

*Experimental Medicine*

## The Association of Blood Pressure Levels with Peritoneal Insulin Absorption in Diabetic Patients on Peritoneal Dialysis

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**ABSTRACT.** Intraperitoneal insulin administration is very important for diabetic patients to control blood glucose level and to prevent development of peripheral hyperinsulinemia, which increases the risk of atherosclerosis. Factors affecting intraperitoneal insulin absorption are unclear, and our aim was to study some of the parameters which theoretically can play a role in insulin absorption. One of these parameters is blood pressure, which in itself is associated with the peritoneal transport status. In the results, we give the correlation between insulin absorption and blood pressure; numbers of blood pressure above normal contribute to insulin absorption ( $p=0.045$ ). This fact is very important in the treatment of diabetic patients, to ensure good control of blood glucose level. © 2007 Bull. Georg. Natl. Acad. Sci.

**Key words:** peritoneal dialysis, membrane transport status, insulin absorption, blood pressure.

Diabetic nephropathy is the only growing cause of end-stage renal disease (ESRD). Continuous ambulatory peritoneal dialysis (CAPD) has become the preferred mode of dialysis therapy for diabetics with ESRD in many centers [1-3] because CAPD offers the advantages of reduced cardiovascular stress, a steady biochemical state, good control of hypertension, and intraperitoneal administration of insulin [2-5].

Intraperitoneal insulin administration can restore the glucose control to near normal values, better than those obtained with subcutaneous therapy [6].

The degree of hyperinsulinemia is less than with subcutaneous administration. At a given dose of insulin, the amount reaching the periphery is much less in intraperitoneal than in subcutaneous administration. This is especially important because the circulating insulin is directly correlated with the risk of atherosclerosis [7].

Intraperitoneally administered insulin is absorbed more rapidly and evenly than subcutaneously administered insulin. It passes directly into the portal vein sys-

tem. From the liver, it influences glucose and lipid metabolism [8].

If insulin is instilled into the abdominal cavity along with the dialysis solution, switching from subcutaneous to intraperitoneal administration entails an increase of insulin requirement by approximately 30% [9].

Higher insulin requirements with intraperitoneal delivery, compared to subcutaneous administration, during CAPD might be due to several factors: incomplete peritoneal absorption of insulin, which is concentration- and time-dependent; possible intraperitoneal degradation of insulin by insulinase enzymes; degradation within omental adipocytes; and adsorption of insulin to the surface of fluid containers and connecting tubes.

Factors affecting this insulin absorption are unclear, but membrane transport characteristics could be important. During peritonitis, when membrane characteristics change to high transport status, peritoneal insulin requirements fall, suggesting that insulin peritoneal transport is related to membrane transport status. According

Table 1.

## Correlation of intraperitoneal insulin absorption with blood pressure levels

Patient group	Blood pressure levels	Insulin absorption	(p)
group I	<120/70 mmHg (1) (n=2)	91.7% ± 11.5%	p <sub>1-2</sub> = 0.24 (NS)
group II	120/70-140/90 mmHg (2) (n=6)	97.9% ± 2.5%	p <sub>1-3</sub> = 0.29 (NS)
group III	>140/90 mmHg (3) (n=2)	99.4% ± 0.2%	p <sub>2-3</sub> = 0.35 (NS)

NS- statistically unreliable

some authors data, the blood pressure level is associated with membrane transport status [10].

**Materials and methods.** We have studied 10 diabetic (4-Type I, 6-Type II) patients on peritoneal dialysis. There were 7 male and 3 female patients with mean age 42.8±14.0 years.

Duration of diabetes 13-34 years (mean 21.5±1.85 years); 24-hour insulin requirements was 14-56U (mean 34.9±5.9U); and mean HbA<sub>1c</sub> was 7.44±0.5%. None of the patients had peritonitis in the previous 2 months and had no temperature.

Peritoneal membrane solute transport in peritoneal dialysis (PD) patients is assessed by the peritoneal equilibration test (PET), which measures the ratio of creatinine in the dialysate to plasma after a standardized 4-h dwell (D/P<sub>0</sub>). Patients then are classified as high (H), high-average (HA), low-average (LA), or low (L) transporters on the basis of this result [8]. In our study we have patients with H, HA and LA membrane transport status. The patient's dose of Actrapid was injected into plastic bags. Dialysate insulin was analyzed using the enzyme-linked immunosorbent assay (ELISA) (DakoCytomation, Denmark) before and after test. Blood pressure was measured before beginning the test.

**Results and their discussion.** Variation in peritoneal insulin absorption was observed (mean of 90.34%±6.65%). A relationship was found between membrane transport status and percent of intraperitoneal insulin absorption (LA-95.8%±1.3%; H-99.7%; p=0.011).

To determine the role of blood pressure levels in intraperitoneal insulin absorption, in those diabetic patients who were on peritoneal dialysis, we measured blood pressure during the procedures. According to blood pressure levels patients were divided into three groups: low-<120/70 mmHg, normal – 120/70-140/90

mmHg, high->140/90 mmHg (Table 1).

In our results insulin absorption was high, when the level of blood pressure was above 140/90 mmHg, and the same parameter was low when the blood pressure level was 100/70 mmHg. These results were statistically unreliable, there was no relationship between the percentage of intraperitoneal insulin absorbed and blood pressure levels (p<sub>1-3</sub>=0.29).

To account for these results and small number of patients, we decided to divide them into two groups. (group I - T/A-d"120/70 mmHg, group II -T/A>120.70 mmHg). This attempt was successful, showing a correlation between intraperitoneal insulin absorption and blood pressure levels. This result was statistically significant (p=0.045). (Table 2).

Table 2.

## Correlation of intraperitoneal insulin absorption with blood pressure levels

Patient group	Blood pressure levels	Insulin absorption
group I	≤120/70 mmHg (n=6)	95.5% ± 3.0%
group II	>120/70 mmHg (n=4)	99.5% ± 0.3%
p=0.045		

In conclusion, intraperitoneal insulin absorption, as it was expected, is related with membrane transport status. Also, our results demonstrate that high blood pressure level, which is frequent in diabetic patients who are on peritoneal dialysis, contributes to intraperitoneal insulin absorption, probably due to increased peritoneal blood flow. These facts are very important in treatment of diabetic patients, to give them the proper dose of insulin, and ensure good control of blood glucose level.

სამედიცინო მეცნიერებანი

## სისხლის არტერიული წნევის კავშირი ინტრაპერიტონეალურად შეყვანილი ინსულინის აბსორბციასთან, პერიტონეალურ დიალიზზე მყოფ დიაბეტიან პაციენტებში

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