 g of activated aluminium oxide[7]. The flow from the column was facilitated by using a slight air pressure to pass the total volume of plasma in 10 min. Catecholamines were eluted with 0.25 N acetic acid in a volume of 3 ml added in 3 aliquots. 1 ml of the eluate was used for determination of catecholamines, each assay was performed in duplicate. The determination of catecholamines was carried out according to the method of Euler and Lishajko[6], using an Aminco-Bowman spectrofluorometer with ellipsoidal mirror. To determine the recovery of the colums, standard amounts of epinephrine and norepinephrine were passed through them. The mean recovery of epinephrine and norepinephrine from such column was 60±5% and 60±5%, respectively. The mean values presented were not corrected for recoveries. Under our conditions, the sensitivity of the method was 1.2 ng of either epinephrine or norepinephrine per ml of plasma. The Student t-test was used for comparisons of the means and the F-test for comparison of variance.

Results. The results concerning newborn infants are summarized in the table. The mean value of total catecholamines in the plasma of infants born under abnormal conditions (8.58±3.02 μg/l) was apparently double that of infants born under normal conditions (4.23±1.02 μg/l). However, the variability of the individual values in the abnormal cases is very high, which accounts for the fact that the difference is not significant. As shown in the figure, the values obtained in the newborn infants with abnormal patterns vary according to the different clinical conditions. In each group, except in the case of induction of labour, the variance of total catecholamines is significantly different from the normal group ($0.001 < p < 0.02$). The greatest variances are found in the 'pathological FHR' and 'Apgar < 7' groups. The mean concentration of catecholamines in maternal plasma at normal delivery was 2.16±0.51 μg/l (26 cases). This value does not significantly differ from that of infants born under normal conditions. There is no statistical correlation between the catecholamine levels in the plasma of normal newborn infants and that of their mother (20 cases, $r = 0.04$). Moreover, the plasma catecholamine levels do not vary significantly between the beginning of normal spontaneous labour (stage 3-4 cm) and delivery.

Discussion. The levels of norepinephrine in the plasma of normal newborn infants are considerably higher than those of resting adults[8]. These high levels suggest a large release of norepinephrine from the sympatho-adrenal system of the normal infant at birth. However, the exact origin of the catecholamines found in the plasma of the umbilical cord is unknown. A number of studies have been devoted to the transplacental transfer of catecholamines between the maternal and fetal circulation[9]. This transfer has been a subject of marked controversy. In the human fetoplacental unit, studies with labeled epinephrine and norepinephrine have shown that such transfer is minimal, at least under physiological conditions[9]. Moreover, our results show the absence of correlation between the plasma catecholamine levels of the newborn and the mother, strongly suggesting the fetal origin of most of the catecholamines found in the umbilical cord. In cases of pathological FHR and Apgar < 7, the variances in the catecholamine level are much higher than in the normal cases, probably reflecting different degrees of fetal distress. The stimulus for the release of norepinephrine from the newborn is unknown. Among the numerous stress factors capable of provoking norepinephrine release is hypoxia which has been shown to play an important role in the fetal lamb[4] and in the newborn infant[10,11]. The physiological consequences of the catecholamine release from the human newborn remain to be elucidated. It has, however, been shown that injection of norepinephrine delays the direct cerebrocortical response in asphyxiated newborn rabbits[12].

Our results concerning the mothers show that total plasma catecholamine level is elevated at normal delivery as compared to that in resting nonpregnant women[13]. These results are in agreement with those of Beard and coll.[14], suggesting that parturition is a stressful stimulus which may increase the activity of the maternal sympatho-adrenal system. They do not correlate with the previous findings of Gemzell and coll.[15], who found that the excretion of norepinephrine and epinephrine does not vary during the different stages of labour, and those of Israel and coll.[16], who found relatively constant levels of catecholamines in the blood of pregnant, parturient and post-partum women.

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