epitheliocytes and connective tissue cells. Subsequently, the mitotic activity and proliferation of basal epitheliocytes dropped to the level typical for normal stratified epithelium; however, foci of proliferation were still seen, with maximal viability of epithelial cells and submucosa during the stimulation of proliferative processes.

Thus, the initial destructive processes observed in the tracheobronchial mucosa and functional depression of the intact cellular elements gave way on the 8th day to reparative processes developing in the affected area, which were characterized by activated division of basal epitheliocytes with a high functional activity of the new transitional epithelium. On the 17th day the process of morphological and functional changes in the tracheobronchial mucosa appears to go through a new stage: normal tracheobronchial epithelium is being formed. Although this process was rather intensive transitional epithelium with aggregates of epitheliocytes undergoing intensive mitosis persisted as long as 24 days following injury.

The pathogenetic characteristics of inhalation injury and restoration of the respiratory function observed for treatment with fibrobronchoscopy open up new arenues for further speeding up the organism's compensatory and adaptive reactions to maintain homeostasis, and make it possible to predict the outcome of bronchopulmonary complications in burn patients.

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Development of Chronic Renal Deficiency in Spontaneously Hypertensive Rats

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Experimental modeling of chronic renal deficiency (CRD) performed on animals with a subtotal nephrectomy [5] demonstrates the role of nonimmunogenic factors in CRD development. A comparative study of CRD formation in normotensive and spontaneously hypertensive rats (SHR) makes it possible to assess the significance of the systemic hemodynamics damage [4].

MATERIALS AND METHODS

A comparative analysis of the development of CRD was performed in a subtotal nephrectomy model in Wistar rats and Okamoto SHR which are a model

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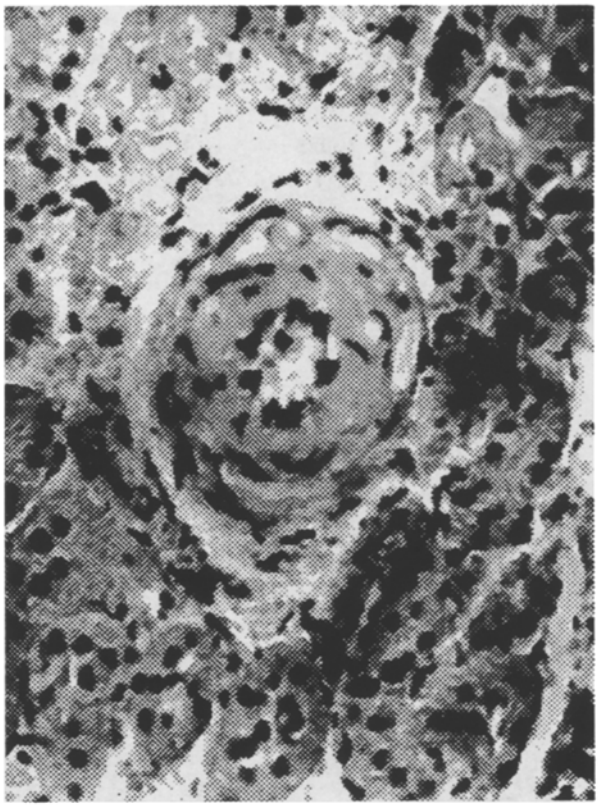

Fig. 1

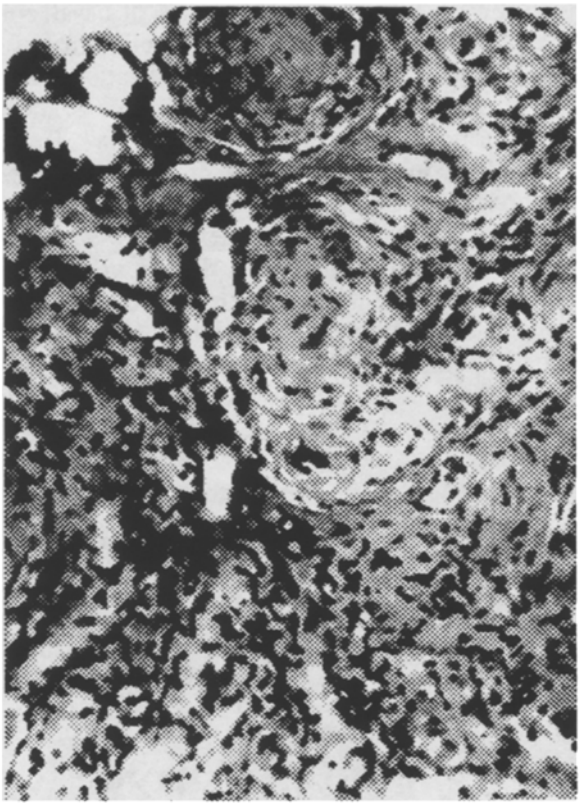

Fig. 2

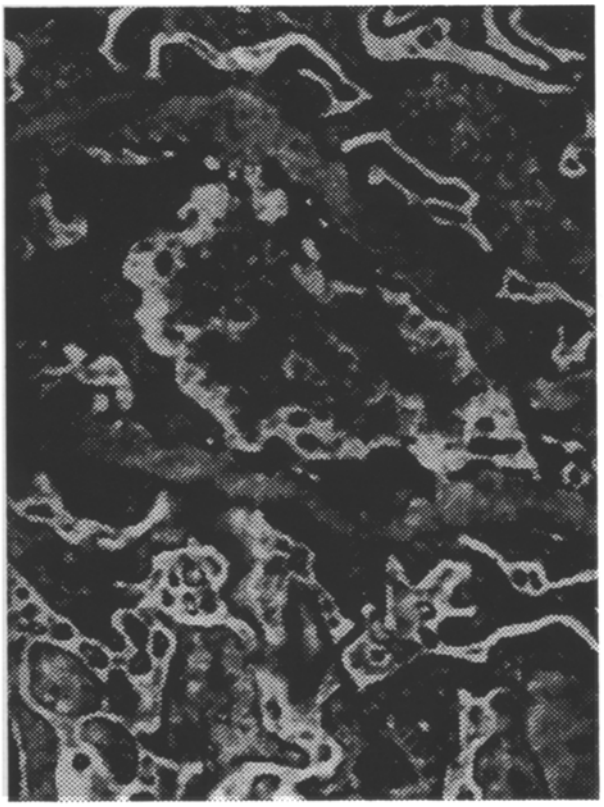

Fig. 3

Fig. 1. Kidney of Okamoto rat at the age of 2 months. A thickening of the arteriole wall, vacuolization, and serous infiltration. Hematoxylin – eosin staining. ×400.

Fig. 2. Kidney of Okamoto rat 3 months after subtotal nephrectomy. Total hyalinization of glomeruli. Hematoxylin – eosin staining. ×200.

Fig. 3. Electronogram of kidney of Okamoto rat 3 months after subtotal nephrectomy. ×30,000.

TABLE 1. Biochemical Parameters of Blood and Urine after a Subtotal Nephrectomy ($x \pm \sigma x$).

Rat strain	Period after operation	Blood (mmole/liter)						Urine		
		Cr	Ur	K	Na	Ca^{2+}	Ca_{tot}	Protein g/liter	RGF, ml/min	minute diuresis
Wistar	Control($n=40$)	0.055± 0.009	5.57± 0.29	7.01± 0.139	140.3± 3.81	1.18± 0.004	2.39± 0.018	0.28± 0.14	0.57± 0.011	0.0019± 0.00045
	1 month($n=10$)	0.125± 0.017*	16.0± 4.27*	7.14± 0.183	139.3± 2.94	0.89± 0.007*	2.39± 0.01	0.46± 0.29	0.42± 0.018*	0.0037± 0.0011*
	2 months($n=10$)	0.14± 0.011*	16.7± 2.18*	6.98± 0.71	144.3± 3.72	0.87± 0.005*	2.39± 0.005	0.76± 0.265*	0.27± 0.117*	0.0029± 0.009
	3 months($n=10$)	0.24± 0.022*	28.3± 4.13*	7.07± 1.04	140.07± 0.002*	0.85± 0.064	2.38± 0.342*	1.37± 1.98	0.272± 0.183*	0.0020± 0.00057
Okamoto	Control($n=20$)	0.056± 0.011	6.17± 0.41	6.83± 0.13	144.7± 2.32	0.94± 0.011	2.39± 0.009	0.44± 0.214	0.70± 0.023	0.0017± 0.00035
	1 month($n=10$)	0.175± 0.0073*,**	16.09± 2.37*	7.09± 0.064*	140.5± 1.74	0.91± 0.008*	2.36± 0.014*,**	1.6± 0.41*	0.40± 0.009*	0.0027± 0.0013
	2 months($n=10$)	0.27± 0.0085*,**	29.8± 4.35*,**	7.15± 0.082*	139.8± 2.74*	0.865± 0.022*,**	2.28± 0.016*,**	3.35± 0.157*,**	0.25± 0.231*	0.0026± 0.00098*
	3 months($n=10$)	0.32± 0.017*,**	38.3± 4.62*,**	7.05± 0.24	145.3± 1.37**	0.82± 0.012*	2.19± 0.043*,**	3.59± 0.47*,**	0.14± 0.057*,**	0.0011± 0.00062*,**

Note. One asterisk – difference reliable for $p<0.05$ for one strain; two asterisks – a difference reliable for $p<0.05$ between strains.

of human essential hypertension [2] and, unlike other strains, exibit arterial hypertension, hypocalcemia, and an elevated level of serum parathyroid hormone [3]. The operation technique and the main stages of CRD development in Wistar rats were described previously [1]. The animals (male rats weighing 180-200 g) were maintained on a standard diet. Blood and urine were examined during the operation and after sacrifice (Table 1). Unified techniques were used in the biochemical assays.

The remaining kidney was fixed with 10% formalin for paraffin embedding; some of the samples were fixed with glutaraldehyde, postfixed with osmium tetroxide, and embedded in Epon for electron microscopy. The histological sections were stained with hematoxylin-eosin, chromotrope, and PAS for assessement of the state of the glomeruli, tubules, vessels, and interstice (Table 2). Arterial pressure (AP) was measured indirectly in the caudal artery (Table 3).

RESULTS

There were no significant differences of AP level (Table 3) in Wistar and Okamoto rats (substrain, 10th generation) at the time of the operation (age of rats 2 months), although morphological examination of the kidneys prior to the operation revealed hypertension-specific alterations in the renal arterioles, such as thickening of the media and serous infiltration of the arteriole wall (Fig.1, Table 2). The blood indexes did not differ significantly except for a Ca^{2+} decrease in Okamoto rats (Table 1).

Azotemia in Okamoto rats after the operation was significantly higher than that in Wistar rats (Table 1). The other parameters, except for Ca^{2+}, were not reliably affected. There was a twofold increase of proteinuria in Okamoto rats in comparison with Wistar rats, the protein content increasing with the passage of time. The rate of glomerular filtration (RGF), determined according to creatinine, progressively diminished in rats of both strains. However, its ratio to the number of preserved nephrons remained high during 2 months. The RGF dropped by the 3rd month, and it was twice as low in Okamoto as in Wistar rats (Table 1). Hypertension developed in the animals of both strains as CRF progressed, but there were no reliable differences in AP between the strains by the 3rd month after the subtotal nephrectomy (Table 3).

The development of the sclerotic changes was considerably more rapid in Okamoto rats: for instance, segmental sclerosis was noted in glomeruli of Wistar rats and total sclerosis in Okamoto rats 3 months after the operation (Fig. 2, Table 2). The dystrophic changes in the tubules and sclerosis of the interstice were more pronounced in Okamoto rats. The renal vessels exhibited hypertension-specific lesions in rats of both strains (Table 2).

Electron-microscopic examination revealed foci of a confluence of the podocyte pedicel processes and regions of detachment of the endothelium from the basal membrane (BM) in Wistar rats 3 months after the operation. Okamoto rats demonstrated a more pronounced deformation and confluence of the podocyte processes, as well as a diffuse endothelium destruction in functionally preserved glomeruli (Fig. 3).

Studies of glomerular damage in different experimental models have attested to the severity of this condition relating to the state of the peripheral ves-

TABLE 2. Structural Changes in Kidney of Wistar and Okamoto Rats 3 Months after Subtotal Nephrectomy (Conventional Units).

Parameters of structural changes	Wistar		Okamoto	
	control	experiment	control	experiment
GLOMERULI				
Mesangium proliferation	0	2	0	2
Matrix enlargement	0	1	0	1
Fibrin thrombi in capillaries	0	1	0	3
Segmental glomerulus sclerosis	0	3	0	3
Total glomerulus sclerosis	0	1	0	3
PROXIMAL TUBULES				
Granular degeneration	1	3	1	2
Hyaline–drop degeneration	0	1	0	2
Epithelium atrophy	0	1	0	3
Protein casts with fibrin	0	3	0	3
DISTAL TUBULES				
Dystrophy	0	3	0	1
Atrophy	0	1	0	3
Cystic degeneration	0	3	0	4
Protein casts with fibrin	0	3	0	4
STROMA				
Sclerosis of medullary substance	0	1	0	3
Focal sclerosis of cortical substance	0	2	0	3
Diffuse sclerosis of cortical substance	0	1	0	4
VESSELS				
Thickening of arteriole wall, serous infiltration.	0	2	2	2
Elastofibrosis of medium–size and small arteries	0	1	0	3
Perivascular sclerosis	0	1	0	2

sels (mainly the afferent arterioles) rather than AP. Glomerular damage was not significant in Okamoto rats (pure strain), in which the afferent arterioles showed an increased resistance [4,5]. The slow development of glomerular sclerosis in hypertensive Milan rats as opposed to normotensive rats, as well as after a subtotal nephroectomy in SHR related to the enhancement of afferent arteriole resistance [4]. These facts suggested to us a more favorable course of the pathological process in the kidneys of SHR in our experiments. However, the Okamoto rats at our disposal (2 months old at the time of the operation) did not demonstrate the AP elevation to 200 mm Hg that was typical for the pure strain. This phenomenon indirectly attested to a diminished peripheral artery resistance and, in particular, a decrease of the tone of the afferent arterioles at the moment of surgical trauma. The decreased afferent arteriole resistance resulted in a transference of the rising systemic AP to the glomerulus capillaries and promoted a rise of the intraglomerular pressure [6]. Dilatation of the afferent arterioles triggers the reaction of capillary damage and disturbed in permeability. Distension of the afferent arteriole wall is accompanied by an increase of prostaglandin E_2 production, resulting in the release of angiotensin II, which acts upon the efferent arteriole as a target. Constriction of the latter promotes a stable elevation of the glomerular pressure [4]. Okamoto rats in comparison with Wistar rats exhibited an increased level of catecholamines and other vasoconstrictive agents in the blood [3], their concentration being stepped-up due to postsurgical stress.

Thus, it may be assumed that at the root of the dramatic development of renal sclerosis in

TABLE 3. Arterial Pressure in Wistar and Okamoto Rats after Subtotal Nephrectomy (mm Hg) ($x \pm \sigma x$)

Rat strain	Normal	Period after subtotal nephrectomy		
		1 months	2 months	3 months
WISTAR	115.0±3.5* $n=12$	113.5±4.4** $n=13$	144.2±4.2 $n=17$	174.8±6.7* $n=15$
OKAMOTO	125.0±7.2* $n=6$	152.2±6.7** $n=6$	157.0±11.0 $n=6$	175.5±5.8* $n=23$

Note. One asterisk – difference reliable for $p<0.05$ for one strain; two asterisks – difference reliable for $p<0.05$ between strains.

Okamoto rats lies an autoregulatory disturbance due both to a genetic peculiarity of the metabolism and the state of the artery wall.

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