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ORIGINAL ARTICLE

Analysis of Risk Factors in Elderly Patients with Purple Urine Bag Syndrome: A Retrospective Analysis in a Medical Center in Northern Taiwan

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Background: Purple urine bag syndrome (PUBS), an uncommon phenomenon that turns urine tubes or bags purple or blue, can be encountered in long-term-care facilities. A thorough literature review shows that East Asia has a high incidence of PUBS. It is important to recognize the clinical features and risk factors of this phenomenon. The aim of this study is to explore the characteristics of patients with PUBS and correlate the onset of PUBS symptoms with risk factors. **Materials and Methods:** We reported nine cases of clinically confirmed PUBS between January 2009 and June 2013. Pertinent clinical information was collected, including age, feeding type, renal function, type of Foley catheter, urine analysis, and bacteriological data. **Results:** All of patients with PUBS presented with stable vital signs without evidence of clinical infection, such as fever or chills. The mean age of the patients was 86.6 ± 10.1 years, with a preponderance of females (77%). Five PUBS patients (55%) had a history of chronic renal insufficiency. Six patients (66%) had constipation. A logistic regression univariate analysis demonstrated a statistically significant urine pH in patients with PUBS [odds ratio (OR), 3.078; $P = 0.036$]. Risk factors, such as gender, were found to be significant using logistic regression multivariate analysis (OR, 0.031; $P = 0.021$). During the follow-up, all of the patients had Foley catheters re-inserted, and all of the patients received health education. **Conclusion:** The incidence of PUBS in the elderly population is associated with asymptomatic bacteriuria, urine pH, and gender but not renal function, type of feeding, or type of Foley catheter used. To understand PUBS and maintain urological hygiene, it is important to educate families and health care workers about PUBS and to recognize that PUBS is not regarded as a symptom of severe disease.

Key words: Purple urine bag syndrome, home care, asymptomatic bacteriuria

INTRODUCTION

The first article on purple urine bag syndrome (PUBS) was published in 1978.[1] The patient had a purple-colored urine bag after urinary catheterization was used for a period of time.[2] PUBS is regarded as asymptomatic bacteriuria if there is no fever >38°C and no urgency or frequency of urination, dysuria, or suprapubic tenderness. Purple urine itself is not considered a symptom of urinary tract infection.[3] Although the definitive risk factors for PUBS have not been established, the majority of authors believe that PUBS is associated with a bed-bound state, constipation, female sex, or dementia.[4-9] However, differences in study populations and institutions sustain the controversy surrounding the link between PUBS and those risk factors. Furthermore, there is a lack of sufficient epidemiological evidence from long-term-care facilities or home care. The objective of this study, therefore, was to identify the prevalence, clinical features, causative or associated factors, and potential risks of PUBS in long-term catheterized patients.

MATERIALS AND METHODS

This retrospective study was conducted in the Tri-Service General Hospital (TSGH). This study was approved by the Institutional Review Board at TSGH in accordance with the revised Helsinki Declaration. We reviewed the medical records of all of the patients who had been diagnosed with PUBS and who lived in long-term-care facilities and home care served by TSGH from January 2009 to June 2013. The

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patients had been diagnosed with PUBS based on clinical findings (i.e., purple discoloration of urinary catheters and bags).[1] These patients were cared for by families or foreign nursing workers. The patients were regularly visited by family doctors and home-care nurses and received regular changes of their nasogastric tubes and Foley catheters. We selected pertinent clinical information, including age, sex, feeding type, prior history, type of Foley catheter, the presence of bedsores or constipation, urine analyses, and bacteriological data. We used Fisher's exact test to compare categorical variables and Student's *t*-test to compare continuous variables. We used logistic regression (univariate and multivariate) to compare the positive PUBS group with the negative PUBS group. All of the statistical analyses were performed using SPSS statistical software version 19.0 for Windows (SPSS, Inc., Chicago, IL, USA). $P < 0.05$ was considered to be statistically significant. We also conducted a systematic literature review using the PubMed, Medline, Cochrane, and Embase databases. The predisposing factors, clinical presentations, prevalence, and therapeutic strategies were evaluated.

RESULTS

Among 200 patients in home care who were served by TSGH, nine fulfilled the criteria for a clinical diagnosis of PUBS. Their urine bags were characterized by purple discoloration [Figure 1]. The mean age of the patients was 86.6 ± 10.1 years. The patients' demographic data, clinical characteristics, and laboratory findings are shown in Table 1. All of the patients were reported to have long-term catheter use and to be bed-bound. Seven (77%) of these patients were female. Five patients (55%) had chronic renal insufficiency, including patient nine, who had ESRD. Three patients (33%) had bedsores. *Escherichia coli*, *Candida albicans*, *Enterococcus*, *Serratia marcescens*, *Pseudomonas aeruginosa*, and *Proteus mirabilis* were identified in the patients' urine cultures. Six patients (66%) had long-term constipation. All of the patients had stable vital signs without evidence of infection (such as fever or chills) or renal or urologic system complications, despite persistent PUBS and bacteriuria in some cases. The prevalence of PUBS in our patients was 0.005 PUBS cases/catheterized patient-month during the survey period. The major variables in the two groups are shown in Table 2. The logistic regression univariate analysis demonstrated statistically significant findings on urine pH cultures in patients with PUBS [odds ratio (OR), 3.078; $P = 0.036$; Table 3]. Risk factors, such as sex, were found to be statistically significant using logistic regression multivariate analysis (OR, 0.031; $P = 0.021$). Nine studies on PUBS were also identified [Table 4]. Most of the studies in the literature, with the exception of case reports, originated in East Asia. The predominant sex was female, and the mean age of the patients was older than 70 years. A high prevalence of constipation was also noted in the majority of the studies.

Figure 1. Purple urine bag

Table 1. Demographic data, age, laboratory findings, constipation, and type of Foley catheterization of nine patients with PUBS

Patient	1	2	3	4	5	6	7	8	9
Gender/age	Female/82	Female/83	Female/85	Female/103	Female/81	Male/94	Female/98	Female/83	Male/70
Constipation	Yes	No	Yes	Yes	Yes	No	Yes	Yes	No
Urine pH	7	6.5	8.0	7.0	5.5	7.0	5.5	7.5	6.5
Urine culture	Mixed flora	*Candida albicans*	Nil	*E. coli* *Enterococcus*	Mixed flora	*S. marcescens* *P. aeruginosa*	*E. coli*	*P. mirabilis* *E. coli*	ESBL *E. coli*
Creatinine level (mg/dL)	0.7	1.1	0.4	1.3	0.9	0.9	1.4	1.1	7.6
Feeding route	NG	NG	NG	Oral	Oral	NG	Oral	NG	Oral
Foley's material	Silicon	Silicon	Rubber	Rubber	Silicon	Silicon	Rubber	Rubber	Silicon
Bedsore	No	Yes	No	No	No	No	Yes	No	Yes
GFR (mL/min/1.73 m^2)	85.14	50.4	160	39.7	63	83	36.9	50.4	ESRD

GFR = glomerular filtration rate; NG = nasogastric tube; *E. coli* = *escherichia coli*; *P. aeruginosa* = *pseudomonas aeruginosa*; *S. marcescens* = *serratia marcescens*; *P. mirabilis* = *proteus mirabilis*; ESBL = extended-spectrum beta-lactamase; PUBS = purple urine bag syndrome; ESRD = end-stage renal disease

DISCUSSION

In this study, the predisposing factors of nine cases of PUBS were investigated. All the patients with PUBS were catheterized because of significant disability, and they lived in long-term-care facilities or at home. Seven of the patients were female. The high incidence of PUBS in females has been previously reported.[6,7,10] This high frequency of PUBS in females is assumed to be the result of the shorter female urethra. In general, alkaline urine is more likely to cause a proliferation of bacterial flora; consequently, alkaline urine is a risk factor for PUBS.[11,12] The finding that alkaline urine tends to be a factor that differentiates between the PUBS group and the control group was noted in our study (OR, 3.078; 95% confidence interval, 1.075-8.812; $P = 0.036$). Several articles have reported that PUBS was also found in patients with acid urine;[13,14] therefore, alkaline urine may not be an absolute requirement for PUBS. Although related enzyme (indoxyl phosphatase, sulfatase) activities were especially high in strongly alkaline urine,[13] their occurrence in acidic urine is also likely, especially as a result of different bacteria.[14]

This study focused primarily on home care and long-term-care populations. The prevalence of PUBS was 0.005 PUBS cases/catheterized patient-month. The precise prevalence of PUBS is uncertain because it varies among studies; the prevalence of PUBS was observed to be 8.3% (13/157) at a long-term-care service center,[6] 26.67% (16/60) in geriatric wards,[15] and as high as 42.1% (8/19) in urinary catheterized patients at a nursing home.[9] The differences may be related to the different institutions (hospital wards, nursing homes, long-term-care facilities, home care), care quality, and study periods examined. PUBS was diagnosed clinically, and no confirmation method was used. Consequently, the color and the depth of the color purple are presumed to vary according to different people, thus contributing to a varied prevalence.

Several articles mentioned that PUBS has a higher prevalence in Taiwan than in other countries because Taiwan has a higher rate of dialysis-treated patients.[16] In previous

Table 2. Demographics of patients with and without PUBS

Variables	PUBS (n = 9)	Non-PUBS (n = 57)	P value
Age	86.56 (10.06)	83.74 (9.99)	0.435
Male sex (%)	2 (22.22)	28 (49.12)	0.166
Constipation (%)	6 (66.67)	44 (77.19)	0.676
GFR (%)	70.98 (40.29)	81.10 (57.77)	0.635
Urine pH >7 (%)	2 (22.22)	4 (7.02)	0.119
Feeding type (%)			
NG	4 (44.44)	33 (57.89)	0.491
Oral	5 (55.56)	24 (42.11)	
Foley's type (%)			
Silicon	5 (55.56)	46 (80.70)	0.192
Rubber	4 (44.44)	11 (19.30)	

PUBS = purple urine bag syndrome; GFR = glomerular filtration rate; NG = Nasogastric tube

Table 3. Risk factors by univariate and multivariate logistic regression analysis for PUBS

	Univariate analysis	P value	Multivariate analysis	P value
	OR (95% CI)		OR (95% CI)	
Age	1.036(0.950-1.129)	0.430	1.206(0.997-1.459)	0.054
Gender	0.296(0.057-1.549)	0.149	0.031(0.002-0.585)	0.021*
Constipation	0.591(0.130-2.696)	0.497	0.699(0.078-6.258)	0.749
Urine PH	3.078(1.075-8.812)	0.036*	5.108(0.995-26.206)	0.051
GFR	0.996(0.978-1.013)	0.632	0.996(0.973-1.020)	0.762
Feeding type	0.582(0.141-2.398)	0.453	0.211(0.021-2.066)	0.181
Foley type	0.299(0.069-1.300)	0.107	1.499(0.151-14.884)	0.730

OR= odds ratio; CI= confidence interval; *:p <0.05

Table 4. Studies reporting on PUBS

Study	Case number of PUBS	Prevalence	Study group	Age (mean)	Gender (Male/female)	CKD	Country	Constipation	Urine pH value ≥7	Ref
1	3	No data	Geriatric wards	82	3/3	No data	Japan	3/3 (100%)	No data	4
2	13	13/157 (8.3%)	Nursing home, Home care	79.3	2/11	No data	Taiwan	11/13 (84.6%)	No data	6
3	14	14/84 (16.7%)	Nursing home, Home care	80.9	1/13	No data	Taiwan	10/14 (71%)	10/14	7
4	6	No data	Dementia ward	87.7	3/3	No data	Japan	6/6 (100%)	5/6	8
5	10*	8/19 (42%)	Nursing home	76.1	3/5	No data	Taiwan	3/8 (37.5%)	8/8	9
6	14	No data	Long-term care wards	78.9	2/12	No data	Japan	No data	13/14	10
7	16	16/60 (26.7%)	Geriatric wards	79.5	16/16	No data	Korea	No data	No data	15
8	10	10/40 (25%)	Nursing home, Respiratory care ward	78.9	4/6	6/10	Taiwan	8/10 (80%)	No data	16
9	2	No data	Geriatric wards	75.5	1/1	No data	Hong Kong	No data	2/2	20
10	9	0.005§	Long-term-care facilities, Home care	87	2/7	5/9	Taiwan	6/9 (66.7%)	5/9	Our report

*two from medical record review; § cases/catheterized patient-month

literature, 80% of those >70 years of age had a calculated creatinine clearance of <60 mL/min.[17] All of the patients in our study were older than 70 years, and 5 patients (55%) had a calculated clearance of <60 mL/min (including ESRD in one patient). The prevalence of chronic renal failure was not higher than average in our study. Renal function was likely not a risk factor of PUBS. According to a thorough review of the literature, East Asia is one of the areas with a high incidence of PUBS. Potentially important but largely unknown factors include chronic disease, diet, residence, and care setting. Therefore, additional information is required to determine whether specific factors contribute to differences in PUBS prevalence among populations.

The high incidence of constipation in PUBS has been previously reported.[10,12,18] Six (66%) of our patients had long-term constipation. Although constipation was highly prevalent in long-term-care facilities, there was no significant difference between the PUBS group and the control group. In one study, patients with PUBS had lower tryptophan levels.[19] That finding offers indirect proof that constipation is commonly associated with decreased colonic motility, resulting in the increased metabolism of tryptophan and indole absorption. Tryptophan was converted to indole by intestinal bacterial metabolism. Indole was absorbed into the portal circulation and conjugates with SO_4 to form indoxyl sulfate. Indoxyl sulfate was excreted into the urine and metabolized by bacteria to produce indigo (blue) and indirubin (red, Figure 2).

In recent reports, PUBS was regarded as an asymptomatic bacteriuria. However, its potential relationship with urinary tract infection has been mentioned in publications.[20,21] Four of our patients had PUBS on and off for at least 1-week to several months. None of the patients received antibiotic treatment. We replaced their indwelling urinary catheters and drainage bags more frequently and encouraged the patients to drink cranberry juice to improve their catheter care quality. All of the patients with PUBS recovered without any complications. PUBS without abnormal findings is a benign symptom.

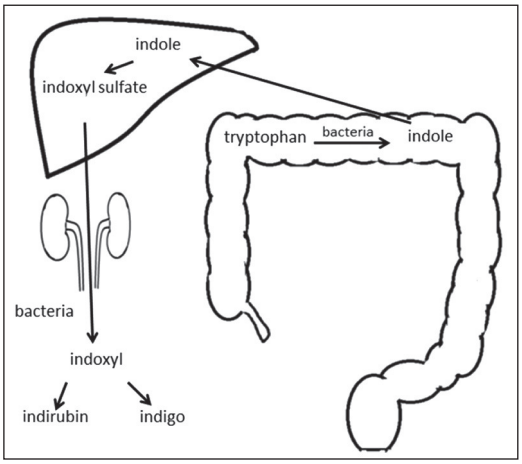

Figure 2. Pathogenesis of purple urine bag syndrome

The Ministry of Health and Welfare of Taiwan estimated that elderly people will exceed 15% of the total population within the next decade. Therefore, long-term health care will pose a challenge in an era of aging populations. Caregivers, who are usually family members or foreigners, do not have the professional skills that nurses in hospitals provide. PUBS often perplexes these caregivers. They must send the patients to the hospital for additional evaluations, thus wasting time and money. Doctors must prove to the patients and caregivers that there is no problem and that nothing is wrong. These caregivers should be educated about PUBS; they should learn to regard PUBS as a benign problem, not a cause for fear. PUBS may be a quality indicator for health care facilities in the future.

CONCLUSION

We found that PUBS had a higher incidence in patients with alkaline urine and female gender. Prospective studies exploring the association between prognostic outcomes and PUBS were warranted to enable more specific interpretation of the findings.

DISCLOSURE

The authors have no conflicts of interest to declare.

REFERENCES

1. Barlow GB, Dickson JA. Purple urine bags. Lancet 1978;28:220-1.
2. Dealler SF, Hawkey PM, Millar MR. Enzymatic degradation of urinary indoxyl sulfate by *Providencia stuartii* and *Klebsiella pneumoniae* causes the purple urine bag syndrome. J Clin Microbiol 1988;26:2152-6.
3. Ga H, Kojima T. Purple urine bag syndrome. JAMA 2012;307:1912-3.
4. Matsuo H, Ishibashi T, Araki C, Sakamaki H, Mazume H, Ueki Y, *et al*. Report of three cases of purple urine bag syndrome which occurred with a combination of both *E. coli* and *M. morganii*. Kansenshogaku Zasshi 1993;67:487-90.
5. Dealler SF, Belfield PW, Bedford M, Whitley AJ, Mulley GP. Purple urine bags. J Urol 1989;142:769-70.
6. Su FH, Chung SY, Chen MH, Sheng ML, Chen CH, Chen YJ, *et al*. Case analysis of purple urine-bag syndrome at a long-term care service in a community hospital. Chang Gung Med J 2005;28:636-42.

7. Shiao CC, Weng CY, Chuang JC, Huang MS, Chen ZY. Purple urine bag syndrome: A community-based study and literature review. Nephrology (Carlton) 2008;13:554-9.
8. Muneoka K, Igawa M, Kurihara N, Kida J, Mikami T, Ishihara I, *et al*. Biochemical and bacteriological investigation of six cases of purple urine bag syndrome (PUBS) in a geriatric ward for dementia. Nihon Ronen Igakkai Zasshi 2008;45:511-9.
9. Lin CH, Huang HT, Chien CC, Tzeng DS, Lung FW. Purple urine bag syndrome in nursing homes: Ten elderly case reports and a literature review. Clin Interv Aging 2008;3:729-34.
10. Mantani N, Ochiai H, Imanishi N, Kogure T, Terasawa K, Tamura J. A case-control study of purple urine bag syndrome in geriatric wards. J Infect Chemother 2003;9:53-7.
11. Umeki S. Purple urine bag syndrome (PUBS) associated with strong alkaline urine. Kansenshogaku Zasshi 1993;67:1172-7.
12. Robinson J. Purple urinary bag syndrome: A harmless but alarming problem. Br J Community Nurs 2003;8:263-6.
13. Ollapallil J, Irukulla S, Gunawardena I. Purple urine bag syndrome. ANZ J Surg 2002;72:309-10.
14. Chung SD, Liao CH, Sun HD. Purple urine bag syndrome with acidic urine. Int J Infect Dis 2008;12:526-7.
15. Ga H, Park KH, Choi GD, Yoo BI, Kang MC, Kim SM, *et al*. Purple urine bag syndrome in geriatric wards: Two faces of a coin? J Am Geriatr Soc 2007;55:1676-8.
16. Yang CJ, Lu PL, Chen TC, Tasi YM, Lien CT, Chong IW, *et al*. Chronic kidney disease is a potential risk factor for the development of purple urine bag syndrome. J Am Geriatr Soc 2009;57:1937-8.
17. Iseki K, Kinjo K, Iseki C, Takishita S. Relationship between predicted creatinine clearance and proteinuria and the risk of developing ESRD in Okinawa, Japan. Am J Kidney Dis 2004;44:806-14.
18. Lin HH, Li SJ, Su KB, Wu LS. Purple urine bag syndrome: A case report and review of the literature. J Intern Med Taiwan 2002;13:209-12.
19. Nakayama T, Kanmatsuse K. Serum levels of amino acid in patients with purple urine bag syndrome. Nihon Jinzo Gakkai Shi 1997;39:470-3.
20. Tang MW. Purple urine bag syndrome in geriatric patients. J Am Geriatr Soc 2006;54:560-1.
21. Mohamad Z, Chong VH. Purple urine bag: Think of urinary tract infection. Am J Emerg Med 2013;31:265.e5-6.