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Morphofunctional Peculiarities of the Effects of Electric Coagulator on Thyroid Tissue

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Morphological changes in the thyroid tissue after exposure to coagulators were studied. Application of a monopolar coagulator resulted in the formation of narrow marginal coagulation necrosis on day 3, with a fibrous capsule of different thickness, and marginal sclerosis of the glandular parenchyma; inflammatory changes in the connective tissue in the resection edge persisted for 14 days. Bipolar coagulator produced the most pronounced damaging effect leaving septae up to 10 mm long penetrating into the depth of the gland and causing stubborn persistent deep and marginal sclerosis of the gland.

Key Words: *thyroid; bipolar coagulator; monopolar coagulator; suturing material; follicles*

Despite numerous clinical, pathophysiological, biochemical, and morphological studies, many important aspects in the etiology and pathogenesis of thyroid diseases remain unclear and the results of their treatment unsatisfactory.

The treatment efficiency depends on targeted etiotropic and pathogenetic therapy. This indicates the importance of profound studies of the etiology and pathogenesis of thyroid tissue changes during the postoperative period on experimental material [2].

Morphological studies of the dissected thyroid tissue after application of coagulators are difficult. The results of analysis of thyroid biopsy specimens are more reliable, but the possibility of obtaining this material is limited [4]. Therefore, experimental material is particularly valuable [4].

The model of experimental application of coagulators used in our study is most convenient: it can be reproduced on laboratory animals (dogs). The morphological picture of the thyroid tissue and operation area is standard: the dogs easily tolerate the intervention with favorable outcomes in almost 100% cases [3].

This model has no prototype in human diseases, but it is convenient for studies of the patho- and morphogenesis of thyroid injuries, primarily due to standard results obtained in several series. It is possible to induce changes of different severity, including those with a favorable prognosis needing no sophisticated treatment. The time course of the pathological process from the moment of the gland damage until complete healing of the focus of injury can be thus followed up [4].

MATERIALS AND METHODS

Changes in the thyroid tissue were studied in 8 adult dogs of both sexes (10-20 kg) [1] with consideration for "Regulations for Studies on Experimental Animals". All operations were carried out on narcotized animals with strict adherence to aseptic and antiseptic rules. The dogs were injected with 2.5% sodium thiopental (0.4-0.5 ml/kg).

By vertical median incision of the skin and subcutaneous fat on the neck (from the thyroid cartilage downwards, just not reaching the jugular incision of the sternum) the muscular fascia was exposed. Longi-

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tudinal muscles of the anterior surface of the neck (sterno-sublingual muscles) were mobilized on both sides of the trachea. Elongated thyroid lobes, resembling a large lymph node, were separated from under the muscles and from the neurovascular formations. The thyroid gland in dogs has no isthmus. Edges of both thyroid lobes were resected one after the other. The wounds were coagulated, thyroid tissue of 4 dogs was resected with a monopolar coagulator and of 4 other dogs by a bipolar one. After 3, 7, 14, and 30 days the thyroid tissue was repeatedly resected at the site of the intervention, fixed in 10% formaldehyde, and studied by histological methods.

RESULTS

Up to 10 cm^2 serous fluid was found after 3 days in the thyroid bed after application of by monopolar coagulator. The resection edges were irregularly shaped, charred, at some sites up to 8 mm wide, brown, at some sites whitish, tuberous at palpation.

A thinned portion of coagulation necrosis of the glandular parenchyma was detected in the resection edge 3 days after thyroid resection and tissue hemostasis by a monopolar scalpel. Dilated plethoric blood vessels and perivascular sclerosis with lymphoid in-

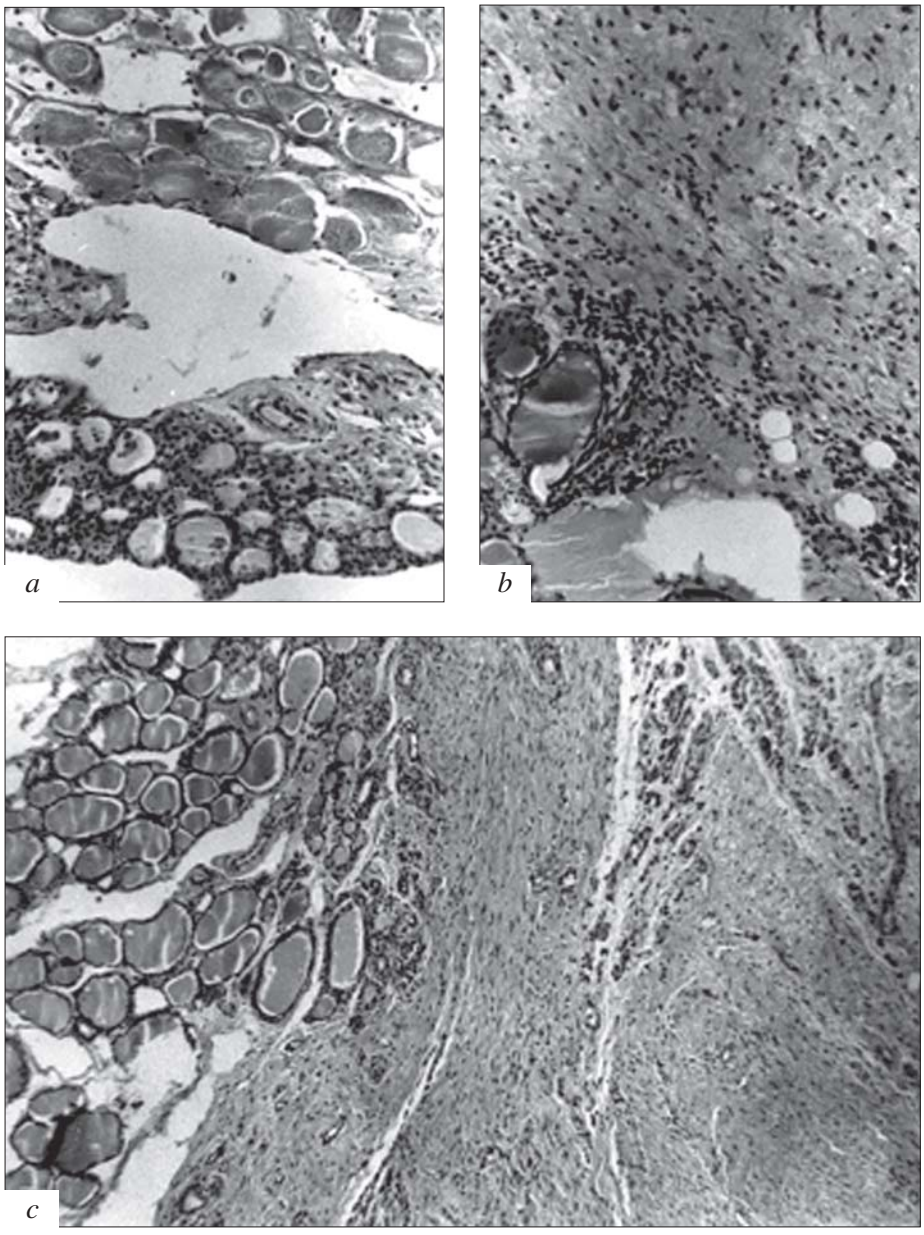

Fig. 1. Histological changes in the thyroid tissue 3 (*a*), 14 (*b*), and 30 (*c*) days after thyroid resection with a monopolar scalpel. *a*) marginal coagulation necrosis of glandular parenchyma with dilatation of a venule and perivascular inflammatory infiltration; *b*) inflammatory lymphoplasmacytic infiltration in the fibrous capsule edge; *c*) wide fibrous capsule with subcapsular atrophy of follicles. Hematoxylin and eosin staining, ×250 (*a*, *b*), ×125 (*c*).

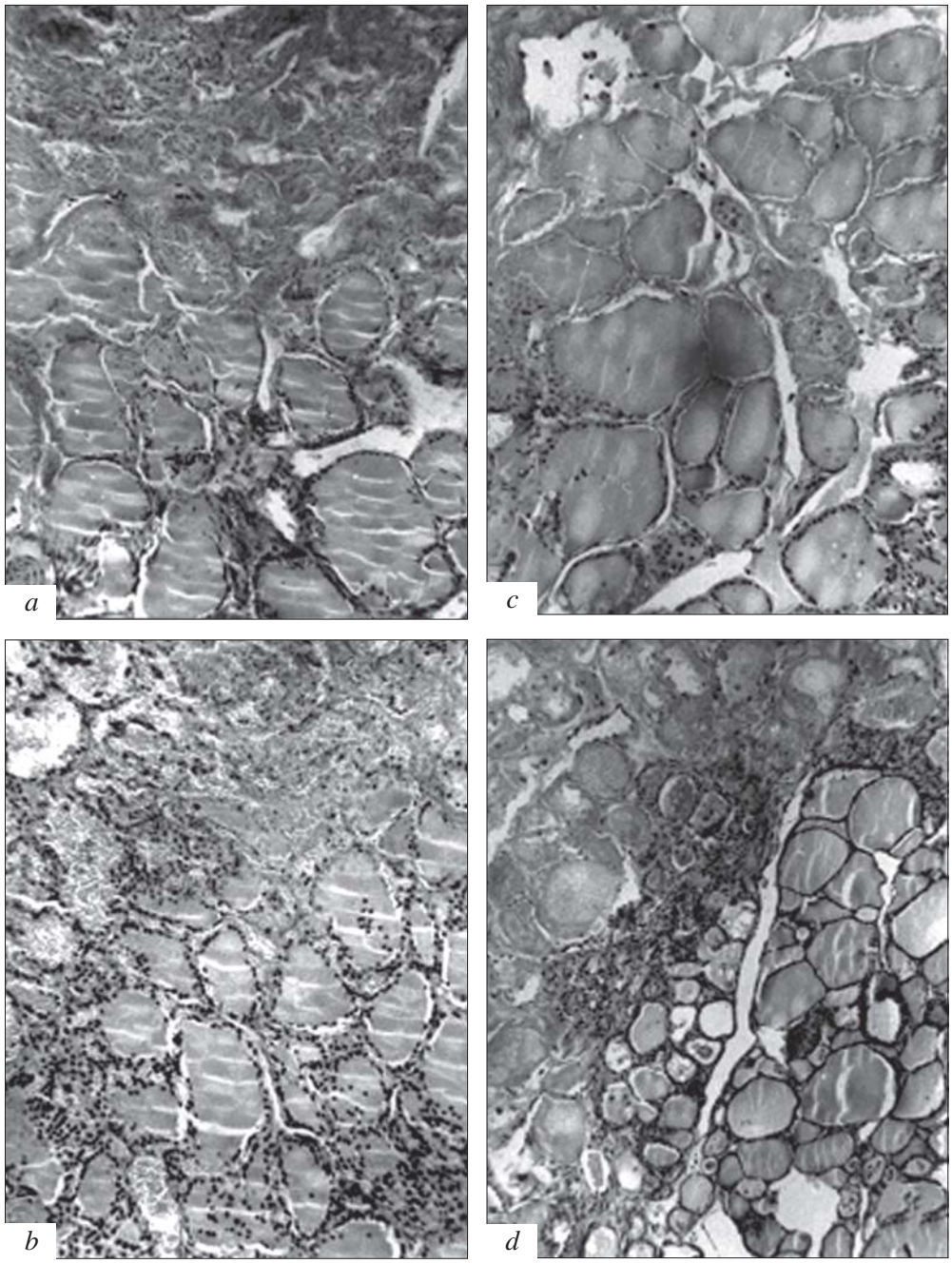

Fig. 2. Histological changes in thyroid tissue 3 (*a*, *b*), 7 (*c*), and 14 days (*d*) after resection with a bipolar scalpel. *a*) wide zone of coagulation necrosis without signs of demarcation; *b*) hemorrhage into follicular lumen in necrobiotic zone of glandular parenchymatous tissue; *a-c*) no demarcation of coagulation necrosis; *d*) narrow zone of forming sclerosis at the interface of necrotic tissue. Hematoxylin and eosin staining, ×250 (*a-c*), ×125 (*d*).

flammatory infiltration in the perivascular spaces were seen at the interface of this necrosis in the adjacent glandular parenchyma. Signs of interstitial edema were detected in the underlying thyroid tissue. Decreased follicles and inflammatory infiltration in the interfollicular connective tissue were seen (Fig. 1, *a*).

After 7 days fibrin deposit and up to 7 cm^2 serous fluid were found in the thyroid bed. The resection edge was uneven (up to 10 mm), tuberous, the rest tissue has rigid consistency and brownish-whitish color.

Histological study 7 days after resection showed the absence of glandular tissue; the material consisted of fibrous fatty tissue with signs of acute inflammation presenting as diffuse and perivascular leukocytic infiltration.

After 14 days a fibrous capsule formed in the thyroid resection edge with underlying sclerosed fatty

tissue. Fibrous tissue with scanty cells clearly delineated the glandular parenchyma. Signs of chronic inflammation (diffuse lymphoid infiltration, Fig. 1, *b*) persisted in the connective tissue capsule and septae penetrating into the depth of the gland.

After 30 days histological study showed fibrous capsule of different thickness with arterial and venous vessels in the resection edge.

No inflammatory changes were seen in the connective tissue, but some septae originating from the capsule penetrated into the depth of the gland causing marginal sclerosis.

The use of monopolar scalpel for thyroid resection resulted in the formation of narrow marginal coagulation necrosis on day 3 with the formation of a fibrous capsule of different thickness and marginal sclerosis of the glandular parenchyma.

Inflammatory changes in the connective tissue in the resection edges persisted for 14 days.

Involvement of fatty tissue in the demarcation process promoted extension of the sclerotic zone in the connective tissue and the adjacent glandular parenchyma.

Macroscopic examination 3 days after application of bipolar coagulator showed up to 10 cm^2 serous fluid, the edge of the resected tissue was charred and brown. Palpation revealed uneven tuberous edge of up to 10 mm. The rest tissue has soft elastic consistency.

Histological study 3 days after resection of the thyroid and hemostasis with bipolar scalpel showed a wide zone of coagulation necrosis and necrobiosis in the resection edge and in the depth of the glandular tissue.

Some areas of necrotic tissue were characterized by extensive fields of hemorrhages into follicular lumens and interfollicular strata of connective tissue. The interface between damaged zone and intact tissue was blurred because of wide transitional necrobiotic zone. No inflammatory changes were seen in the thyroid tissue (Fig. 2, *a*).

Macroscopic examination 7 days after resection showed serous exudation of up to 10 cm^2 and fibrin deposit. The resection edge was charred, uneven, compact, up to 10 mm, whitish at some sites. The remaining tissue has rigid consistency.

Seven days after thyroid resection wide zones of coagulation necrosis exhibited no trend to demarcation from viable parenchyma. The formation of demarcating capsule, presenting as islets of loose connective tissue with numerous vessels in it, without signs of inflammation (Fig. 2, *b*) started in just few areas.

Macroscopic examination after 14 days showed adhesive process and a negligible amount of serous liquid in the resected tissue sheath. The edges of the resected gland were uneven and blurred. The edges were tuberous, up to 8 mm wide. The remaining tissue has rigid consistency.

After 14 days there were wide zones of non-encapsulated glandular tissue necrosis, with foci of sclerosis forming at some areas with intact glandular parenchyma. Signs of chronic inflammation were found in the demarcating connective-tissue strata (Fig. 2, *c*).

Morphological studies of thyroid tissue after resection and hemostasis with bipolar scalpel showed wide zones of marginal tissue necrosis, delayed encapsulation of necrotic areas, and inhibition of inflammatory reaction to injury.

Application of mono- and bipolar scalpels leads to the formation of wide persistent zones of not only marginal necrosis, but of foci of injuries in the depth of tissues, slow demarcation from intact tissues, and late cicatrization.

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