

## Research Article

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# Is Additional Fluid Therapy Effective in the Treatment of Children with Urinary Tract Infection?

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## Introduction

Urinary tract infection (UTI) is a common childhood infection. About 3 – 5 % of the girls and boys suffer from UTI. The mean age at the first UTI episode is 5 years old and it is most common during infancy among girls. In boys, it is mostly observed during the first year of infancy in those who have not been circumcised. Unlike adults, UTI does not have clear symptoms in children and sometimes occurs with unusual manifestations such as weight loss, FTT (failure to thrive), anorexia, jaundice, and pyrexia with an unknown

**Introduction:** Urinary tract infection can result in many complications such as abscess, hypertension, renal failure, renal scar, reflux, etc. Since there is no general agreement on the administration of additional fluid (1.5 times maintenance) for the early treatment of UTI, this study was conducted to evaluate the effect of additional fluid therapy.

**Materials and Methods:** In This clinical trial study, 206 children with UTI who were admitted at Amir Kabir Hospital (Arak, Iran) from March 2012 to March 2013 were divided into two groups of 103. One group received the usual amount of maintenance fluid while the other group received 1.5 times more than usual maintenance. The course of the resolution of dysuria, frequency, malodorous urine, abdominal pain, and fever was compared between the two groups. Urine culture was performed for all patients 2, 7-10, and 90 days after admission. The patients were age and sex matched. The data was analyzed using descriptive statistics and the X2 method based on independent sample t-test.

**Results:** Additional fluid had a significant effect on malodorous urine dysuria. However, it had an inverse effect on the treatment of fever and urinary frequency as it made them last longer. There was no difference in other parameters like abdominal pain and urine culture in 3 stages.

**Conclusions:** Based on our study, the intake of excessive amounts of water has no significant effects on the results of the UTI treatment. However, due to lack of adequate evidence, further studies should be conducted in this field.

**Keywords:** Urinary Tract Infection; Child; Fluid Therapy.

**Running Title:** Additional Fluid Therapy in Urinary Tract Infection

origin. Therefore, it attracts the physician's attention less often [1, 2]. UTI can be asymptomatic or part of a disseminated infection [3]. Due to its complications including early ones such as sepsis and bacteremia, and late complications like hypertension, chronic renal failure, and reflux nephropathy, early diagnosis and timely treatment of this disease is of great importance [1]. In the studies conducted in the U.S. in 1994, pyelonephritis and reflux nephropathy comprised about 8.3 % of the cases

of chronic renal failure [4]. Hypertension is a long-term complication of pyelonephritis. Pyelonephritic scarring is the most common unilateral renal parenchymal injury and one of the common causes of hypertension in children and adolescents [5]. Therefore, considering the high percentage of UTI resulting from chronic renal failure and since renal scarring can be prevented by early diagnosis and timely treatment, and also due to financial and social problems of renal failure for patients, the necessity of appropriate and practical strategies for timely diagnosis and treatment of UTI and prevention of long-term complications is felt. There is no consensus on whether oral or intravenous (IV) treatment should be used on which extensive researches have been already conducted. In many cases, no difference has been found between oral and IV treatment [6]. There is also disagreement on fluid consumption during UTI treatment. It has been traditionally taken for granted that UTI is better controlled by abundant water consumption. This hypothesis seems to be true due to decreased urinary stop and increased urinary flow. However, some researchers have noted that increased water consumption decreases the concentration of the antibiotics in the urine and its acidity. They believe that abundant water consumption can prevent good recovery from UTI [7-9]. We decided to conduct this investigation because there is still no consensus on whether additional fluid should be consumed (1.5 times more than maintenance fluid).

### Materials and Methods

This clinical trial study was conducted on children aged 3 – 13 years old who were diagnosed with UTI and admitted based on the pediatrician's advice and did not suffer from underlying diseases such as renal and liver failure. Overall, 206 patients were studied in two groups with 103 members. The inclusion criteria were pyrexia of higher than 38.5°C, clinical symptoms, and abnormalities on urinalysis and a positive urine culture. The cases with renal insufficiency were excluded from the study. The criteria for a positive urine culture were either more than 10<sup>5</sup> colony counts of a single pathogen in a urine sample collected with a urine bag or any count of individual bacterial growth in the suprapubic sample. Moreover, the findings of urinalysis included hematuria, pyuria (the presence of more than 3–5 WBCs (Wight Blood Cells) in a microscopic field at ×40 magnification), positive

nitrite, and low specific gravity of the urine considering the age of the child, bacteriuria, and WBC cast and clump. Furthermore, symptoms such as the patient's illness, inability to receive fluids orally, nausea and emesis, symptoms of sepsis, and abdominal pain were among admission criteria. The randomized block design method was used in two-level blocks in order to randomly assign the subjects to groups. Accordingly, UTI patients were randomly assigned into two groups of treatment with additional fluid (1.5 times more than the usual maintenance fluid) and treatment with maintenance fluid. The patients in both groups were completely matched in terms of age and gender. They were examined for urinary symptoms such as dysuria, urinary frequency, malodorous urine, urinary urgency, abdominal pain, pyrexia during hospitalization every day. After discharge, outpatient treatment was continued for up to 14 days. Moreover, urine culture was requested 48 hours after the start of treatment and 7–10 days and within 3 months after its completion. The examiner of the symptoms had no knowledge about the type of fluid regimen prescribed for the patient. The patients were included in the study after receiving their parents' consent. The patients who did not adhere to the protocol of the study were replaced and excluded from the study.

With regards to the fact that the type of antibiotic treatment was different based on the results of antibiogram, it was decided to examine the cases in whom antibiogram in the urine culture was sensitive to ceftriaxone and cefixime. Overall, 206 patients were studied in two groups of 130. The amount of the maintenance fluid was calculated based on the 17<sup>th</sup> edition of Nelson Textbook of Pediatrics. The same serum was selected for both groups (1:3 and 2:3 serums). Moreover, in patients who suffered from pyrexia, the maintenance fluid was increased by 12% per every degree of temperature rise above 38°C. In terms of antibiotic treatment before the culture and antibiogram results were available, ceftriaxone 50-75mg/kg/24h/div was used in 2 doses until 48 hours after the improvement of pyrexia. Furthermore, treatment was continued orally often with cefixime 8 mg/kg/24h/div in 2 doses for 14 days. The total IV and oral treatment duration was 14 days. In addition, in case of hyperthermia, first UTI in boys, recurrent UTI in girls, family background of vesicoureteral reflux, lack of response to treatment after 48 hours, and increased creatinine, imaging studies such as

ultrasonography were requested. The X<sup>2</sup> method was employed for statistical analysis based on the independent sample t-test at a confidence level of 95% and alpha of 0.5 using SPSS<sup>18</sup>. The study was approved by the Ethics Committee of Arak Medical Sciences University and written consent was obtained from all the patients' parents or guardians. The patients could also withdraw from the study at any time. The researchers were committed to the Declaration of Helsinki throughout the research.

**Results**

Of the participants, 164 were girls (79.6%) and 42 were boys (20.4%). The average improvement of the clinical symptoms in both 103-member groups after 24, 48, 72, and 96 hours is presented in Table 1. The frequency of a positive urine culture 24 hours after the completion of treatment in both groups is presented in Table 2.

Urine culture 48 hours after treatment: About 85.4 % and 14.6 % of the patients had negative and positive cultures, respectively. All of them had negative cultures 7–10 days and during 3 months after the treatment.

Dysuria: There was a significant difference in the mean duration of recovery from dysuria between the two groups. Therefore, receiving fluid had a significant effect on the dysuria recovery time (p<0.05).

Urinary frequency: A significant difference was observed in the mean duration of recovery from urinary frequency between the two groups (p<0.05) which increased from 24 hours to 48-72 hours in the group receiving additional fluid.

Abdominal pain: There was no significant difference in the mean duration abdominal pain improvement. Malodorous urination: The mean duration of recovery from malodorous urination decreased after receiving additional fluid (p<0.05).

Pyrexia: Receiving additional fluid had a negative effect on pyrexia and increased its recovery time (p<0.05).

Urine culture: There was no significant difference in culture results between groups 48 hours after the start of treatment and 7–10 days and during three months after its completion (p<0.05)

**Table 1.** Comparison of the mean recovery time of clinical symptoms between 2 groups of patients diagnosed with UTI

Time		Recovery from Pyrexia		Recovery from Frequent Urination		Recovery from Malodorous Urination		Recovery from Abdominal Pain		Recovery from Dysuria	
		Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2
24 hours later	Frequency	11	6	44	33	24	42	11	49	19	25
	percent	10.9	5.8	62.9	36.7	35.8	46.2	10.9	52.7	19.6	25.5
48 hours later	Frequency	65	52	18	37	15	30	65	27	39	48
	percent	64.4	50.5	25.7	41.1	22.4	33	64.4	29	40.2	49
72 hours later	Frequency	21	34	7	19	21	16	21	16	29	23
	percent	20.8	33	10	21.1	31.3	17.6	20.8	17.2	29.2	23.5
96 hours later	Frequency	4	11	1	1	7	3	4	1	10	2
	percent	4	10.7	1.4	1.1	10.4	3.3	4	1.1	10.3	2
Total	Frequency	101	103	70	90	67	91	101	93	97	98
	percent	100	100	100	100	100	100	100	100	100	100

Group 1. The group that did not receive additional fluid. Group 2. The group that received additional fluid.

It should be noted that according to the urine culture results of 206 patients, 183 cases suffered from E. coli, 17 cases from Proteus, and 6 ones from Klebsiella. Moreover, according to the X<sup>2</sup>

statistical test, no significant relationship was observed between age and gender and the mean duration of recovery from dysuria, urinary frequency, malodorous urination, abdominal pain,

and urine culture. Furthermore, the type of the pathogen in the initial urine culture did not have any impact on the above cases.

**Table 2.** Comparison between the mean negative urine cultures 48 hours after treatment completion of 2 groups of patients diagnosed with UTI

Urine culture	The group which did not receive additional fluid		The group which received additional fluid	
	Frequency	Net percentage	Frequency	Net percentage
Negative urine culture after 48 hours	93	90.3	88	85.4
Positive urine culture after 48 hours	10	9.7	15	14.6
Total	103	100	103	100

### Discussion

UTI patients are usually encouraged to drink as much fluid as possible [7]. Removal of the bacteria from the epithelium of the urinary tract due to abundant fluid consumption can decrease their count and temporarily improve the patient's symptoms [10]. In some cases, abundant fluid consumption can kill infection transiently. However, the urine flow usually decreases after reduced fluid consumption. Consequently, bacterial grow in the urine and symptoms recur [11]. Furthermore, abundant fluid consumption can cause problems in the urine acidity, decrease antibiotic concentration in the urine, and result in aggravated obstruction and vesicoureteral reflux [12].

In previous studies on UTI conducted by Wennerstorm, it was stated that increased fluid consumption could be harmful due to the decreased concentration of antimicrobial drugs in the urine [13]. On the other hand, abundant fluid consumption during UTI treatment was recommended in another research. In another UTI comparison made by another group, the additional liquid was recommended to be intravenously received 1–1.5 times more than the maintenance fluid [14].

Based on researches by scientists, fluid consumption has no effect on UTI early recovery [15]. None of the above studies were trial ones and no statistical data was provided. According to

the results of our study, receiving additional fluid has a positive effect on recovery from dysuria and malodorous urination. Therefore, it is recommended for the improvement of these two symptoms. However, it is not recommended for other symptoms such as abdominal pain and at the time of negative urine culture since it has no effect on these parameters. Pyrexia and frequent urination improved faster in the group that did not receive additional fluid. Therefore, receiving additional fluid has an inverse effect on frequent urination and pyrexia and increases their recovery duration.

### Conclusions

Based on our study, the intake of excessive amounts of water has no significant effect on the results of the UTI treatment. However, due to lack of adequate evidence, it is recommended to conduct further studies in this field.

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### Conflict of Interest

The author declared no competing interests.

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None declared

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