

# PHYSICOCHEMICAL PROPERTIES OF CIRCULATING IMMUNE COMPLEXES IN SERUM AND TEARS OF PATIENTS WITH CATARACT BEFORE AND AFTER OPERATION

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In recent years the broadening of indications for implantation of an artificial lens has been accompanied by an increase in postoperative complications of an inflammatory nature, to which the name anterior uveitis has been given. Contradictory opinions have been expressed in the literature on the etiology of this complication. Meanwhile some workers have expressed the view that anterior uveitis is autoimmune in nature and based on an imbalance of interconnections in the T- and B-system of cellular immunity, accompanied in particular by disturbances in the complement system and by a marked increase in the concentration of circulating immune complexes (CIC) [1-5, 10]. For instance, CIC have been found in the aqueous humor and in the serum of patients with some forms of uveitis, but at the same time they were not present in the aqueous humor of patients with senile cataract [6].

Disturbances of this kind have been observed during the development of postoperative uveitis not only in patients with cataract, but also in experiments on rabbits [5, 10].

CIC with pathogenic properties, playing a leading role in the development of autoimmune diseases, have been found to be of great diagnostic and prognostic significance, and it was this fact which motivated the present investigation. Its aim was to assess the physicochemical properties of CIC in patients with cataract before and after the operation, and also to study correlation with the postoperative course.

## EXPERIMENTAL METHOD

CIC were studied in the tears and serum of 67 patients with cataract before and after operative treatment by implantation of an artificial lens, by the laser nephelometry method [9]. The concentration of CIC and their mean molecular weight were determined in IgG units. The complexes are regarded as small if their molecular weight lies between 2 and 9 IgG, middle-sized between 9 and 21 Ig G, and large if bigger than 21 IgG [7]. The control group consisted of healthy individuals (18 people).

During assessment of the physicochemical properties of CIC in the blood serum and tears before and after the operation on patients with cataract it was found that they differ significantly (Tables 1-3). For instance, whereas CIC were present in the blood serum before the operation in 76% of patients, they were present in the tears in only 30%. The pattern was different after the operation, for CIC were found in the serum and tears in 93 and 97% of patients respectively. Not only the quantity of CIC in the media was changed, but also their properties.

The data in Tables 1 and 2 show that before the operation CIC mainly of medium size were present in the serum and tears of 49 and 70% of patients respectively. Small and large CIC were discovered in fewer subjects in these media. For instance, small CIC were found in the serum and tears of 26.5 and 17% of patients, large in 17 and 5% of patients respectively.

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TABLE 1. Trend of Serum CIC Level and Correlation with Postoperative Course ( $M \pm m$ )

CIC	Number of patients with de- tected CIC		Mean concentration of CIC, mg/ml	
	before operation	after operation	before operation	after operation
Small (2-8.0)	18	22	$2.88 \pm 0.9$	$3.8 \pm 1.06$
Average (9-21)	30	29	$0.94 \pm 0.3$	$2.34 \pm 0.2$
Large (21)	10	8	$0.66 \pm 0.08$	$1.5 \pm 0.23$
Not found	9	—8	—	—

TABLE 2. Trend of Physicochemical Parameters of CIC in Tears and Correlation with Postoperative Course ( $M \pm m$ )

CIC	Number of patients with de- tected CIC		Mean concentration of CIC, mg/ml	
	before operation	after operation	before operation	after operation
Small (2-8.0)	3	1	$2.64 \pm 0.4$	2.50
Average (9-21)	14	33	$0.82 \pm 0.005$	$2.08 \pm 0.4$
Large (21)	3	31	$0.23 \pm 0.05$	$0.97 \pm 0.03$
Not found	47	2	—	—

After the operation the number of patients found to have CIC in their tears was considerably increased (98%), whereas the number of patients with CIC in their serum was virtually unchanged. Whereas mainly small and medium-sized CIC were found in the blood (in 52 and 42% of cases respectively), in the tears mainly medium-sized and large complexes were found (52 and 46%). The CIC concentration in the media tested likewise was unstable. An operation was accompanied by a sharp increase in the concentration of small and medium sized CIC in the tears but only a very small increase in their concentration in the serum. Whereas the number of small and medium-sized CIC in the tears was increased almost threefold, their concentration in the serum was only doubled.

The type of operation has a significant effect on the character of changes in the physicochemical properties of CIC (Table 3). The sharpest increase in the concentration of small and medium-sized complexes in the serum and tears was found after removal of the lens together with opening of its capsule and preservation of the capsule.

It is interesting to note that the increase in the concentration of medium-sized immune complexes in the tears to 1.2 mg/ml or more, was accompanied as a rule by the appearance of symptoms of anterior uveitis, which were particularly marked on the 3rd and 5th day. The results are further confirmation that CIC play an important role in the development of uveitis. It can be tentatively suggested that as a result of an operation to replace an opaque lens with an artificial lens, a certain part of the lens proteins will enter the anterior chamber of the eye. These proteins or their conglomerates, being antigens, stimulate the production of specific antibodies and the formation of antigen-antibody complexes. The presence of a polymer support may facilitate the immunization process and may act as a form of adjuvant in this process.

This hypothesis is confirmed by the fact that, first, the development of symptoms of uveitis takes place until the 3rd-5th day after the operation (the period of maximal antibody formation) and, second, removal of the lens without evacuation of the lenticular masses (intracapsular extraction) and implantation of an artificial lens are not accompanied by the appearance of CIC in the tears and by a significant increase in the CIC concentration in the serum.

The time course of changes in the physicochemical properties of the complexes (their size and concentration) during the development of postoperative uveitis in eyes with an artificial lens also corresponds to the classical trend of these parameters in autoimmune diseases. Thus, as a result of antigenic immunization with lenticular masses an excessive quantity of antigen-antibody complexes with pathogenic properties (medium-sized molecular masses and an increased

TABLE 3. Trend of Physicochemical Parameters of CIC and Correlation with Type of Operation ( $M \pm m$ )

	Number of eyes	Number of patients	Distribution of CIC in serum, mg/ml			Distribution of CIC in tears, mg/ml		
			small	medium sized	large	small	medium sized	large
Before EEC operation	11	10	$1.1 \pm 0.8$	$0.8 \pm 0.2$	$0.6 \pm 0.04$	0.4	—	—
After operation	11	10	$3.3 \pm 1.4$ (3)	$2.0 \pm 0.1$ (6)	$1.2 \pm 0.04$ (2)	—	$2.1 \pm 0.7$ (4)	$2.2 \pm 0.4$ (5)
Before EEC + IAL operation	40	39	$1.6 \pm 0.4$	$2.0 \pm 0.2$	$0.7 \pm 0.5$	2.36	$0.8 \pm 0.1$	—
After operation	40	39	$2.3 \pm 0.4$	$2.2 \pm 0.2$	$0.6 \pm 0.2$	—	$2.0 \pm 0.1$	$1.0 \pm 0.1$
Before IEC operation	4	4	—	$0.1 \pm 0.03$	—	0.34	$0.68 \pm 0.01$	—
After operation	4	4	—	0.96	—	$1.4 \pm 0.1$	$2.7 \pm 0.7$	—
Before IEC + IAL operation	5	5	$3.8 \pm 1.0$	0.7	0.3	—	—	—
After operation	5	5	$4.6 \pm 2.0$	—	1.72	0.17	2.39	$1.0 \pm 0.1$

**Legend.** EEC) Extracapsular extraction of cataract, EEC + IAL) extracapsular extraction of cataract + implantation of artificial lens, IEC) intracapsular extraction of cataract, IEC + IAL) intracapsular extraction of cataract with implantation of artificial lens.

concentration [8]), is formed. These complexes may be initiators of activation of the complement system and of the development of an inflammatory reaction inside the eye.

The appearance of antigen-antibody complexes with pathogenic properties predominantly in the tears in the postoperative period, by contrast with the serum, indicates local formation of CIC at the site of maximal presence of the antigen.

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