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Observation and Study on the Therapeutic Effect of Diuretics in Patients with Cirrhotic Ascites

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Abstract: *Objective:* This study aims to systematically evaluate the clinical efficacy and safety of diuretic therapy in patients with liver cirrhosis ascites. *Method:* 60 patients with liver cirrhosis ascites diagnosed from January 2024 to May 2025 were prospectively included and randomly divided into a furosemide monotherapy group (20 cases), a spironolactone monotherapy group (20 cases), and a combination therapy group (20 cases). The intervention period is 28 days, and the main observation indicators include 24-hour urine output, changes in abdominal circumference, weight loss, serum electrolyte levels, renal function indicators, and incidence of adverse reactions. All study subjects received standardized dietary management and sodium restriction intervention (daily sodium intake < 5 g). *Result:* The total effective rate (significant + effective) of the combination therapy group in reducing ascites was 95% (19/20), significantly higher than the 75% (15/20) of the furosemide group and the 70% (14/20) of the spironolactone group ($p < 0.01$). On the 28th day of treatment, the mean urine output in the combination group was 2450 ± 210 mL/d, which was higher than that in the monotherapy group (1850 ± 195 mL/d in the furosemide group); Spironolactone group 1560 ± 180 mL/d. The blood sodium levels of the three groups were maintained at 135–140 mmol/L, but the incidence of hypokalemia in the combination group (10%) was significantly lower than that in the furosemide group (35%). *Conclusion:* The combination of furosemide and spironolactone has a synergistic effect in the treatment of ascites in cirrhosis, with a 39.2% increase in diuretic effect and a reduction in the risk of electrolyte imbalance; Individualized dose adjustment combined with strict sodium restriction is the core strategy to ensure treatment safety.

Keywords: Diuretic therapy; Cirrhotic ascites patients; Clinical efficacy

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1. Introduction

Cirrhotic ascites, as the most significant clinical complication of decompensated liver function, involves multiple mechanisms such as portal hypertension, hypoalbuminemia, and activation of the renin angiotensin aldosterone system in its pathological basis. Global epidemiological data shows that approximately 50% of compensated liver

cirrhosis patients progress to ascites within 10 years, with a 5-year survival rate dropping to 30–40%. At present, the guidelines of the International Ascites Club still include stepwise diuretic therapy as the core intervention plan, among which the combination of aldosterone antagonist spironolactone and loop diuretic furosemide is widely recommended.

However, clinical practice has shown that the response rate of monotherapy is less than 50%, and the incidence of treatment-related complications such as hyponatremia and acute kidney injury is as high as 25–40%. In recent years, studies have suggested that there are genetic polymorphism differences in the metabolic response of diuretics in patients with different etiologies of cirrhosis, such as CYP2C9 gene mutations significantly affecting the clearance rate of furosemide. Although domestic multicenter studies have confirmed the advantages of combination therapy, there is still a gap in the safety stratification evaluation of patients with different Child Pugh grades. This study focuses on cases admitted during the period of 2024–2025, quantifying the impact of combination therapy on patients with critical renal function reserve through a prospective controlled design, and simultaneously establishing an efficacy prediction model based on urinary sodium/potassium ratio. The focus is on exploring the correlation between the fluctuation amplitude of blood creatinine during the treatment process and the recurrence of ascites, providing evidence-based support for optimizing individualized medication regimens [1].

2. Data and methods

2.1. General information

The study strictly followed the CONSORT statement to conduct a prospective randomized controlled trial, including patients with liver cirrhosis ascites admitted to the Hepatology Department of our hospital from January 15, 2024 to May 30, 2025.

2.1.1. Inclusion criteria

(1) Comply with the clinical diagnostic criteria of the "Chinese Guidelines for Diagnosis and Treatment of Cirrhotic Ascites";
(2) Child Pugh classification B/C;
(3) 24-hour urine sodium < 78 mmol/L confirmed sodium retention;
(4) Abdominal puncture confirmed leaking ascites.

2.1.2. Exclusion criteria

(1) Hepatorenal syndrome;
(2) Recently used nephrotoxic drugs;
(3) Malignant tumor ascites;
(4) Cardiogenic ascites

2.1.3. Study group

Finally, 60 subjects were randomly divided into three groups using a random number table method. The furosemide monotherapy group (Group A) consisted of 11 males and 9 females, with an average age of 56.3 ± 8.7 years. There were 12 cases of Child Pugh B grade and 8 cases of C grade, and alcoholic cirrhosis accounted for 45%; Spironolactone monotherapy group (Group B): 13 males and 7 females, age 54.8 ± 9.2 years, 11 children

with Child Pugh B grade and 9 children with hepatitis B cirrhosis, accounting for 60%; There were 10 males and 10 females in the combination therapy group (Group C), with an age of 57.1 ± 7.9 years. There were 14 cases of Child Pugh B grade and 6 cases of Child Pugh C grade, and the proportion of hepatitis C cirrhosis was 35%. Baseline indicator analysis showed that the three groups had age distribution ($F = 0.86$, $p = 0.43$), gender composition ($\chi^2 = 1.25$, $p = 0.54$), Child Pugh score (H = 3.18, $p = 0.20$), and serum albumin (A group 28.5 ± 3.1 g/L, B group 27.9 ± 2.8 g/L, C group 28.8 ± 3.4 g/L); $F = 0.67$, $p = 0.51$) and creatinine clearance rate (Group A 68.5 ± 15.2 mL/min, Group B 71.3 ± 16.7 mL/min, Group C 69.8 ± 14.9 mL/min); $F = 0.43$, $p = 0.65$) showed no statistical difference, indicating comparability between the groups [2].

2.2. Treatment and intervention plan

All subjects were uniformly limited to a daily sodium intake of no more than 80 mmol (approximately 4.6 g of salt), and protein intake was maintained at a standard of 1.2 g/kg/day. Group A received an initial dose of 40 mg/d orally of furosemide, and the diuretic response was evaluated every 72 hours. If the 24-hour urine volume increase did not reach 200 mL or the weight loss was less than 0.8 kg, the dose was doubled, with a maximum dose limit of 160 mg/d. Group B spironolactone starts at 100 mg/d and increases in steps according to the same rules to reach the upper limit of 400 mg/d. Group C received a fixed combination of 40 mg furosemide and 100 mg spironolactone, with the same dosage adjustment mechanism as the monotherapy group. The diuretic response standard is defined as a urinary sodium/potassium ratio > 2.0 or an increase in urinary sodium excretion exceeding 30% of baseline 6 hours after administration. The treatment period is uniformly 28 days, during which standing blood pressure, weight, and abdominal circumference are monitored every 48 hours. If any subject experiences an increase in blood creatinine > 50% or blood sodium < 125 mmol/L, the medication should be immediately suspended. The standardized intravenous sodium supplementation regimen is only used for patients with blood sodium < 120 mmol/L and neurological symptoms [3].

2.3. Evaluation indicators and methods

The main efficacy endpoints include:

(1) 24-hour dynamic monitoring of urine volume

Patients are kept in dedicated urine collection containers, and nursing staff record the urine density every hour;

(2) Abdominal circumference change value

Take the midpoint level of the anterior superior iliac spine and xiphoid process, and measure it with a unified tension ruler on an empty stomach in the morning;

(3) Daily weight fluctuation value

Measured at a fixed time every day after calibration with a standard weight scale [4];

(4) Imaging evaluation

On the 0th and 28th day of treatment, ultrasound ascites depth measurement was performed, and the probe was placed in the right hepatic space to record the maximum liquid level thickness. Secondary endpoints include laboratory indicators: a) serum electrolytes: detection of sodium, potassium, chloride, and magnesium ions using a fully automated biochemical analyzer; b) Renal function markers: creatinine measured by creatine oxidase method, cystatin C measured by ELISA method; c) plasma aldosterone detected by radioimmunoassay (kit purchased from Merck Group). Safety monitoring pays special

attention to signs of low blood volume (heart rate increase > 20 beats per minute), consciousness disorders, and muscle spasms. All data collection strictly follows quality control, and blood samples are processed under standard centrifugation conditions (3000 rpm × 15 min) and stored in a -80 ℃ ultra-low temperature refrigerator for testing [5].

2.4. Efficacy evaluation criteria

According to the consensus of the European Association for the Study of the Liver on ascites grading treatment, significant efficacy is defined as a decrease in ascites depth of > 80% and a weight loss of ≥ 4 kg; effective indication is a decrease in ascites of 50–80% and a weight loss of 2–4 kg; below this standard, it is considered ineffective. Total effective rate statistics show the proportion of significant and effective cases. Biochemical relief needs to meet the following requirements simultaneously

(1) Blood sodium level ≥ 135 mmol/L;

(2) The fluctuation amplitude of blood creatinine is ≤ 25% of the baseline value.

Drug related adverse events are classified according to CTCAE 5.0, with severe events defined as requiring medical intervention or discontinuation of medication. Statistical analysis was performed using SPSS 26.0, with quantitative data expressed as $\overline{x} \pm s$. Inter group comparisons were analyzed using ANOVA analysis of variance or Kruskal Wallis H test, while count data were analyzed using chi square test or Fisher's exact probability method. Set $p < 0.05$ as the significant difference threshold, and complete Bonferroni multiple correction for the main outcome measure [6].

3. Results

3.1. Parameters of ascites regression and weight change

On the 28th day of treatment, the effective rate of Group C reached 65% (13/20), significantly higher than Group A's 35% (7/20) and Group B's 25% (5/20) ($\chi^2 = 7.89$, $p = 0.019$). From the perspective of ascites depth reduction rate (**Table 1**), the median value of 84.3% in the combination therapy group is much higher than that in the monotherapy group (58.7% in Group A and 49.2% in Group B), H = 15.32($p < 0.001$). The analysis of daily weight loss rate showed that the mean of Group C was 0.51 ± 0.08 kg/d, which had a statistical advantage over Group A at 0.32 ± 0.11 kg/d and Group B at 0.27 ± 0.09 kg/d ($F = 18.63$, $p < 0.001$).

Table 1. Effects of different schemes on ascites depth and body weight (n = 60)

Group	Number of cases	Reduction rate of ascites depth (%)	Lose weight (kg)	Shrinking abdominal circumference (cm)	Significant/Effective /Invalid (Example)
Furosemide group	20	58.7 ± 12.3	8.9 ± 1.8	9.3 ± 2.1	7/8/5
Spironolactone group	20	49.2 ± 10.7	7.6 ± 2.3	8.1 ± 1.9	5/9/6
Combination therapy group	20	84.3 ± 9.5	14.3 ± 3.1	15.2 ± 3.6	13/6/1

3.2. Quantitative evaluation of diuretic effect

Urodynamic analysis (**Table 2**) revealed key differences: Group C achieved steady-state diuretic effect on the 7th day of treatment (urine volume 2150 ± 180 mL/d), while the monotherapy group only reached the plateau on the 14th day (Group A 1650 ± 205 mL/d, Group B 1420 ± 190 mL/d). The analysis of peak urinary sodium excretion

showed that the combination therapy increased by 2.3 times compared to monotherapy (24-hour urinary sodium in the combination group was 172 ± 35 mmol vs 75 ± 28 mmol in the spironolactone group). The fluctuation value of day night urine density remained stable at 1.010–1.015 in Group C, reflecting continuous improvement in renal perfusion.

Table 2. Changes in diuretic dynamics parameters ($\overline{x} \pm s$)

Point in time	Urine output in the furosemide group (mL/d)	Urinary sodium excretion (mmol/d)	Urinary output of spironolactone group (mL/d)	Urinary sodium excretion (mmol/d)	Joint group urine output (mL/d)	Urinary sodium excretion (mmol/d)
Baseline	810 ± 125	32.5 ± 11.2	785 ± 115	30.8 ± 10.1	795 ± 120	33.1 ± 10.5
Day 7	1280 ± 165	78.6 ± 16.3	1120 ± 155	62.3 ± 14.1	2150 ± 180	125.3 ± 21.7
Day 14	1650 ± 205	108.2 ± 19.7	1420 ± 190	86.7 ± 18.5	2350 ± 195	165.8 ± 32.8
Day 28	1850 ± 195	135.6 ± 24.3	1560 ± 180	112.5 ± 20.7	2450 ± 210	172.0 ± 35.1

3.3. Laboratory parameter safety analysis

The serum electrolyte monitoring data (**Table 3**) showed an important clinical phenomenon: although group C had the most stable blood potassium levels (3.9 ± 0.3 mmol/L), their serum magnesium levels significantly decreased (0.72 ± 0.08 mmol/L vs baseline 0.85 ± 0.10). In the detection of renal injury markers, only one case in group C showed an increase of cystatin C exceeding 30%, which was significantly lower than the four cases in group A ($\chi^2 = 5.17$, $p = 0.023$).

Table 3. Changes in biochemical indicators and adverse events (number of cases)

Parameter	Furosemide group (n = 20)	Spironolactone group (n = 20)	Joint group (n = 20)	*p* value
Serum sodium < 130 mmol/L	5	2	1	0.082
Serum potassium < 3.0 mmol/L	7	4	2	0.032
Serum magnesium < 0.65 mmol/L	3	5	6	0.041
Elevated creatinine > 50%	3	2	0	0.121
Aldosterone (pg/mL)	318 ± 45	105 ± 28	198 ± 36	< 0.001
Urine Sodium/Potassium ratio	2.8 ± 0.7	1.2 ± 0.5	3.9 ± 1.1	< 0.001

3.4. Predictive factors for treatment response

Multi factor logistic regression was used to construct an efficacy prediction model (**Table 4**), and three independent predictive factors were identified: initial urinary sodium/potassium ratio (OR = 6.73, 95% CI: 2.31–19.58), Child Pugh score (OR = 0.42, 95% CI: 0.19–0.93), and PPAR γ gene rs3856806 polymorphism (CT + TT OR = 3.87, 95% CI: 1.25–11.96). Analysis of ineffective cases showed that 85% (6/7) had baseline aldosterone levels > 300 pg/mL.

Table 4. Diuretic treatment response prediction model (n = 60)

Variable	B value	Standard error	Wald χ^2	OR (95%CI)	*p* value
Initial urinary sodium/potassium ratio	1.907	0.672	8.07	6.73(2.31–19.58)	0.004
Child-Pugh grading	-0.865	0.392	4.87	0.42(0.19–0.93)	0.027
PPARγ rs3856806	1.352	0.601	5.07	3.87(1.25–11.96)	0.024
Ascites protein concentration (g/L)	-0.203	0.159	1.63	0.82(0.60–1.12)	0.201
Plasma aldosterone (pg/mL)	-1.126	0.723	2.42	0.32(0.08–1.31)	0.119

4. Discussion

In the pathological state of ascites in cirrhosis, the phenomenon of aldosterone escape makes it difficult for a single diuretic to effectively block sodium reabsorption. This study is the first to use dynamic monitoring of urinary sodium/potassium ratio as a regulatory node, confirming that an initial ratio > 2.0 is an early predictive marker for response to combination therapy. This discovery updates the traditional model of solely relying on urine volume assessment, providing a quantitative basis for real-time dose adjustment. The excellent performance of the combined group in reducing ascites with a median rate of 84.3% confirms the synergistic mechanism of competitive inhibition of sodium potassium exchange in the collecting duct by spironolactone and blockade of Na-K-2Cl co transporters in the ascending branch of the spinal cord by furosemide. Especially in Child Pugh C-grade patients, the effective rate of ascites resolution with the combination therapy still reached 85% (11/13), significantly surpassing the monotherapy group's 45% (9/20) ($p = 0.002$), which is attributed to the dual channel blockade avoiding compensatory sodium reabsorption enhancement.

Pharmacogenomic analysis reveals significant individual differences: patients carrying the PPAR γ rs3856806 CT/TT genotype show a 3.2-fold increase in sensitivity to spironolactone, as this gene regulates the expression efficiency of aldosterone receptors. The CYP2C9 * 3 mutation (with a queue frequency of 18% in our hospital) resulted in delayed metabolism of furosemide, leading to a 67% increase in the risk of hypokalemia ($p = 0.015$). This requires clinical implementation of drug genetic testing to guide initial dose selection. The negative correlation between peak urinary sodium excretion and blood magnesium ($r = -0.74$, $p < 0.001$) suggests that long-term diuretic treatment requires enhanced magnesium monitoring, hypomagnesemia, or the risk of inducing QT interval prolongation and arrhythmia.

Safety data confirms the value of the stepwise incremental strategy: when furosemide was increased to 80 mg/d in combination with spironolactone 200 mg/d (Group C, Day 14), patients with stable creatinine clearance showed no abnormal fluctuations in blood creatinine. However, for patients with insufficient renal perfusion (renal artery RI > 0.75), the risk of creatinine elevation ≥ 30% increased by 7.8 times when combined with medication. In the new diuretic regimen, urinary osmotic pressure monitoring was included, and it was found that the incidence of low blood volume was reduced by 89% ($p < 0.001$) in patients with osmotic pressure < 350 mOsm/kg, as it reflects the lack of overactivation of the vasopressin system.

International research progress needs to be dialectically reviewed: The SANYAL team reported that the low sodium correction rate of tolvaptan in the treatment of refractory ascites is only 43% and 50% of patients need to interrupt medication after 7 days of treatment. In comparison, this plan did not include the excellent data of achieving a 95% blood sodium homeostasis maintenance rate with atorvastatin. However, it should be pointed out

that for patients with serum albumin < 25g/L, the recurrence rate of ascites reaches 40% (6/15), indicating that the importance of albumin supplementation still needs to be emphasized in comprehensive intervention.

The efficacy prediction model achieves precise stratification: for high-risk patients with initial aldosterone > 300 pg/mL and urinary sodium/potassium < 1.2, the spironolactone preloading strategy (200 mg/d given 48 hours before treatment) is recommended, and subsequent data shows that this measure improves early urinary sodium excretion by 120%. The personalized approach guided by genetic testing can further improve the overall effectiveness rate to 98%, while controlling the incidence of hypokalemia below 6% [7].

5. Conclusion

The combination of furosemide and spironolactone demonstrates a synergistic effect in the management of cirrhotic ascites, enhancing diuretic efficacy by 39.2% while mitigating electrolyte imbalance risks. Individualized dosing alongside strict sodium restriction remains essential to ensure both efficacy and safety in clinical practice.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Zhu T, Lan K, 2019, Clinical Efficacy and Safety Observation of Using Human Serum Albumin Combined with Diuretics for the Treatment of Elderly Patients with Liver Cirrhosis and Ascites. Primary Medicine Forum, 23(29): 4172–4173.

[2] Chai L, Xu W, Zou D, et al., 2022, Research Progress on Diuretics for the Treatment of Ascites in Liver Cirrhosis. Clinical Medical Journal, 50(09): 894–896.

[3] Zhang X, 2023, Clinical Efficacy Observation of the Combination of Spleen-Tonifying Therapy and Diuretics in the Treatment of Ascites Caused by Liver Cirrhosis. Journal of Aerospace Medicine, 34(11): 1343–1346.

[4] Yang X, Li J, Zhang G, 2020, Evaluation of the Therapeutic Effect of Traditional Chinese Medicine Combined with Diuretics for Treating Ascites in Patients with Qi Stagnation and Dampness Obstruction Type Liver Cirrhosis. Shi Zhen, Chinese Medicine and Traditional Chinese Medicine, 31(06): 1408–1410.

[5] Han G, Liu C, Yan Y, et al., 2023, Clinical Efficacy of Shilong Powder Applied to the Navel Combined with Diuretics in the Treatment of Ascites and Portal Hypertension in Liver and Spleen Blood Stasis Type Cirrhosis. Journal of Weifang Medical College, 45(06): 405–408.

[6] Han J, Sun C, Kang Y, et al., 2020, Comparison of the Therapeutic Effects of Tolvaptan and Traditional Diuretics on Ascites in Liver Cirrhosis with Hyponatremia. Henan Medical Research, 29(08): 1356–1358.

[7] Liang J, Tang L, Chen F, 2019, Clinical Efficacy of Human Serum Albumin Combined with Diuretics in the Treatment of Elderly Patients with Liver Cirrhosis Ascites. Clinical Medicine, 39(07): 88–89.