Preoperative Immune Status and Lipid Peroxidation as Risk Markers for Pyelonephritis Attack after Percutaneous Nephrolithotomy

I. A. Volchegorskii and A. N. Popov

Translated from *Byulleten' Eksperimental'noi Biologii i Meditsiny*, Vol. 130, No. 8, pp. 220-222, August, 2000
Original article submitted May 18, 2000

Pyelonephritis attack after percutaneous nephrolithotomy can be predicted on the basis of immunity parameters and blood level of lipid peroxides.

Key Words: *neutrophils; immunoglobulins; lipid peroxidation; postoperative pyelonephritis; percutaneous nephrolithotomy*

Percutaneous nephrolithotomy (PN) is a modern highly effective method for endosurgical treatment of nephrolithiasis. Although this intervention is sparing, the early postoperative period (PP) after PN is often complicated by pyelonephritis attack [4]. Scanty and often contradictory reports about bacteriological risk factors for postoperative pyelonephritis [6,8] do not help to predict inflammatory complications after PN. On the other hand, reaction to phlogogenic factors can be predicted from initial parameters of the immune status and the content of lipid peroxidation (LPO) products in the blood [3].

MATERIAL AND METHODS

Sixty-eight patients with nephrolithiasis (44 women and 24 men) were hospitalized in endourology department for planned PN. Their immune status was evaluated and LPO products in the blood were measured 24 h before surgery. Control group consisted of healthy donors (n=60).

Serum immunoglobulins (IgA, IgM, IgG) were measured as described previously [7]. The function of blood neutrophils was evaluated by NBT test and phagocytosis of polystyrene latex particles using standard kits (Reakompleks, Chita). In addition to baseline (spontaneous) parameters, the phagocytic reaction and NBT test were evaluated after *in vitro* prodigiosan stimulation. The neutrophil functional reserve was estimated as the ratio of stimulated to spontaneous NBT test activity. The content of LPO products in heptane-isopropanol extracts of the serum was measured by spectrophotometry [2] and the results were expressed as oxidation indexes E_{232}/E_{220} and E_{278}/E_{220} for primary and secondary LPO products, respectively.

Depending on the clinical condition during PP, a group of "realized risk" of pyelonephritis attack was distinguished. The results of preoperative examinations of this group were compared with the respective values in donors and in patients with uneventful PP.

The data were statistically processed using the Student, Wilcoxon—Mann—Whitney, and Wald—Wolfowitz tests.

RESULTS

Percutaneous nephrolithotomy was complicated by pyelonephritis attacks in 22 (32.4%) patients. Preoperative immune status in patients with postoperative pyelonephritis differed from that of patients without complications and donors (Table 1): spontaneous activity of neutrophil phagocytosis and functional reserve of neutrophils increased significantly. The initial blood content of IgG in patients with postoperative pyelonephritis was decreased in comparison with patients without complications. The levels of IgM and

Chelyabinsk State Medical Academy

0007-4888/00/0008-802$25.00

TABLE 1. Preoperative Values of Immune Status and Serum LPO Products in Patients with Different Course of PP ($M \pm m$)

Parameter	Donors (control, n=60)	Uneventful course of PP (n=46)	Postoperation pyelonephritis (n=22)
Spontaneous NBT test, %	39.5±1.9	37.4±2.3	42.6±2.0*
Neutrophil functional reserve, arb. units	1.30±0.07	1.06±0.06+	1.28±0.10*
Immunoglobulins, g/liter			
IgM	2.17±0.23	2.18±0.25	2.41±0.44+
IgA	2.69±0.17	2.89±0.22	3.36±0.43+
IgG	12.00±0.41	12.75±0.49	10.96±0.54*
Diene conjugates, E_{232}/E_{220}	0.53±0.01	0.63±0.04+	0.58±0.03
Ketodienes and conjugated trienes, E_{278}/E_{220}	0.29±0.01	0.39±0.04+	0.28±0.02*

Note. $p<0.05$: *vs. uneventful course of PP, +vs. healthy controls.

IgA in the group of realized risk were significantly higher than in healthy controls and patients without complications. These shifts indicate initial stimulation of the phagocytic component of immunity and activation of primary antibody production in the presence of depressed secondary immune response in the "realized risk" patients. The impaired immune status in these patients can reflect latent infectious inflammation in the kidneys.

The relative deficiency of secondary immune response promotes persistence of pathogenic and/or opportunistic bacteria in the pelviocaliceal system of the kidney. Activation of primary immune response under these conditions can be regarded as a compensatory adaptive reaction. The differences in the blood IgM concentrations and risk of pyelonephritis after PN in men and women athested to the importance of this compensatory mechanism. In women PP was complicated by pyelonephritis in 22.7% and in men in 50% cases ($p<0.05$), the preoperative content of IgM being 2.31±0.30 g/liter in women (n=34) and 1.56±0.21 g/liter in men (n=12, $p<0.05$). In donors IgM levels were also different in women and men: 2.69±0.39 and 1.73±0.25 g/liter respectively, $p<0.05$.

The differences in the preoperative LPO values in the groups agree with the concept on the bacteriological activity of LPO products and their regulatory effect on the immune system [5,9,10]. A favorable course of PP was associated with an initial accumulation of serum isopropanol-soluble LPO products in comparison with donors (Table 1). Preoperative level of secondary isopropanol-soluble LPO products (ketodienes and conjugated trienes) in the realized risk group was significantly decreased in comparison with that in patients without complications. This relatively high level of LPO products can inactivate neutrophils and prevent the realization of their phlogogenic potential in response to intervention. A significant decrease in the neutrophil functional reserve in patients without complications in comparison with the realized risk group and healthy donors confirms this hypothesis. A similar relationship between the neutrophil functional reserve and the content of LPO products in expirate was demonstrated in coronary patients with chronic bronchitis [1].

Using discriminant analysis of the data, we deduced an algorithm of preoperative quantitative evaluation of the risk of pyelonephritis attack after PN:

$$S_1 = -28340.1 + 563.5S - 109.3(E_{278}/E_{220}) + 0.7\ IgG - 7.1\ IgA + 44.7\ IgM + 15.9\ InF - 8.9\ NBT_r;$$

$$S_2 = -28550.5 + 565.6S - 112.0\ (E_{278}/E_{220}) + 0.3\ IgG - 6.6\ IgA + 45.2\ IgM + 16.1\ InF - 7.3\ NBT_r,$$

where S_1 is the score for the group with uneventful course of PP, S_2 is the score for the group at risk of complications, S is patient sex (100 for female and 101 for male), InP is intensity of phagocytosis for prodigiosan-stimulated neutrophils (number of latex particles phagocytosed by one cell), and NBT_r is neutrophil functional reserve evaluated by the activity of NBT test.

The probability of postoperative pyelonephritis is high at $S_1 < S_2$, while at $S_1 > S_2$ the course of PP will be uneventful. The accuracy of preoperative prognosis with this algorithm is 80.6%.

REFERENCES

1. I. A. Volchegorskii, G. L. Ignatova, E. G. Volkova, and O. L. Kolesnikov, *Byull. Eksp. Biol. Med.*, **126**, No. 10, 452-454 (1998).
2. I. A. Volchegorskii, A. G. Nalimov, B. G. Yarovinskii, and R. I. Livshits, *Vopr. Med. Khim.*, No. 1, 127-131 (1989).
3. D. A. Dyatlov, *The Immune Status and Prediction of Infectious Inflammatory Diseases in Qualified Ski Racing Athletes during the Annual Training Cycle*, Abstract of Doct. Biol. Sci. Dissertation, Chelyabinsk (1996).

4. A. G. Martov, *Urol. Nefrol.*, No. 6, 5-9 (1994).
5. A. N. Mayanskii and D. N. Mayanskii, *Essays on the Neutrophil and Macrophage* [in Russian], Novosibirsk (1989).
6. K. I. Savitskaya, M. F. Trapeznikova, A. V. Rusanova, *et al.*, *Urol. Nefrol.*, No. 4, 4-8 (1995).
7. A. A. Tikhomirov, *Lab. Delo.* No. 1, 45-47 (1977).
8. T. M. Korman and M. L. Grayson, *Aust. Fam. Physician*, **24**, No. 12, 2205-2211 (1995).
9. R. J. Schaur, G. Dussing, E. Kink, *et al.*, *Free Radic. Res.*, **20**, 365-373 (1994).
10. P. D. Thomson, G. O. Till, J. K. Prasad, and D. J. Smith, *J. Burn Care Rehabil.*, **12**, No. 1, 38-40 (1991).