Studies on the Glomerular Filtration

I. On the Glomerular Filtration in Cases of Exudative Pleurisy, Especially on the Cause of Water Diuresis

By

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INTRODUCTION

Many factors concern the increase and decrease of the quantity of urine, but the production of it in the kidney is influenced by the following four factors; that is, the increase and the decrease of the quantity of filtration in the glomeruli, the increase and the decrease of the quantity of reabsorption in the tubuli. Thereupon I tried this experiment as I thought it clinically and pathologic-physiologically important to investigate the glomerular filtration and the tubular reabsorption concerning two or three medical diseases, the prognostic significance of which can be judged from the increase and decrease of the quantity of urine. In Part I, I report my studies on pleurisy.

It has been well known that in the case of pleurisy the quantity of urine decreases in the excretion state of exudate and increases in the absorption stage. Therefore it is very helpful for its prognosis and treatment to know the condition of water metabolism of the body and thereby to presume the acute stage or the absorption stage of the disease.

In 1924 Peyrer¹⁾ for the first time applied water test to pleuritic patients for the purpose of finding the acute stage or the absorption stage of pleurisy, and recognized its significance. Greuel²⁾ also making a similar experiment and comparing it with blood sedimentation rate and temperature, emphasized its significance. This is supported by Mumme³⁾ and some Japanese scholars f.i. Hirai.⁴⁾⁻⁸⁾ But there have been very few experimental reports of water test on pleuritic patients. There is only one report made by Okazaki⁹⁾ in 1926, but the result of his examination is not very clear. Moreover in any of their water tests the relation between the change of the quantity of urine and the mechanism of urine production in the kidney is entirely unknown. Therefore I tried my water test on those pleuritic

patients who entered Prof. Nakazawa's medical clinic in and after 1946, simultaneously estimating glomerular filtration and reabsorption of the kidney and investigated its significance.

EXPERIMENTAL

Material and Method

Out of the patients who entered Prof. Nakazawa's medical clinic in and after 1946, I chose 30 genuine wet pleuritic patients, excluding such patients as might mistake my judgment on the result of experiment: i.e. those with pulmonary tuberculosis, those with high temperature and profuse sweating, those with edema caused by kidney or heart trouble, and those with diarrhea or constipation were eliminated. Following Volhard, I examined the diluting and concentrating power of the kidney and estimated glomerular filtration (GF) and reabsorption of the kidney (RR) per minute during the period in which secretion of urine is imagined greatest, and at the same time I calculated reabsorption percent of the kidney (RR %). As Volhard did, I gave the patient 1,000 cc. of water in 10 minutes after emptying the bladder at 8 a.m., and then I took the excretion of urine every 30 minutes before noon and every 2 hours after noon till 8 p.m., moreover adding the all excretion till 8 a.m. of the next morning. I estimated the quantity and specific gravity of this urine. As to the estimation of GF, I followed Rehberg's¹⁰⁾ principle; but without loading creatinine, I made a calculation by the following formula in consideration of the quantity of urine produced in an hour from 9 a.m. till 10 a.m. and the density of the urine and blood creatinine (Cu & Cp).

$$GF = \frac{U}{60} \times \frac{Cu}{Cp} \quad RR = GF - \frac{U}{60} \quad RR\% = \frac{RR}{GF} \times 100$$

Of course during the experiment the patient was given only dried food.

Results

As control investigation I chose 20 healthy persons who had no past history of kidney trouble. Each of the water tests is normal (Tab. I). Average GF is 167.8 cc. and RR% is 92.5 (Tab. II).

According to Nakazawa and Kusakari¹¹⁾ GF of healthy persons is 160–190 cc. and RR% is 99.3 and according to Asano¹²⁾ who does not load creatinine RR% is almost the same, but GF is so small as 107.3 cc. I myself, making an estimation of 20 healthy persons without doing water test or loading creatinine, had the value of GF 129.5 cc. and RR% 98.6. Comparing this value with that of water test, I found that by water test the value of GF increases and RR% decreases. This result is significant, the probability of error being below 1%. This shows the same tendency

TABLE I

No. of case	Age	Sex	Quant. of urine in 4 hours (cc.)	Quant. of urine in first 2 hours (cc.)	Quant. of urine in 24 hours (cc.)	Maximum quant. of urine in half an hour (cc.)	Specific gravity	
							Max.	Min.
1	23	♂	1860	1385	2375	515	1,031	1,000
2	30	♂	1720	1135	2220	440	1,030	1,002
3	41	♂	1800	1460	2340	470	1,030	1,004
4	17	♂	1310	1015	1655	435	1,034	1,001
5	16	♂	1285	935	1825	350	1,030	1,004
6	25	♂	1635	1345	2050	465	1,029	1,000
7	30	♂	1770	1425	2170	490	1,030	1,000
8	27	♂	1635	1325	2045	480	1,028	1,000
9	34	♂	1455	1095	1840	410	1,030	1,002
10	38	♂	1270	950	1760	360	1,028	1,002
11	37	♀	1075	855	1635	420	1,027	1,001
12	22	♀	1250	945	1600	350	1,030	1,002
13	31	♀	1390	745	1735	360	1,030	1,004
14	20	♀	1345	1135	1675	460	1,032	1,001
15	20	♀	1405	1140	1825	580	1,028	1,000
16	23	♀	1245	980	1605	420	1,030	1,001
17	22	♀	1500	1100	1815	400	1,030	1,001
18	45	♀	1170	860	1660	390	1,028	1,002
19	38	♀	1295	755	1750	360	1,030	1,001
20	25	♀	1220	910	1640	400	1,028	1,001
Average			1432	1075	1861	427		

with the result once obtained by Hiratsuka¹⁸⁾ under Prof. Nakazawa's direction.

I divided the result of the water test on the pleuritic patients into 3 groups. The first group consists of those that are in the acute stage according to the clinical picture, the quantity of urine in 4 hours being much less than the dosis of drinking water. The second group consists of those that are still far from absorption stage though there is no symptom of being in clinically acute stage, the quantity of urine in 4 hours being nearly the same as the dosis of drinking water. The third group consists of those that are already in clinically absorption stage, the quantity of urine in 4 hours being much more than the dosis of drinking water.

1. *The first group: acute stage* (Tab. III, IV)

The excretion of water is prevented; the average quantity of urine in 4 hours is 568 cc., which is less than $\frac{1}{2}$ of the normal quantity. The excretion of water reaches maximum within the first 2 hours, but the maxi-

TABLE II

No. of case	Age	Sex	Urine an hour		Creatinine mg/dl		Quant. of urine per min. cc.	GF cc.	RR cc.	RR %
			Quant. of urine (cc.)	Specific gravity	Urine	Plasma				
1	23	♂	980	1,000	10,51	0,80	16,3	214,0	197,7	92,3
2	30	♂	810	1,002	9,38	0,53	13,5	238,9	225,4	94,3
3	41	♂	905	1,004	10,40	0,85	15,0	181,1	166,1	91,6
4	17	♂	650	1,001	8,13	0,67	10,8	131,0	120,2	91,7
5	16	♂	590	1,004	12,45	0,61	9,8	187,7	177,9	94,7
6	25	♂	890	1,000	7,59	0,77	14,8	145,8	131,0	89,8
7	30	♂	920	1,000	8,26	0,82	15,4	155,1	139,7	90,0
8	27	♂	850	1,001	9,06	0,78	14,1	163,7	149,6	91,3
9	34	♂	720	1,002	9,53	0,62	12,0	184,2	172,1	93,4
10	38	♂	600	1,002	11,75	0,65	10,0	180,7	170,7	94,4
11	37	♀	620	1,001	10,50	0,83	10,3	130,3	120,0	92,0
12	22	♀	595	1,004	14,10	0,78	9,9	178,9	169,0	94,4
13	31	♀	590	1,004	9,34	0,60	9,8	152,5	142,7	93,5
14	20	♀	810	1,001	7,98	0,63	13,5	171,0	157,5	92,1
15	20	♀	960	1,000	7,19	0,65	16,0	176,9	160,9	90,9
16	23	♀	680	1,002	10,32	0,76	11,3	153,4	142,1	92,6
17	22	♀	750	1,001	9,75	0,72	12,5	167,9	155,4	92,5
18	45	♀	650	1,002	11,06	0,81	10,8	147,4	136,6	92,6
19	38	♀	580	1,002	11,07	0,75	11,3	141,6	132,0	93,2
20	25	♀	630	1,001	10,31	0,68	10,5	154,6	144,1	93,2
Average			739		9,93	0,71	12,4	167,8	155,4	92,5

TABLE III

No. of case	Age	Sex	Quant. of urine in 4 hours (cc.)	Quant. of urine in first 2 hours (cc.)	Quant. of urine in 24 hours (cc.)	Maximum quant. of urine in half an hour (cc.)	Specific gravity	
							Max.	Min.
1	19	♂	205	124	815	35	1,032	1,024
2	25	♂	495	285	1250	135	1,032	1,014
3	29	♀	580	395	1035	150	1,030	1,012
4	19	♀	585	485	745	225	1,032	1,002
5	59	♀	590	385	990	185	1,024	1,008
6	32	♀	740	630	1080	240	1,030	1,006
7	21	♀	780	470	1205	215	1,030	1,006
Average			568	396	1017	169		

TABLE IV

No. of case	Age	Sex	Urine an hour		Creatinine mg/dl		Quant. of urine per min. cc.	GF cc.	RR cc.	RR %
			Quant. of urine cc.	Specific gravity	Urine	Plasma				
1	19	♂	62	1,024	111,67	1,14	1,0	97,9	96,9	98,8
2	25	♂	135	1,014	57,33	1,27	2,2	99,3	97,1	97,6
3	29	♀	270	1,012	18,06	0,85	4,5	95,6	91,1	95,3
4	19	♀	330	1,002	17,59	0,78	5,5	124,0	118,5	95,5
5	59	♀	125	1,010	12,66	0,59	2,0	42,9	40,9	95,3
6	32	♀	460	1,006	14,83	0,88	7,6	128,0	120,4	94,0
7	21	♀	325	1,006	22,53	0,96	5,4	126,7	121,3	95,7
Average			244		36,38	0,92	4,0	102,0	98,0	96,0

imum quantity of urine in half an hour averages 169 cc., which shows less than $\frac{1}{3}$ of the dosis of drinking water. In 3 cases the quantity of urine in 24 hours does not reach the dosis of drinking water, and in 4 cases it shows delay, incomplete reaction. The minimum specific gravity except 1 case is above 1,004 and the diluting power of the kidney is prevented, and the maximum specific gravity is normal except 1 case. Besides, there is 1 case that excretes 20–30 cc. of urine with high specific gravity every 30 minutes all through the course. Next, average GF is 102.0 cc., and RR% is 96.0 which shows that though GF decreases, RR% increases. This fact proves that, in the water test, the diluting power is prevented and that the concentrating power is normal. The decrease of GF and the increase of RR% show statistically that the probability of error is below 1% and so it is significant. Therefore it is clear that though the oliguria is mainly due to the decrease of GF, it is partly due to the increase of RR.

2. *The second group: middle stage* (Tab. V, VI)

The excretion of water is considerably better than that in the acute stage. The quantity of urine in 4 hours averages 1080 cc., which is almost normal. In 4 cases the maximum quantity of urine in half an hour is above $\frac{1}{3}$ of the dosis of drinking water. In 5 cases the quantity of urine in 24 hours is above 1,500 cc., and shows delay, excessive reaction; and in 4 cases it shows delay, incomplete reaction. The minimum specific gravity is a little prevented in 3 cases, but the maximum specific gravity is normal respectively. GF averages 144.2 cc., which is considerably more than that in the acute stage, but is less than the normal value. This decrease of GF shows statistically that the probability of error is below 5% and so it is significant. RR averages 93.0% and so it is nearly normal. Therefore in the middle stage, though GF decreases, RR suppression is almost

TABLE V

No. of case	Age	Sex	Quant. of urine in 4 hours (cc.)	Quant. of urine in first 2 hours (cc.)	Quant. of urine in 24 hours (cc.)	Maximum quant. of urine in half an hour (cc.)	Specific gravity	
							Max.	Min.
1	19	♂	890	775	1435	330	1,032	1,003
2	24	♀	913	747	1186	305	1,032	1,006
3	22	♀	1045	915	1220	350	1,034	1,003
4	46	♂	1055	935	1580	350	1,031	1,002
5	52	♂	1066	883	1691	345	1,027	1,003
6	22	♂	1090	640	1357	270	1,033	1,005
7	29	♀	1137	837	1501	405	1,036	1,002
8	46	♂	1235	915	1775	330	1,028	1,002
9	25	♂	1295	970	2100	315	1,034	1,008
Average			1080	846	1538	333		

TABLE VI

No. of case	Age	Sex	Urine an hour		Creatinine mg/dl		Quant. of urine per min. (cc.)	GF cc.	RR cc.	RR %
			Quant. of urine (cc.)	Specific gravity	Urine	Plasma				
1	19	♂	515	1,003	15,44	0,87	8,5	150,8	142,3	94,3
2	24	♀	535	1,004	14,23	1,24	8,9	102,1	93,2	91,2
3	22	♀	680	1,004	11,47	0,72	11,3	180,0	168,7	93,7
4	46	♂	670	1,002	10,11	0,75	11,1	149,6	138,5	92,5
5	52	♂	545	1,003	14,15	0,81	9,0	157,2	148,2	94,4
6	22	♂	530	1,005	12,23	0,90	8,8	119,5	110,7	92,6
7	29	♀	560	1,003	12,07	0,65	9,3	172,7	163,4	94,6
8	46	♂	625	1,002	9,15	0,64	10,4	148,6	138,2	93,0
9	25	♂	625	1,008	9,16	0,81	10,4	117,6	107,2	91,1
Average			587		12,00	0,82	9,7	144,2	134,5	93,0

normal and so it seems that comparatively much quantity of urine is excreted, though not satisfactorily.

3. The third group: absorption stage (Tab. VII, VIII)

The excretion of water is very good. The quantity of urine in 4 hours averages 1423 cc. and the most part of it is excreted within the first 2 hours. Besides, in some cases good excretion continues even two hours longer. The maximum quantity of urine in half an hour is over 1/3 of the dosis of drinking water in every case. The quantity of urine in 24 hours is over 1,640 cc., showing excessive excretion reaction. The mini-

TABLE VII

No. of case	Age	Sex	Quant. of urine in 4 hours (cc.)	Quant. of urine in first 2 hours (cc.)	Quant. of urine in 24 hours (cc.)	Maximum quant. of urine in half an hour (cc.)	Specific gravity	
							Max.	Min.
1	25	♀	1300	895	1640	370	1,031	1,006
2	24	♂	1340	1100	2085	480	1,031	1,001
3	52	♂	1360	930	1890	385	1,030	1,003
4	21	♀	1360	1055	1790	450	1,031	1,001
5	21	♂	1370	1195	1695	420	1,033	1,002
6	19	♂	1375	1125	1920	610	1,032	1,003
7	25	♀	1390	1045	1790	580	1,032	1,010
8	32	♀	1400	1090	1735	350	1,032	1,002
9	29	♀	1405	1010	2015	390	1,026	1,006
10	27	♂	1410	960	1890	450	1,028	1,004
11	29	♀	1475	960	1965	390	1,028	1,002
12	48	♂	1500	1170	1940	335	1,028	1,003
13	22	♂	1530	1330	2000	600	1,038	1,004
14	25	♂	1730	965	2495	405	1,031	1,005
Average			1423	1059	1921	443		

TABLE VIII

No. of case	Age	Sex	Urine an hour		Creatinine mg/dl		Quant. of urine per min. (cc.)	GF cc.	RR cc.	RR %
			Quant. of urine (cc.)	Specific gravity	Urine	Plasma				
1	25	♀	700	1,006	8,23	0,65	11,6	146,8	135,2	92,0
2	24	♂	650	1,002	15,23	0,75	10,8	219,3	208,5	95,0
3	52	♂	635	1,003	11,74	0,72	10,5	171,2	160,7	93,8
4	21	♀	770	1,001	9,91	0,66	12,8	192,1	179,3	93,3
5	21	♂	700	1,002	11,56	0,78	11,6	171,9	160,3	93,2
6	19	♂	810	1,003	10,72	0,71	13,5	203,8	190,3	93,3
7	25	♀	905	1,010	11,50	0,68	15,0	253,6	238,6	94,0
8	32	♀	690	1,002	8,06	0,60	11,5	154,4	142,9	92,5
9	29	♀	625	1,006	9,69	0,69	10,4	146,0	135,6	92,8
10	27	♂	740	1,004	14,64	0,82	12,3	219,6	207,3	94,3
11	29	♀	750	1,002	10,83	0,64	12,5	211,5	199,0	94,0
12	48	♂	635	1,003	12,19	0,70	10,5	182,8	172,3	94,6
13	22	♂	985	1,004	8,52	0,60	16,4	232,8	216,4	92,9
14	25	♂	610	1,005	10,07	0,62	10,1	164,0	153,9	93,8
Average			729		10,92	0,68	12,1	190,7	178,6	93,5

mum specific gravity is slightly prevented in 3 cases, but the maximum is normal in every case. GF averages 190.7 cc., which is more than normal. This fact shows statistically that the probability of error is below 5% and so it is significant. RR% averages 93.5 and so it is a little higher than normal. Therefore polyuria in the absorption stage is mainly due to the increase of GF and the suppression of RR.

I can summarize the above results as follows. In the acute stage the excretion of water is poor, and diluting power is prevented. This oliguria is due to the decrease of GF and the slight suppression of RR. In the middle stage the excretion of water is a little better, and almost normal. In this stage GF decreases, but as RR is suppressed, the excretion of sufficient quantity of water is possible. In the absorption stage the excretion of water is excess owing to the increase of GF and the suppression of RR, though in a few cases the diluting power is a little prevented.

To confirm the above results, I made estimations in several periods of 3 patients who were in hospital for a long time from the beginning of their disease. The first case: 19 years old male patient who entered hospital at the beginning of disease, with a clinical picture indicating the acute stage. As Tab. IX, X show, the quantity of urine increases as the symptom grows slighter. The diluting and concentrating power, prevented at first, becomes normal again. GF, very little at first, grows remarkable afterward. RR suppression, also very little at first, becomes great afterward. The second and third cases show the same process though the grade of each patient is different. That is, in the acute stage of pleurisy the result of water test is bad, but grows better as it progresses, and in the absorption stage it becomes excessive excretion. Therefore it is clear that in the acute stage the change of the quantity of urine is due to the decrease of GF and the slight suppression of RR; and in the absorption stage it is due to the increase of GF and the suppression of RR.

CONSIDERATION

Concerning diuresis by water test, Underhill and Pack¹⁴⁾⁻¹⁵⁾ etc. made their experiments on dogs and stated that they could not recognize any hydremia, but I think it is unreasonable in common sense. Hashimoto¹⁶⁾⁻²⁰⁾ and many others proved hydremia by animal and human experiment, concluding that in time of water diuresis, extra-renal total hydremia plays an important part. Concerning the influence of this hydremia upon GF and RR, there are many reports. Poulsson,¹⁹⁾ Rehberg, Holten²¹⁾⁻²⁵⁾ etc. say that though GF does not increase, RR decreases remarkably. Chrometzka and Unger²⁶⁾⁻²⁷⁾ etc. say that GF increases temporally, but decreases after all and that RR suppression becomes remarkable. However, Hiratsuka¹⁸⁾ recognizes in his experiments on dogs that not only the decrease of RR

TABLE IX

No. of case	Age	Sex	Quant. of urine in 4 hours (cc.)	Quant. of urine in first 2 hours (cc.)	Quant. of urine in 24 hours (cc.)	Maximum quant. of urine in half an hour (cc.)	Specific gravity	
							Max.	Min.
1	19	♂	205	124	815	35	1,032	1,024
			890	775	1435	330	1,027	1,003
			1375	1125	1920	610	1,032	1,003
2	25	♂	495	285	1250	135	1,032	1,014
			1295	970	2100	315	1,034	1,008
			1730	965	2495	405	1,031	1,005
3	29	♀	580	395	1035	150	1,030	1,012
			1137	837	1501	405	1,036	1,002
			1475	960	1965	390	1,028	1,002

TABLE X

No. of case	Age	Sex	Urine an hour		Creatinine mg/dl		Quant. of urine per min. (cc.)	GF cc.	RR cc.	RR %
			Quant. of urine (cc.)	Specific gravity	Urine	Plasma				
1	19	♂	62	1,024	111,67	1,14	1,0	97,9	96,9	98,8
			515	1,003	15,44	0,87	8,5	150,8	142,3	94,3
			810	1,003	10,72	0,71	13,5	203,8	190,3	93,3
2	25	♂	135	1,014	57,33	1,27	2,2	99,3	97,1	97,6
			625	1,008	9,16	0,81	10,4	117,6	107,2	91,1
			610	1,005	10,07	0,62	10,1	164,0	153,9	93,8
3	29	♀	270	1,012	18,06	0,85	4,5	95,6	91,1	95,3
			560	1,003	12,07	0,65	9,3	172,7	163,4	94,6
			750	1,002	10,83	0,64	12,5	211,5	199,0	94,0

but also the increase of GF is the cause of water diuresis. Like this, the theories do not agree, as to the cause of diuresis in the water test.

I estimated GF and RR of healthy persons neither making water test nor loading creatinine and obtained the value of GF 129.5 cc. and RR % 98.6, but estimating GF and RR when the quantity of urine is maximum by loading water, I had the value of GF 167.8 cc. and RR % 92.5. This result is statistically significant as I have already stated. Therefore I cannot but support Hiratsuka's theory that the increase of the quantity of urine by water test is caused not only by the RR suppression but also by the increase of GF.

As is well known, there is oliguria in the acute stage and polyuria in the absorption stage of pleurisy, so by estimating the daily quantity of urine, we can imagine the condition of pleura to some degree. But when the absorption of exudate lasts long, there is no remarkable change in the

daily quantity of urine, and so it is not always possible to imagine the condition of pleura. However, Peyrer and others tested pleuritic patients by Volhard's water test and estimating the quantity of urine in 4 hours and 12 hours, they found the quantity is very little compared with the dosis of drinking water in the acute stage, and remarkably much in the absorption stage; which, they asserted, is helpful for deciding when pleurocentesis should be done, and consequently gives some therapeutic effect. But they mainly treated of the change of the quantity of urine and did not refer to the mechanism of urine in the kidney by water test. They did not make clear whether it is owing to the decrease of GF or to the extreme acceleration of RR though GF is normal, that the quantity of urine in 4 hours is so much less than the dosis of drinking water in the acute stage. Nor did they make clear whether it is owing to increase of GF or to the suppression of RR or to both, that the quantity of urine in 4 hours is so excessive in the absorption stage. These problems have been solved by my experiment.

Next, I tried to make a theoretical examination on the way of cure from the result of my experiment. There is no doubt that the change of GF and RR in pleurisy is due to the abnormality of exudation and resorption at the very locality where pleurisy exists, but judging from the fact that in many pleuritic patients we sometimes find temporary nephritic symptom caused by tubercular allergy, I think it can be concluded that in the case of pleurisy there occurs an abnormality of the function of kidney as one of the symptoms of allergy, which causes the change of GF and RR.

Now, as oliguria in the acute stage occurs on account of the decrease of GF and the slight suppression of RR, we ought to try to increase GF and to decrease RR% for the purpose of increasing the quantity of urine. Consequently we are suggested to dose Euphyllin which is believed to expedite diuresis, or Salyrgan which is believed to suppress RR. But as Nonnenbruch²⁸⁾ says, the genesis and absorption of pleural exudate is not due to the total water metabolism but to the partial condition of the patient, and when the inflammation is severe, it is impossible to change oliguria into polyuria and moreover it is more reasonable to keep the kidney quiet than to stimulate it which is very sensitive on account of allergy; so I do not think it is very effective to dose diuretic carelessly in such a case. Besides, with the exception of Trousseau's indication, there are pro and con views as to the removal, by puncture, of the liquid produced in the acute stage. Mumme and others say, according to their experiments, that pleurocentesis is not advisable in the acute stage when oliguria is found by water test, and I myself have the same opinion, because in the acute stage the liquid is easily produced again if it removed by puncture. Again I

found that the water test in the acute stage does not show any side action, though I had an experience of finding the decrease of the quantity of urine for one or two days after the test, which however became normal soon again.

In the middle stage there is a decrease of GF though the suppression of RR is enough, so that administration of Euphyllin can be expected as it is helpful to increase GF. Besides, I have an interesting experience that soon after the trying of water test in this stage the quantity of urine increases remarkably sometimes, because the water test itself becomes the means of water thrust test, expediting reabsorption so much.

Finally, in the absorption stage there is sometimes a want of RR suppression, though GF is enough, so by suppressing RR more, greater quantity of urine can be produced. Therefore the administration of Salyrgan is reasonable, as it is helpful to suppress RR. In this case too, there are some cases in which water test itself becomes water thrust test, which therefore needs no other means.

CONCLUSION

In the acute stage of wet pleuritic patients the result of water test is bad. The oliguria in this stage is due to the decrease of glomerular filtration and to the decrease of the suppression of the kidney reabsorption. In the absorption stage the excretion of urine is excess. This is due to the excessive increase of glomerular filtration and to the suppression of reabsorption of the kidney. From this foundation I have referred to the way of cure.

Summarising this, I can say that in the clinical treatment of pleuritic patients the water test and the estimation of glomerular filtration and reabsorption of the kidney do not give any unpleasant influence to the patients, but help to decide whether they are in the acute stage or in the absorption stage, and consequently give suggestions to the way of cure, and moreover give sometimes a good influence to them as means of water thrust test.

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