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Original Research Article

Prevalence of urinary tract infection and antibiotic sensitivity pattern in children with severe acute malnutrition from 6 months to 5 years in a tertiary care centre

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ABSTRACT

Background: Malnutrition is major health problem in developing countries of the world. Almost 45% in India and a similar number in developing countries are undernourished. The resistance of human beings to infection is adversely affected in malnutrition. Prevalence of UTI in malnourished children varies in different studies.

Materials and Methods: This is cross sectional study was conducted on severely malnourished children, aged between 6 months and 5 years, either attending the Pediatrics out-patients department (OPD) or admitted in the Pediatric ward of Chandulal Chandrakar Memorial Medical College, Durg, during the period from October 2017 to August 2019.

Results: Urine culture samples were collected by suprapubic aspiration in 205 (84%) patients and by mid-stream clean catch in the remaining 39 (16%). Out of this the data of 24 children was removed from the final analysis as there was suspicion of contamination of their urine cultures. Of the remaining 220 children enrolled (75 boys and 145 girls), the urine culture reports of 111 (50.45%) children were urine culture positive and 109 (49.5%) were sterile.

Conclusions: Prevalence of UTI is common (50.45%) in children with SAM in our study. In our study, Urinary tract infection was more common in females than males. Fever was the most common presenting symptom with UTI in SAM children.

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1. Introduction

The urinary tract is a common site of infection in children. A urinary tract infection (UTI) is defined as a colonization by a pathogen occurring anywhere in the urinary tract: kidney, ureter, bladder and urethra.¹ It has been estimated that UTI are diagnosed in 2% of boys and 8% of girls.² It is more common among boys during the first year of life with rates of 2.7% compared with 0.7% in girls but after that there is a striking female preponderance with a male to female ratio of 1:10.^{2,3} Studies have shown increased risk of UTI in uncircumcised boys by 10-12 times.^{4,5} Recurrent UTI rate is 12-30% in infants < 6 months; severe vesicoureteric reflex and abnormal renogram at the time of 1st infection are at

greater risk of recurrent UTI.⁶

Unexplained fever and failure to thrive are common presenting symptoms of UTI in infants, besides nausea, vomiting and diarrhea. In older children in addition to the above symptoms, loin or abdominal pain, dysuria, urgency, hesitancy, enuresis and hematuria are also seen.^{1,2} Renal scarring is the most important pediatric complication following acute upper UTI (pyelonephritis), with an estimated incidence of 10%-65% of cases.³ UTI is an important cause of acute morbidity and later in life by chronic medical conditions, such as hypertension and renal insufficiency.^{7,8}

Malnutrition is major health problem in developing countries of the world. Almost 45% in India and a similar number in developing countries are undernourished. The resistance of human beings to infection is adversely

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affected in malnutrition.⁹ In malnourished children, skin and mucosa do not offer effective physical barriers against infections. Impaired chemotaxis, defective bactericidal capacity and impaired cell mediated immunity, all lead to increased chance of infections in PEM.¹⁰ Severe protein-energy malnutrition (PEM), often associated with infection, contributes to high child-mortality in underprivileged communities. Prevalence of UTI in malnourished children varies in different studies. This disparity may be due to the differences in study population. It is generally considered that 5 to 35 percent of children admitted with malnutrition have UTI.^{11–17}

Although, those specific clinical features of UTI can be seen in UTI of malnourished children too, it is highly variable and nonspecific. The results obtained from various studies clearly indicate that UTI is an important occult infection in malnourished children. The state of malnutrition may lead to masking of clinical features of UTI.¹¹ Moreover, the risk of bacteriuria increases significantly with the severity of malnutrition; in one study the incidence was three-fold higher in patients with severe compared with moderate malnutrition. It can, therefore, be said that UTI is an important occult infection in malnourished children and should be specifically looked for in these cases.¹¹ The aims and objective of this study is to find out the prevalence of urinary tract infection in malnourished children between 6 months to 5 year and to find out the causative organisms and its antibiotic sensitivity pattern.

2. Materials and Methods

This is cross sectional study was conducted on children with severe acute malnutrition, aged between 6 months and 5 years, either attending the Pediatrics out-patients department (OPD) or admitted in the Pediatric ward of Chandulal Chandrakar Memorial Medical College, Durg, during the period from October 2017 to August 2019. The study was approved by the Institutional Ethics committee.

Patients admitted in pediatric wards or those attending the pediatric out-patient clinics were screened for severe acute malnutrition (SAM). Cases were selected on the basis of anthropometry and clinical examination, subjected to fulfillment of the criteria based on IAP definition for SAM.

1. Weight for height or Weight for length < -3 SD, using the WHO Growth Charts. OR
2. Presence of visible severe wasting. OR
3. Presence of bipedal edema of nutritional origin. OR
4. Mid upper arm circumference (MUAC) < 115 mm.¹⁸

Exclusion criteria was extremely sick patients (shock, meningitis, malignancy, bleeding), known renal disorders (e.g. glomerulonephritis, nephrotic syndrome, renal abscess, PUV, VUR, urolithiasis), congenital anomalies of urinary tract, patients with recent urinary catheterization (within

previous 48 hours) and patients refusing consent to participate in the study.

A written informed consent was obtained from the parents/legal guardians of the remaining eligible subjects. All these patients were investigated and assessed. Their detailed history and physical examination findings were recorded on a predesigned proforma. Following investigations were done in all patients: complete hemogram (hemoglobin, total and differential leukocyte counts, general blood picture), ESR, blood urea, serum creatinine, urine routine and microscopic examination and urine culture and sensitivity. Cases were defined as children with positive urine cultures. Children having negative urine cultures were used for comparison (Controls). All children with positive urine cultures were treated using standard treatment regimen (8). Other treatment was done as necessary.

Urine collected by supra-pubic aspiration is generally considered as the diagnostic gold-standard since contamination is thus reliably ruled out. Wherever possible, urine samples were collected by supra-pubic aspiration. Only in few cases clean-catch mid-stream specimen of urine was collected. The data were expressed as mean±SD, and percentage was calculated. For all tests, a value of $p < 0.05$ was considered statistically significant. All statistical analyses were performed using SPSS for Windows (version 21.0 SPSS, USA).

3. Results and Observations

This hospital based cross-sectional study was conducted on children with SAM, aged between 6 months and 5 years, either attending the Pediatrics out-patients department (OPD) or admitted in the Pediatric ward of CCM Medical College, Durg. A total of nearly 1500 patients were screened for severe malnutrition during the period from Oct 2017 to August 2019 (Figure 1). 286 cases fitted the eligibility criteria of which 42 patients had to be excluded because they had one or more exclusion criteria (shock $n=20$, meningitis $n=16$, nephrotic syndrome $n=3$, recent urinary catheterization $n=13$). The remaining 244 children were enrolled into the study. Urine culture samples were collected by suprapubic aspiration in 205 (84%) patients and by mid-stream clean catch in the remaining 39 (16%). Out of this the data of 24 children was removed from the final analysis as there was suspicion of contamination of their urine cultures. Of the remaining 220 children enrolled (75 boys and 145 girls), the urine culture reports of 111 (50.45%) children were urine culture positive and 109 (49.5%) were sterile. The analysis of these 111 patients is given as

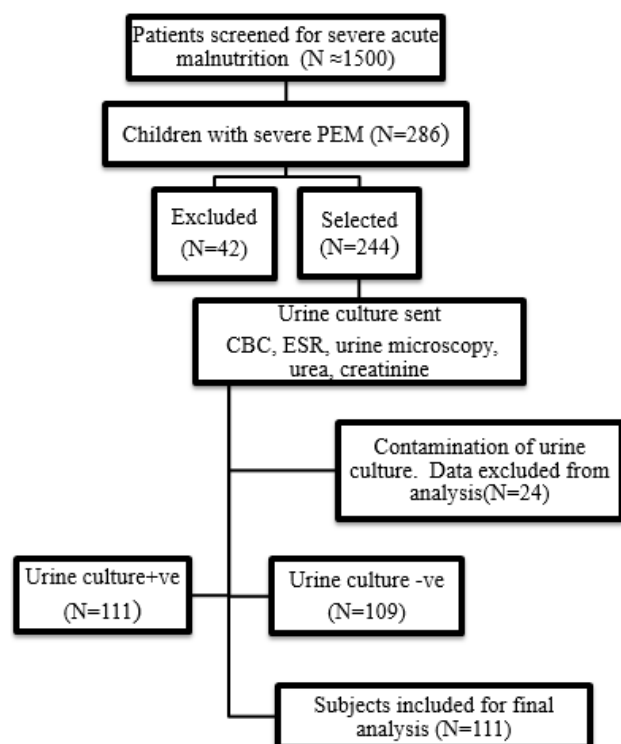
There were more female than male among the age groups. The no. of females also increases as age increases denotes UTI more common in females than males as age advances. Male to Female ratio in culture positive group is 1:2 and in culture negative group is 1:1.7.

Table 1: Age Distribution of the Study Population

Age group	Culture positiven (%) (N=111)		Culture negativen (%) (N=109)		Totaln (%) (N=220)
	Male	Female	Male	Female	
6 m-1yr	16(14.4)	19(17.11)	12(11)	15(13.76)	62(28.18)
1-3yr	11(9.9)	22(19.8)	18(16.51)	29(26.6)	80(36.36)
3-5yr	9(8.1)	34(30.6)	9(8.25)	26(23.85)	78(35.45)
Total	36(32.4)	75(67.56)	39(35.77)	70(64.22)	220

Table 2: Anthropometric profile of study population

Urine Culture Report	Culture+ (N=111)	Culture- (N=109)	Total (N=220)	p-value
z-score weight-for-age	-4.16 ± 0.52	-4.14 ± 0.54	-4.16 ± 0.53	0.978
z-score height-for-age	-3.57 ± 0.91	-3.52 ± 0.86	-3.55 ± 0.87	0.968
z-score weight-for-height	-4.54 ± 1.12	-4.57 ± 0.98	-4.56 ± 1.21	0.984
MUAC	11.55±1.01	11.45±0.99	11.76±1.44	0.943

**Fig. 1:** Flow of patients in the study

All cases enrolled in our study were severely malnourished children, i.e. Z-score of weight-for-height and/or height-for-age and/or weight-for-age below -3. The mean weight-for-age Z-score (SD) of the study population was -4.16 (0.53). The mean Z-score weight-for-age of Culture+ and Culture- were -4.16 and -4.14 respectively. The mean height-for-age Z-score of study population was -3.55, whereas in Culture+ and Culture- were -3.57 and -3.52 respectively. The mean weight-for-height Z-score of study population is -4.56 whereas in Culture+ and Culture- were -4.54 and -4.57 respectively. Anthropometric parameters did not differ between the groups. Details of

anthropometric parameters are given in Table 2.

Out of these 220 cases enrolled in the study, urine culture was positive in 111 cases. The most common organism reported included Gram-negative bacilli of which *E. coli* (68%) was the commonest (Table 3). Among the Gram-positive organisms *Enterococcus* accounted most culture positive reports (10.09%). There was two culture report of growth of fungal (*Candida*) cells.

59(63%) of the 93 gram negative isolates were sensitive to either amikacin or gentamycin (Table 4). The most common organism, *E. coli* is sensitive to amikacin and gentamycin by 69% (47 of 68) and 62% (42 of 68) respectively. They are 48% (45 of 93) sensitive to cefoperazone sulbactam combination, whereas only 27% (25 of 93) sensitive to cefoperazone alone. The proportion of ESBL (Extended spectrum Beta Lactamase) noted among *E. coli* was 13 (14%). All gram-negative organisms were sensitive to Imipenem (100%).

Among gram positive isolates, 75% (12 of 16) were sensitive to gentamycin (table IV). 2 Methicillin Resistant *Staphylococcus Aureus* (MRSA) was also detected among gram-positive organisms. All 12 *Enterococcus* species detected among culture-positive cases were High Level Aminoglycoside Resistance (HLAR) organisms. All gram-positive cocci were sensitive to vancomycin (100%).

Study population consisted of patients with various symptoms such as fever, cough, respiratory distress, loose stool, vomiting, abdominal pain, abdominal distension, irritability, etc Table 5. Majority of patients studied presented for illnesses other than UTI; most common associated conditions were respiratory tract infections (30%), acute gastroenteritis (28%), chronic diarrhea (11%), anemia (12%) and vitamin deficiency disorder, especially vitamin-A. Symptoms specific for UTI like dysuria, pyuria, hesitancy, urgency, increased frequency, flank pain and were infrequent in the culture positive cases (16.21%). Notably only 44.5% of the parents/caregivers sought consultation specifically for failure to thrive.

Table 3: Culture isolates among cases

Organism	N (%)
E. coli	68 (61%)
Klebsiella species	8 (7.2%)
Pseudomonas species	5 (4.5%)
Acinetobacter	5 (4.5%)
Citrobacter	5 (4.5%)
Proteus sp.	2 (1.8%)
Enterococcus	12 (10.9%)
Staphylococcus aureus	2 (1.8%)
Beta-hemolytic Streptococci	2 (1.8%)
Candida sp.	2 (1.8%)
Total	111

Table 4: Gram-Negative organisms and their antibiotic sensitivities

Organism	No.	AM	GM	NF	OF	GATI	CFPR	CFPR SULB	CEFP	CEX	IMIP
E Coli	68	47	42	13	13	8	25	37	35	35	68
Acinetobacter	5	2	0	0	0	0	0	1	2	0	5
Citrobacter	5	0	0	0	0	0	0	0	0	0	5
Klebsiella	8	8	5	0	5	2	0	5	5	0	8
Pseudomonas#	5	0	0	0	0	0	0	0	0	0	5
Proteus	2	2	2	0	2	2	0	2	2	0	2
Total	93	59 (63%)	49 (53%)	13 (14%)	20 (21%)	12 (13%)	25 (27%)	45 (48%)	44 (47%)	35 (38%)	93 (100%)

NO= No. of cases, AM = amikacin, GM = gentamycin, NF = nitrofurantoin, OF = ofloxacin, GATI = gatifloxacin, CFPR = cefoperazone, CFPR SULB = cefoperazone + sulbactam, CEFP = cefipime, CEX = cefixime, IMIP = imipenem.

#Pseudomonas is also sensitive to piperacillin + tazobactam.

Table 5: Gram- positive organisms and their antibiotic sensitivities

Organisms	No.	AM	GM	NF	OX	GAT	CEX	SM	AMX	AMP	EM	VM
Enterococcus	12	0	8	0	0	5	0	12	5	2	0	12
Beta hemolytic streptococci	2	0	2	0	0	0	0	0	2	0	2	2
Staphylococcus aureus	2	0	2	0	0	0	0	0	0	0	2	2
Total	16	0	12 (75%)	0	0	5 (32%)	0	12 (75%)	7 (44%)	2 (13%)	4 (25%)	16 (100%)

NO= No. of cases, AM=amikacin, GM=gentamycin, NF=nitrofurantoin, OX=oxacillin, GATI=gatifloxacin, CEX=cefixime, VM= vancomycin, SM= streptomycin, AMX= amoxicillin, AMP= ampicillin, EM= erythromycin

Table 6: Symptomatic profile of the study population

Symptoms	Culture positive (N=111) n (%)	Culture negative (N=109)n (%)	Total (N=220)n (%)
Fever	44 (39.63%)	47 (43.11%)	94 (42.5)
Urinary symptoms	18 (16.21%)	10 (9.17%)	27 (12.5)
Nocturnal enuresis	10 (9%)	9 (8.25%)	20(9)
Irritability	53 (47.74%)	31 (28.4%)	72 (32.5)
Loose stools	28 (25.22%)	30 (27.5%)	68 (31)
Nausea/vomiting	23(20.7%)	28 (25.6%)	54 (24.5)
Abdominal distension	23 (20.7%)	20 (18.34%)	42 (19)
Abdominal pain	10 (9%)	19 (17.43%)	34 (15.5)
Respiratory distress	15 (13.5%)	26 (23.85%)	48 (22)

4. Discussion

Malnutrition in children is an important issue, especially in developing countries like India, which needs special concern to tackle this condition and its co-morbidities. Because of deranged immunological status, malnourished children are more prone to infection and due to poor host-inflammatory response these infections often remain silent. Urinary tract infection is an important cause of morbidity and mortality in children. Because of the high prevalence of UTI in malnourished children, the disease needs special attention in this subgroup of children. Moreover the risk of bacteriuria is known to increase with increasing severity of malnutrition. In these children, the chances of UTI becoming complicated are more due to its silent nature leading to long term consequences like renal scarring and chronic renal failure.

The prevalence of UTI noted in this study population of severe acute malnutrition (SAM) patients is 50.45% which is high comparable to the prevalence reports (26.1-34.7%) from Africa.^{16,17,19} However this prevalence is higher than previous reports from India among malnourished under 5 children.^{11,20} Banupurmamath et al¹¹ reported 8% prevalence of UTI in severely malnourished children (weight-for-age <60%). Bagga A et al²⁰ studied moderate and severely malnourished (weight-for-age <70%) children and reported a prevalence of 15.2%; they also noted that the prevalence of UTI increases with increasing severity of malnutrition. Sharma IK²¹ et al found prevalence of UTI was 22.4% (19 out of 85) among the severe acute malnourished children. Alwtaify AS²² found prevalence of UTI 22.2% in malnourished children. Prevalence of UTI in our study is higher than other studies. Our study included only children with SAM under-5 children, and expectedly the prevalence of bacteriuria was higher. Moreover we have more of female patients than any other study.

In our study prevalence of UTI was more in females as compared to male children (67% of the female, 32% of male patients). There was female predominance in our study. It was in accordance with the study done by Dholakai PJ, et al²³ and Ghanghro AB, Laghari AH.²⁴ Present study was contrary with the study done by Rabasa AI, Gofama MM.²⁵ Gopal G, Premalatha R,²⁶ Page AL et al²⁷ in those male children were more than female children.

Majority of patients studied presented with symptoms pointing to illnesses other than UTI, yet the prevalence of bacteriuria was high among them. While very few bacteriuric patients in our study had symptoms related to UTI (3%), Bagga A et al²⁰ in their study on malnourished children with UTI found 73% of bacteriuric patients to have symptoms suggestive of UTI (11). It is difficult to delineate a specific illness in the study population because of the multiplicity of symptoms; however the most common associated conditions were respiratory tract infections

(30%), acute gastroenteritis (28%), chronic diarrhea (11%), anemia (12%) and vitamin deficiency disorder. Chaudhary M et al²⁸ noticed fever as most common presentation. Kumar R et al²⁹ found diarrhea as a most common symptom in 54% children of SAM. Gopal G, Premalatha R²⁶ found vomiting in 69.3% cases as a most common presenting complain.

Of the 111 culture isolates, majority were gram-negative bacilli especially *E. coli* (61%), followed by *Klebsiella* species (7.2%), *Pseudomonas* species, *Acinetobacter*, *Citrobacter* (4.5% each) and *Proteus* species (1.8%). This is in agreement with other studies in malnourished children which have established *E. coli* as the major organism causing UTI among malnourished children. But among the gram-positive organisms, *Enterococcus* (10%) was the major organism recovered, contrary to the reports of *Staphylococcus aureus* being the major gram-positive organism. *E.coli* was found to be the commonest bacteria causing UTI in children with SAM by Okomo UA et al,³⁰ Rabasa AI, Gofama MM,²⁵ Gopal G, Premalatha R²⁶ and Page AL et al.²⁷

In our study, 68 out of 111 positive for gram negative bacteria. 100% isolates were sensitive to Imipenem, 63% to Amikacin, 53% to Gentamycin, 47% to Cefipime, 48% to Cefaperazone -sulbactam, 38% to Cefixime, 21% to Ofloxacin and 14% to Nitrofurantoin. This is in accordance with Sharma IK²¹ et al where 100% isolates were sensitive to Imipenem, 79% to Amikacin, 73.7% to Gentamycin.

In this study, we did not have controls. So, we are not able to match and compare the parameters. In this study, we have not evaluated the risk factors causing UTI in malnourished children.

5. Conclusion

Prevalence of UTI is common (50.45%) in children with SAM in our study. In our study, Urinary tract infection was more common in females than males. Fever was the most common presenting symptom with UTI in SAM children. Pain abdomen, loose stool, nausea/ vomiting are associated with UTI in children with SAM. Most common organism for UTI in children with SAM in our study was mainly Gram negative bacteria. *E.coli* is the most common bacteria. Most sensitive first line Antibiotic was Amikacin for UTI in children with SAM, in our study. Most sensitive second line Antibiotic is Imipenem for UTI in children with SAM.

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7. Conflict of Interest

The authors declare they have no conflict of interest.

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