RESULTS

1. Granulation Index Technique :

The different grades of granulation appeared to possess specific features ; viz.,

1. Grade 1 : appearing as a single cell with few granules around the nucleus (Fig.1).
2. Grade 2 : appearing as a collection of 1-3 cells with few granules around their nuclei (Fig. 2) .
3. Grade 3 : appearing as a collection of cells with moderately granulated cytoplasms(Fig.3)
4. Grade 4 : appearing as a collection of more than 3 cells distended with ensely packed granules (Fig. 4) .

As regards the index of granulation, the results of the different groups of animals were collectively presented in Table 1 .

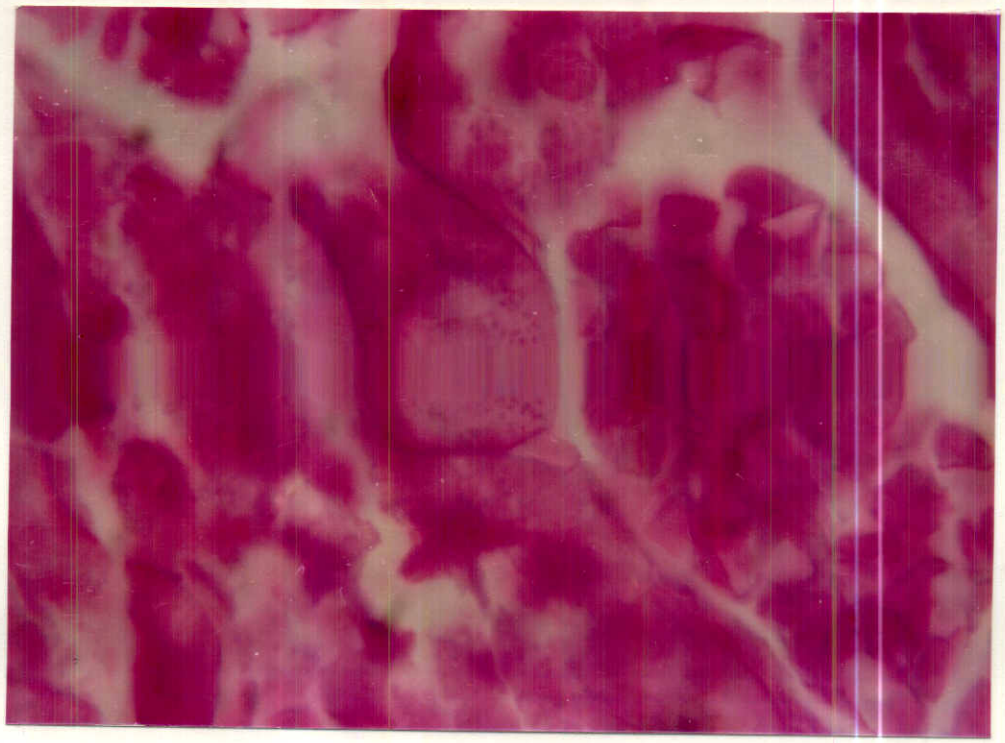

Fig.1 : Showing a grade 1 granulation . Note the presence of few granules around the nucleus of a single cell (arrow)
(PAS , x 1000).

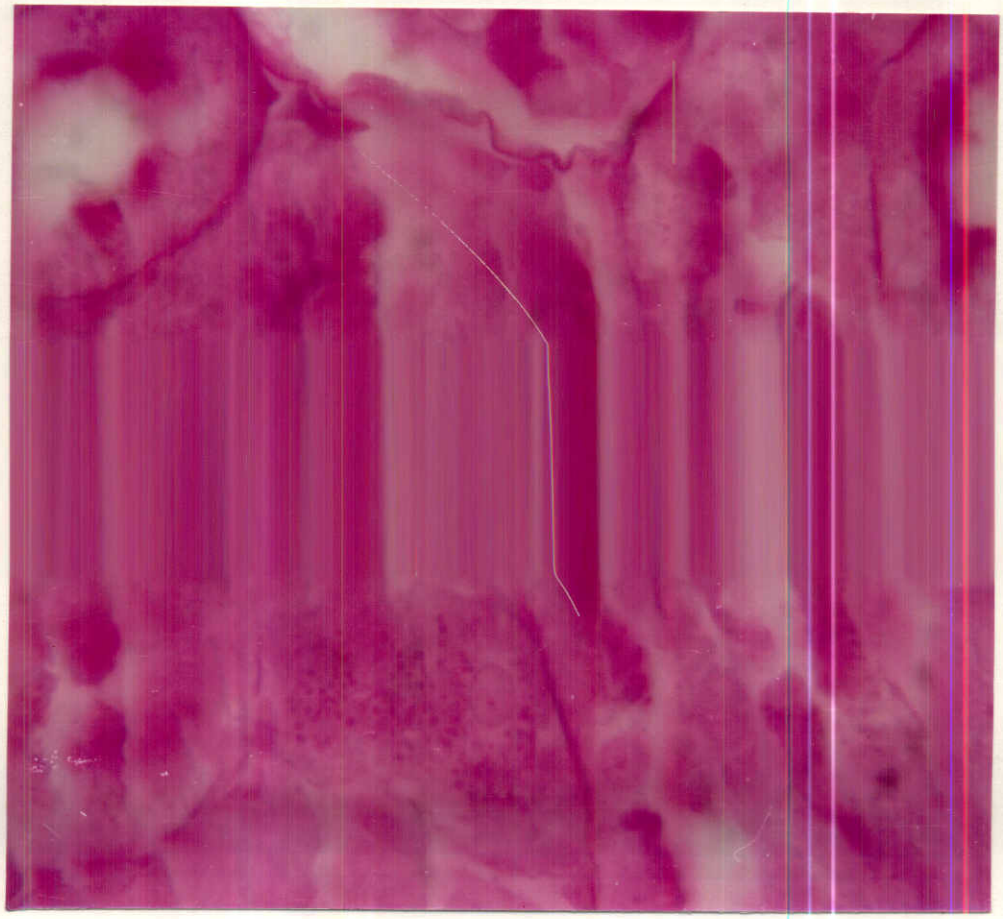

Fig.(2) : Showing a grade 2 granulation . Note the presence of few granules around the nuclei of 3 cells (arrows)
(PAS , x 1000) .

Fig.(3) : Showing a grade 3 granulation . Note the presence of a collection of cells with moderately granulated cytoplasms(arrows) (PAS, x 1000) .

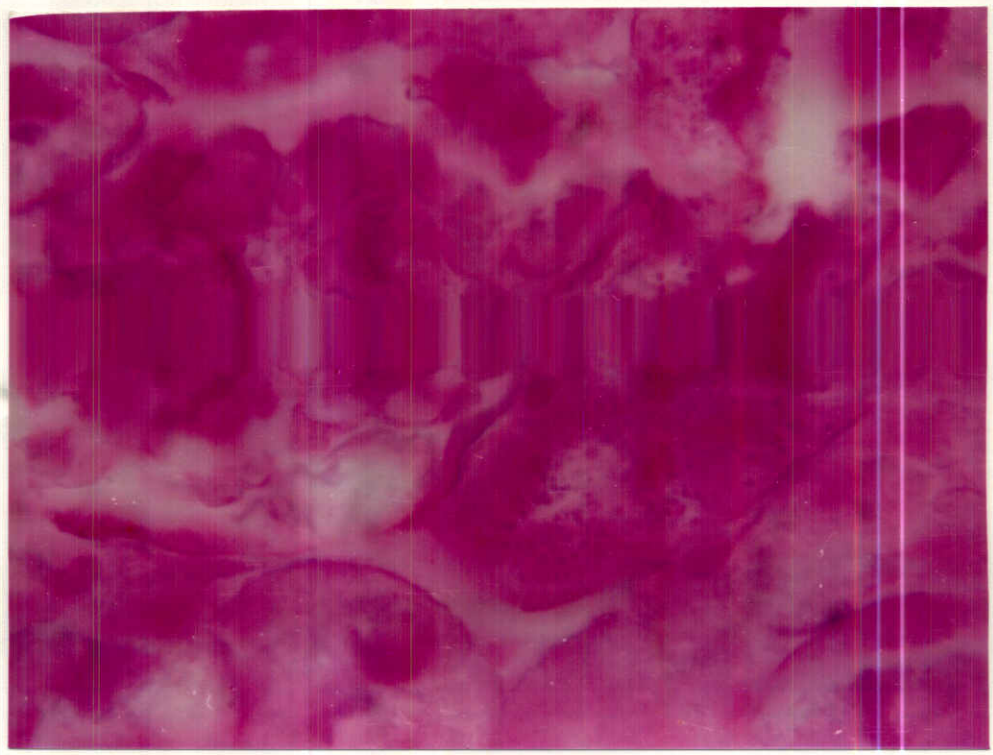

Fig.(4) Showing a grade 4 granulation .Note the presence of a collection of more than 3 cells with heavily granulated cytoplasm (arrows)
(PAS , x 1000) .

Table(1) : Showing the total number of examined glomeruli, the mean value of the granulat ion index, and the population variance of the different groups of experimental animals .

Group	Age	Total No.of Glomeruli	Mean Gran. Index.	Population variance
1	1 day	280	40.32 %	0.95
2	1 week	625	8.52 %	0.29
3	1 month	1050	26.36 %	0.67
4	3 months	1050	40.48 %	1.79
5	6 months	1025	42.64 %	0.57
6	1 year	1075	44.8 %	0.1

1- Group (1) :

The animals had a mean granulation index of 40.32 % with a population variance (σ^2) of 0.95 .

2- Group (2) :

The animals had a mean granulation index of 8.52 % with a population variance (σ^2) of 0.29 .

3- Group (3) :

The animals had a mean granulation index of 26.36 % with a population variance (σ^2) of 0.67 .

4- Group (4) :

The animals had a mean granulation index of 40.48 % with a population variance (σ^2) of 1.79 .

5- Group (5) :

The animals had a mean granulation index of 42.64 % with a population variance (σ^2) of 0.57 .

6- Group (6) :

The animals had a mean granulation index of 44.8 % with a population variance (σ^2) of 0.1 .

The results are presented graphically in Fig. 5

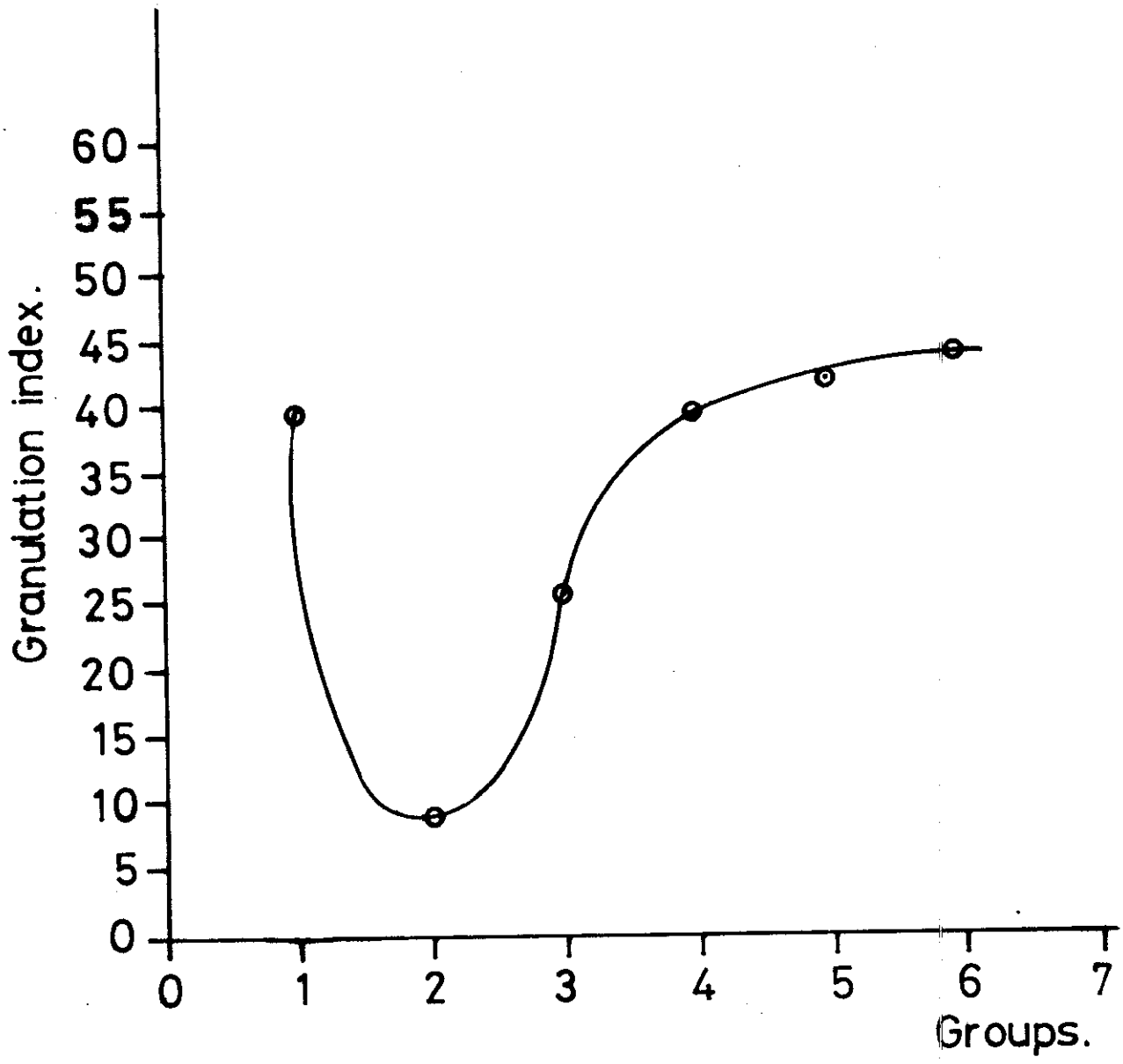

Fig.5 : A chart showing the postnatal alterations in the granulation index of the juxtaglomerular cells in the different age groups.

II. Topographical Tubulo-Vascular Technique:

The direct contact of the macula densa with the vascular pole (bipartite juxtaglomerular apparatus) was shown in Fig. 6, and the results of different groups of animals were collectively presented in Table (2), Fig.(7).

1. Group (1):

None of the examined glomeruli (1500) showed the presence of a direct contact between the vascular pole and the macula densa. Moreover, the aggregated nuclei of the macula region were not observed.

2. Group (2):

The glomeruli, having a direct relation between the vascular and tubular components, had a mean percentage of 12.4 % and a population variance (σ^2) of 0.63.

3. Group (3):

The glomeruli, having a direct relation between the vascular and tubular components, had a mean percentage of 36.79 % and a population variance (σ^2) of 10.25.

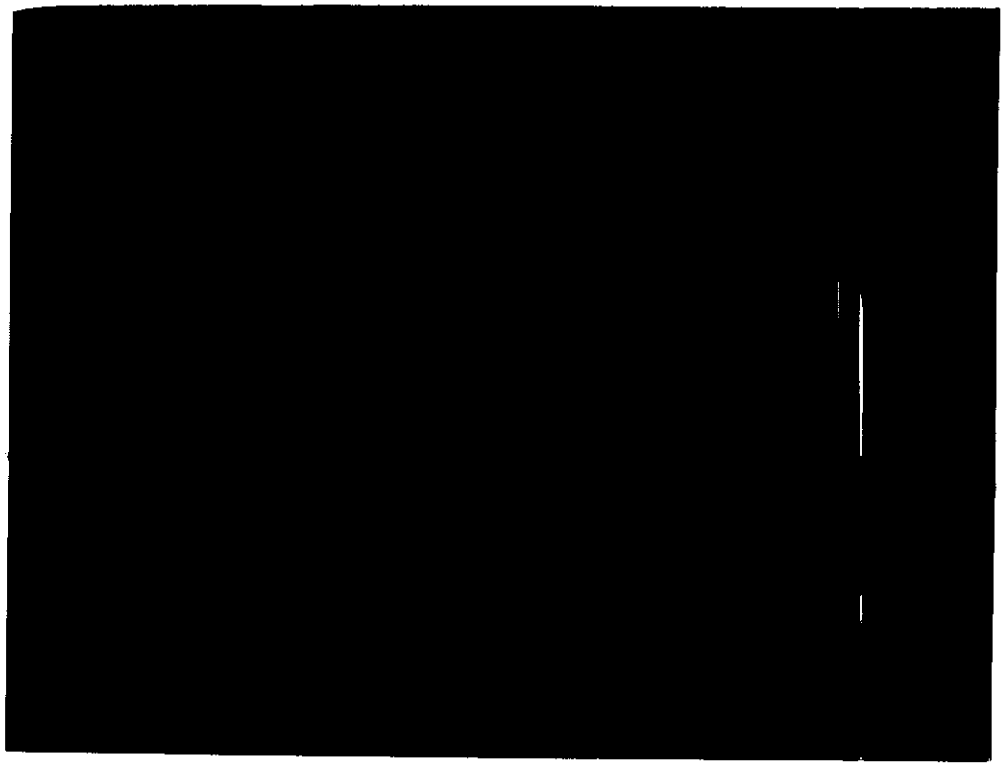

Fig.(6) Showing a direct contact between the aggregated nuclei of the macula densa(arrow) and the wall of the glomerulus(G) near the vascular pole (V). (Hx & E, x 1000.) .

Table (2): Showing the total number of examined glomeruli, the mean percentage of glomeruli with a direct relation between the vascular and tubular components (Bipartite juxtaglomerular apparatus), and the population variance of the different groups of expermintal animals.

Group	Age	Total number of glomeruli examined	Bipartite juxtaglomerular apparatus	Population variance(σ
1	1 day	1500	Zero	Zero
2	1 week	1500	12.4 %	0.63
3	1 month	1500	36.79%	10.25
4	3 months	1500	52.66%	25.04
5	6 months	1500	49 %	6.16
6	1 year	1500	53.2 %	11.82

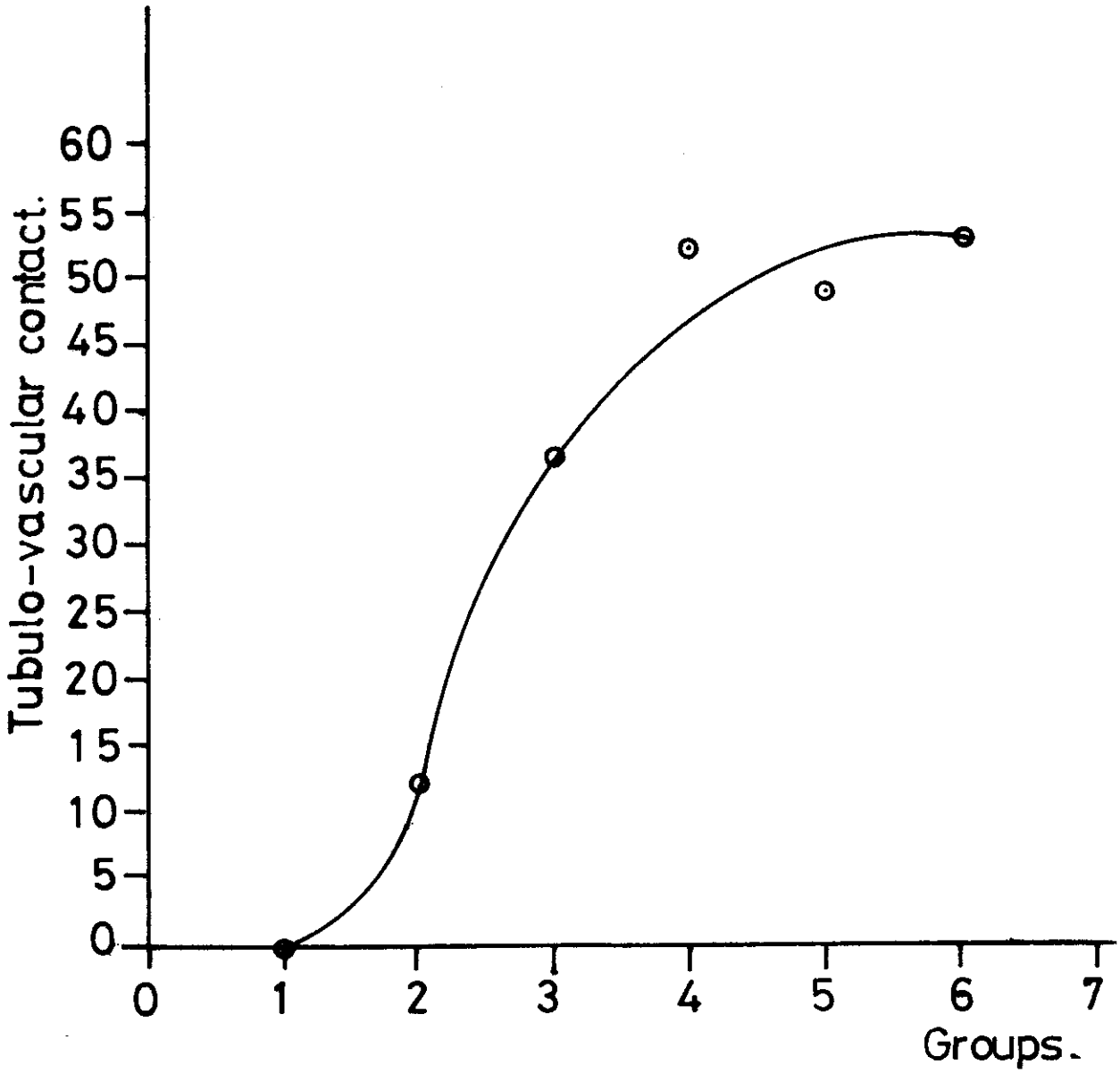

Fig.7 : A chart showing the postnatal alterations in the percentage of tubulo-vascular contact in the different age groups.

4- Group(4) :

The glomeruli, having a direct relation between the vascular and tubular components, had a mean percentage of 52.66 % and a population variance (σ^2) of 25.04 .

5- Group (5):

The glomeruli, having a direct relation between the vascular and tubular components, had a mean percentage of 49 % and a population variance (σ^2) of 6.16 .

6- Group (6):

The glomeruli having a direct relation between the vascular and tubular components had a mean percentage of 53.2 % and a population variance (σ^2) of 11.82 .

DISCUSSION

Juxtaglomerular apparatus is an anatomical unit located at the hilus of the glomerulus and is believed to be involved in the feedback control of renal blood flow and glomerular filt ration rate. In the mammal , it consists of the glomerular arterioles and the extraglomerular mesangium (vascular component), and the macula densa (tubular component). Juxtaglomerular granular cells are modified smooth muscle cells and are believed to be the source of renin. They are present in the vascular component, being most numerous in the afferent arteriole. The cells of the densa segment of the distal tubule are characterized by closely packed nuclei , the basal or lateral position of the Golgi apparatus, and the dispersed mitochondria that show little association with the reduced infoldings of the basal membrane. Physiologically, the vascular component acts as a baroreceptor releasing renin in response to renal ischaemia, whereas the tubular compenent acts as a chemoreceptor which becomes activated in response to altered soduim ion concentration .

Two types of contact between vascular and tubular components are observed ; namely, a complex type involving the distal tubule, the extraglomerular mesangium,

and the efferent arteriole, and a simple type consisting of apposition of the basement membranes of the vascular and tubular components (Barajas, 1979) .

In the present study, two techniques were employed; the granulation index technique and the topographical tubulo-vascular index technique to probe the substantiality of either technique as a morphological parameter in the evaluation of the functional activity of the juxtaglomerular apparatus.The examination of kidney sections of rats showed few mature glomeruli(about 60 in each wholly - scanned coronal section). This finding is supported by the results of Vesna and Spomenka (1980) who stated that the fomation of new nephrons in this species proceeded up to the one month-age of postnatal life,after which only morphological and functional differentiation took place.

Concerning the estimation of juxtaglomerular activity on the basis of the granulation index, the results of the investigators were contradictory. Alexander and Grimason (1967) did not find any differentiated juxtaglomerular cells (containing PAS - positive granules) in the rat kidney before the 14th day of postnatal life. Nevertheless Tsuda, Nickerson and Molteni(1971) stated that mature juxtaglomerular cells could be easily recognized on the 2nd day after birth,and they found relatively few granules at this stage. In addition , Endes ,

Gomba, Devenui, Dauda, Szabo and Soltesz (1973) found granulated juxtaglomemlar cells in the early postnatal period in the rat. They reported that the granulation of the juxtaglomerular cells increased linearly during postnatal life. The present results showed that, on the lst day after birth , juxtaglomerular granules were already present in the vicinity of the glomeruli. The number of positive juxtaglomerular units and the degree of granulation were high. This observation of the high granulation index at this stage may be a result of intensive stimulatory effects on renin production. Such a stimulation may occur in response to the deficiency of sodium intake in this life period as suggested by Hartroft and Hartroft (1953) who showed that the lack of sodium induced a striking rise in the granulation index. Moreover, the low blood pressure in renal arteriole at the time of birth (Bucci, Scalamandre, Savignoni, Mendicini , Piece - Bucci and Piccinato, 1972 ; and Richer, Hornich, Ameil-Tison, Relier and Giudicelli(1977) may add another explanation for the high granulation index as evidenced by the numerous data about intrarenal-baroreceptor mechanism in the control of the synthesis and secretion of renin (Blaine, Davis and

Witty ,1970 ; Blaine and Davis , 1971 ; Gotchal , Davis , Blaine, Musacchia , Braverman, Freeman and Johnson , 1974 ; and Sadowska and Wocial,1977).

The increased granularity of juxtaglomerular cells on the 1st day of life is also in agreement with the data of Hayduck, Krause and Riegger(1975) which showed high plasma renin activity in rats at this stage. Their data also demonstrated the maturity of the renin-angiotensin-aldosterone system in rats at birth. In addition, Richer, et al.(1977) suggested that the neonatal kidney was responsible for the high plasma renin activity and denied the possible transplacental transfer of renin. Moreover, it was recognized that parturition by itself could stimulate an early activation of the juxtaglomerular apparatus for the hight plasma renin activity in the newborn(Broughton Pipkin, lumbers, and Mott, 1974 ; Godard, Hufschmidt, Gaullard and Vollaton, 1975 ; and Laurmenatausta , Eronen and Erkkoia, 1977) .

As for the quantitative variation of the juxtaglomerular granules in postnatal development , the present results are not in agreement with Endes et al.(1973) who found a progressive linear increase in the number of secretory granules during the postnatal life of the rat. The present data recorded a significantly high juxtaglomerular index in the kidney of newborn rats. The indices decreased until the as of 7 day after which they increased gradually up to one year. The explanation of the decrease of juxtaglomerular index from the lst day of life is probably due to the fast development of glomeruli (on the 7th day, the number of glomeruli was twice as high as on the lst day), and the slower differentiation of juxtaglomerular cells. Besides,the stimulatory factors (parturition and low hemodynamic parameters) decrease and a stabilized watersalt balance is achieved .

The statistical analysis revealed a significant difference between each age group and the succeeding one at P level < 0.005 . In addition , the matching of the groups having high granulation indices revealed a significant difference ($P < 0.005$) except for the

lst (1 day) and the 4th(3 month) groups which revealed non-significant difference. Such results provide an evidence that the hormonal status plays an important role in controlling the degree of granulation as supposed by the high hormonal levels in the first group (transplacental) and in the fourth group(around the age of puberty) .

Concerning the anatomical relationship between the tubular and vascular components of the juxtaglomerular apparatus, the present investigation revealed that no contiguity did exist at the new-born age(1 day). However, the contact increased steadily thenceafter till it reached a peak around the age of adulthood. Such results go well with the observations of many investigators (Barajas, 1979) who elucidated a zonal differentiation appearance of juxtaglomerular components with increasing the age examined. In contrast to what has been observed with the granulation index technique, this relation is more stable and steady along the maturation process of the animals.

Accordingly, this deduction may provide a more solid basis upon which one may rely during the interpretation of the histomorphological results as a parameter of function . Synergistically, the changeability of the granulation index with the hormonal status and the amount of dietary salt intake(Vesna and Spomenka, 1980) add more support in favour with the tubulo-vascular topographical relationship .

Statistically, the analysis revealed a highly significant difference ($P < 0.001$) between the mean values of the age groups 1-4, each in comparison with the preceding one. However, a non-significant difference between the mature ages (3 months - 1 year) was observed.These observations suggest a variability in the degree of contact between the tubular and vascular components during the early periods of development. However, a stabilized relationship is achieved thenceafter .