Case Analysis of Purple Urine-Bag Syndrome at a Long-Term Care Service in a Community Hospital

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Background: Purple urine-bag syndrome (PUBS) is a rare phenomenon in which the contents of urine bags turn purple or blue following patient catheterization. The condition often causes care givers tremendous distress. We investigated the prevalence and possible causes of PUBS for a group of elderly patients.

Methods: A total of 157 patients featuring urine catheterization, 13 of whom exhibiting PUBS were analyzed with regards to age, functional status, duration of catheterization, number of daily medications, living location, feeding route, bowel habits, and the pattern of use of a urinary catheter. Urine samples were cultured from all the PUBS patients participating.

Results: Two men who underwent cystostomy and 11 women who underwent urethral catheterization who exhibited PUBS were observed for this study. The age, duration of catheterization, number of daily medications feeding pattern and functional status between the group exhibiting PUBS and the group of patients without PUBS demonstrated no significant differences. A total of 69.2% of the PUBS-affected patients, as compared to 43.1% of the non-PUBS patients, lived in nursing homes, and 84.6% of the PUBS-affected patients were constipated, as were 66 % of the non-PUBD subjects. In total, 72.7% of PUBS patients were reported to be using a laxative suppository, compared with 41% of the non-PUBS group, whereas 92.3% of PUBS patients were catheterized using a plastic (PVC) foley, as compared to 70.8% of the non-PUBS patients. The pH for 12 out of 13 PUBS patients' urine was ≧ 7. *Escherichia coli, Provendicia* var. spp., *Proteus mirabilis, Klebsiella pneumoniae* were the common pathogens isolated from the urine samples provided by our PUBS patients.

Conclusion: We found that PUBS was more likely associated with the female gender, alkaline urine, constipation, institutionalization, the use of a plastic (PVC) urinary catheter, and certain bacteria such as *Provendicia* var. spp., *Escherichia coli, Proteus mirabilis,* and *Klebsiella pneumoniae.*
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Key words: purple urine bag, catheters, tryptophan, indole, indigo blue.

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To the best of our knowledge, purple urine-bag syndrome (PUBS) was first described by Barlow and Dickson in 1978.[1] It is a phenomenon in which the contents of the urinary catheter bag of a patient turns purple over a period of hours or days subsequent to urinary catheterization (Fig. 1).[1-3] This phenomenon is relatively uncommon and occurs predominantly amongst women with chronic catheterization. Many researchers have previously described the clinical and bacteriological background of purple urine-bag syndrome (PUBS).[4-8] The clinical background of PUBS, however, has not been well characterized. The evident discoloration of the contents of urinary drainage bags has been previously reported to be due to the presence, within the catheter bags, of metabolites of tryptophan: indigo (blue), indirubin (red) or a combination of all of these, which subsequently becomes purple.[9] In order to examine the risks associated with PUBS, we carried out a retrospective study and reviewed the medical records of 157 patients from our community-outreach program who featured urinary catheterization, with focus on age, sex, feeding and defecation patterns, the type(s) of urinary catheter used, urine pH, bacterial species isolated and antibiotic sensitivity as determined from each patient's urine.

METHODS

Of the 369 patients cared for under our community out-reach program (Cardinal Tien Hospital, Taipei, Taiwan), 157 patients who featured urinary catheterization during the period from June 2002 through May 2004 inclusively were included in our study. Among these 157 patients, 13 patients with purple urine-bag contents were identified by chart review. Data corresponding to age, Barthel's score, Glasgow coma scale score, IDL (instrumental activities of daily living) and ADL (activities of daily living) scales, duration of catheterization, number of individual daily medication administered, living location, consciousness status, route of feeding, extent of constipation with the pattern of laxative use, and pattern of urinary-catheter use were compared between patients with and without PUBS. For the 13 patients who exhibited purple urine-bag syndrome, urine culture, urine pH, antimicrobial sensitivity and duration of catheterization were also analyzed.

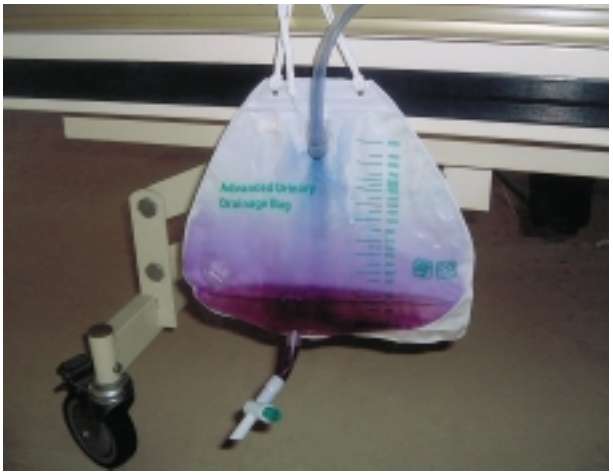

Fig. 1 Purple urine-bag contents illustrating purple urine-bag syndrome.

RESULTS

A total of 157 catheterized patients (75 men) were included in the study (Table 1). They were all significantly disabled (chair and bedridden). Among these patients, the three most-common diagnoses were cerebrovascular accident (68 patients), diabetes mellitus (52 patients) and dementia (28 patients). A

Table 1. Basic Characteristics of PUBS Group and Non-PUBS Group

Variables	PUBS Group		Non-PUBS Group	
	N (%)	Mean (SD)	N (%)	Mean (SD)
Age (year)		79.3 (9.6)		76.3 (12.7)
Gender				
Male	2 (15.4%)		73 (50.7%)	
Female	11 (84.6%)		71 (49.3%)	
Consciousness state				
Normal	5 (38.5%)		71 (49.3%)	
Abnormal	7 (53.8%)		72 (50.0%)	
Agitated	1 (7.7%)		1 (0.7%)	
Glasgow coma scale score		12.31 (2.9)		12.6 (2.8)
Barthel's score		6.3 (16.1)		3.9 (11.8)
IDL scale		30.4 (1.2)		29.1 (5.5)
ADL scale		1.2 (3.2)		2.7 (9.8)
Number of daily medication		5.0 (2.6)		5.33 (2.7)

Abbreviations: ADL: activities of daily living; IDL: instrumental activities of daily living; SD: standard deviation.

total of 13 patients (two cystostomy catheterization men, and 11 urethral catheterization women) exhibiting purple urine-bag syndrome were observed during the above-mentioned study period. The mean age of the group exhibiting PUBS was 79.3+/- 9.6 years and that for the non-PUBS patients was 76.3+/- 12.7 years. The Barthel's scale score, the Glasgow coma scale score and the duration of catheterization for PUBS and non-PUBS study participants were, respectively, 6.3+/- 16.4 and 3.9+/- 11.8, 12.3 +/- 2.9 and 12.6+/-2.8 and 25.8+/- 24.6 and 21.2+/- 24.4 months. The average number of types of daily medication administered for the members of the PUBS group was 5+/- 2.6, whereas for the non-PUBS group it was 5.3+/-2.7.

In total, 69.2 % (9) of PUBS-affected patients lived in nursing homes; whereas, only 43.1% of non-PUBS individuals resided similarly (Table 2). Seven (53.8%) of the PUBS-affected patients required nasogastric feeding while 38.5% of the patients needed assisted feeding, the corresponding non-PUBS figures were 57.3% and 31.5%, respectively.

Constipation and suppository laxative use for PUBS-affected patients versus non-PUBS patients were found in11 (84.6%) versus 95 (66.0 %) subjects, and 11 (72.7%) versus 39 (41.1%) study subjects, respectively.

Catheterization using plastic (PVC) foleys were found in 12 of 13 (92.3%) of the PUBS-affected patients and 102 (70.8%) of the non-PUBS patients. Two different types of drainage bags were used in this study, namely the Crown Urine Bag (04D15B, Meisei Corp., Tokyo, Japan) and the Sunder Advanced Urinary Drainage Bag (A Type, S-31-051-A, Sunder Corp. Yun-Lin County, Taiwan), although no difference with regards to the presence or absence of PUBS was noted when we compared the use of the different bags.

The urine pH value for 12 of the 13 PUBS-affected patients was equal to or greater than seven. A total of 11 urine catheter specimens from different PUBS-affected patients were cultured (Table 3), from which several different bacterial species were detected including *Escherichia coli* (5), *Proteus mirabilis* (3), *Klebsiella pneumoniae* (3), *Providencia stuartii* (2), *Enterobacter cloacae* (2), *Morganella morganii* (2), *Citrobacteria frundii* (1), *Providencia rettgeri* (1), *Proteus vulgaris* (1). The relative sensitivity of such microorganisms to common oral antibiotics revealed that many were resistant to sulfamethoxazole- trimethoprim and ampicillin whereas all were sensitive to ciprofloxacin.

Table 2. Clinical Characteristics of PUBS Group and Non-PUBS Group

Variables	PUBS Group		Non-PUBS Group	
	N (%)	Mean (SD)	N (%)	Mean (SD)
Location of living				
Home	4 (30.8%)		82 (56.9%)	
Institution	9 (69.2%)		62 (43.1%)	
Feeding route				
Self- intake	1 (7.7%)		15 (10.5%)	
With assistance	5 (38.5%)		45 (31.5%)	
NG feeding	7 (53.8%)		82 (57.3%)	
TPN feeding	0 (0.0%)		1 (0.7%)	
Constipation				
Yes	11 (84.6%)		95 (66.0%)	
No	2 (15.4%)		49 (34.0%)	
If constipated, how treated				
Via oral	2 (18.2%)		53 (55.8%)	
Via supp	8 (72.7%)		39 (41.1%)	
Digital dis-impaction	1 (9.1%)		3 (3.2%)	
Duration of Foley use (months)		25.8 (25.0)		21.2 (24.4)
Type of Foley				
PVC plastic	12 (92.3%)		102 (70.8%)	
Silicon	1 (7.7%)		44 (30.6%)	
Via urethra	11 (84.6%)		123 (85.4%)	
Via cystostomy	2 (15.4%)		16 (11.1%)	
Change of urine bag				
Yes	10 (76.9%)		105 (72.9%)	
No	3 (23.1%)		39 (27.1%)	

Abbreviations: NG: nasogastric tube; SD: standard deviation; TPN: total parental nutrition.

DISCUSSION

The contents of an individual's plastic urinary-catheter drainage bag may turn purple a number of hours or days subsequent to catheterization, which becomes increasingly more intense the longer the same drainage bag is left in place.[8-10] Such a phenomenon was, to the best of our knowledge, first reported by Barlow and Dickson in 1978 and termed "purple urine-bag syndrome".[1] Subsequent investigations have revealed that this syndrome typically affects elderly women.[4,5,7,8,11,12] Most PUBS-affected

Table 3. Results of Bacteriological Study of 13 Patients Featuring PUBS

Bacteriological species	Number of Patients
Escherichia coli	5
Proteus mirabilis	3
Klebsiella pneumoniae	3
Providencia stuartii	2
Morganella morganii	2
Enterobacter cloacae	2
Providencia rettgeri	1
Citrobacteria frundii	1
Proteus vulgaris	1
Gram negative bacteria	2
Gram positive cocci	1
No culture performed	2

patients are bed ridden and many exhibit cognitive impairment.[8,9,11] We observed similar characteristics with poor consciousness status and low performance for ADL and IDL scales being featured in members of our PUBS group. In our study among 82 catheterized female patients, the prevalence of PUBS (11 patients) was 13.4% and among the 75 foley-catheterized male patients the incidence of PUBS (two patients) was 2.7%, both of the male patients had cystostomy. To explain the gender differences, we speculate that the occurrence of PUBS may be associated with the actual length of the urethra. There appeared to be no differences with regards to the number of daily medications administered to the patients between the two study groups.

Feeding routes for patients have also been previously reported as being a causal factor for PUBS,[4] although in our study, we did not detect any significant differences with regards to feeding routes between the two test groups.

Constipation has been reported as a frequent symptom of patients exhibiting PUBS.[3,4,8,9,13] The suggestion has been made that chronic constipation may alter gut motility or the specific intestinal bacterial flora which are responsible for dietary tryptophan being converted to indole, pyruvic acid and ammonia by specific bacterial flora containing tryptophanase.[10,13] Under such abnormal conditions, indole is rapidly absorbed in the portal circulation and oxidized in the liver to indoxyl, which is excreted into the urine, in which medium indigo (the purple pigment) is formed subsequent to the oxidation of indoxyl in an alkaline environment.[6,9,13-15] When little oxygen is present, there is a tendency for indoxyl to form into isatin and then to combine further with an indoxyl residue to yield indirubin (the blue pigment).[9] In 1993, Umeki suggested that the occurrence of PUBS was associated with strong alkaline urine.[5] From the results of our study, the urine sample pH values for 12 of 13 of the PUBS-group members were equal to or above 7.0, which appears to confirm that the formation of purple urine is more likely to be alkaline.

There have been, however, some reported cases of PUBS which have presented without any evidence of indicanuria.[7,14,16] The violet pigment in the urine is thought to be due to the activity of a steroidal or bile-acid conjugate.[7,16] Thus, to the best of our knowledge, PUBS- causing factors have not yet been well characterized.[4]

In our study, PUBS-affected patients were much more prone to constipation than their counterparts. We also observed that when constipation was present, the individuals were taking related medication, 61.5% of the PUBS-group members were taking Bisacodyl via suppository as compared with 26.4% of the members of the non-PUBS group. In 1990, Saunders and his colleagues suggested that the suppository Bisacodyl elicited acute injury to the human rectal mucosa.[17] However, whether the long-term application of the suppository Bisacodyl is able to cause damage to the colorectal mucosa and, consequently, change the normal intestinal microorganism flora leading to the preferential growth of certain bacterial species which demonstrate the ability to produce indigo as a by-product, remains an issue for further investigation.

In comparing the residential status of study subjects, we found that nine (69%) of the subjects who featured PUBS were institutionalized, which was greater than the corresponding figure for the non-PUBS group (62; 43.1%). This could be interpreted as suggesting that the greater prevalence of PUBS among institutionalized patients might be due to an overall poorer level of personal hygiene and care. We speculated that it remains possible that the long duration of wearing of soiled napkins may give intestinal microorganisms an opportunity to colonize such soiled napkins and subsequently ascend to within the genitourinary tract, infecting the tract and its contents and thus causing the purple coloration of the

urine to take place.

Several bacterial species have been reported to be associated with PUBS, including *Providencia stuartii, Providencia rettgeri, Klebsiella pneumoniae, Proteus mirabilis, Escherichia coli, Morganella morganii, and Pseudomonas aeruginosa.*[3-7,9,12,16,18,19] In addition to these bacterial species mentioned above, some other species of bacteria (*Enterobacter agglomerans, Yersinia enteroclitis, Providencia alcalifaciens* and *Staphylococcus aureus,* etc.) demonstrate the ability to generate sulphases and phosphates which, under certain conditions, are able to produce blue-colored colonies on agar following incubation for around 48 hours.[6] Nine different bacterial species were isolated and identified from a study of the urine-bag samples deriving from members of our PUBS group, including the following: *Escherichia coli, Proteus mirabilis, Klebsiella pneumoniae, Providencia stuartii, Enterobacter cloacae, Morganella morganii, Citrobacteria frundii, Providencia rettgeri, and Proteus vulgaris.*

Providencia var. spp., as a family, is thought to be an unusual clinical entity because the long-term catheterized urinary tract appears to offer an attractive niche for this particular family of microorganisms.[20] From our observations, however, the duration of catheterization of PUBS-affected and non-PUBS group members was 25.8 $\pm$ 25.0 months and 21.2 $\pm$ 24.4 months, respectively. From such results, it would appear to us that the duration of catheterization is not an absolute criterion for the development of PUBS.

We also found that the longer the PVC bag stayed in use for a patient, the deeper the color purple the bag became, despite the use of two different sterile PVC drainage bags from two different companies, a result compatible with the 1989 findings of Dealler et al.[9]

It was apparent that PUBS affected not only the drainage bags but also the indwelling catheters. Clinical experience has revealed that this PUBS-associated discoloration seems to have affected all catheters, no matter which catheter material was used,[8] although from our observation, 12 of 114 (10.5%) subjects who used a PVC foley developed PUBS, compared with 1/45 (2.2%) of subjects who used a silicon foley who reported PUBS-associated urine-bag discoloration. From our results, it seems to us that the use of a PVC foley is more likely to harbor the presence of microorganisms associated with the development of PUBS than using a silicon foley. We also observed that the greater the room temperature, the more rapidly the colorization of bag contents took place and the deeper the color the bags' contents eventually became.[8] We attributed this to the fact that bacteria multiply more rapidly in a warmer environment than in a cooler environment. Seemingly contrasting this however, we also observed that the blue or purple discoloration did not take place in the intraurethral portion of the catheters for any of the 13 PUBS-affected patients, in spite of the fact that the temperature of this component of the tube (body temperature) was greater than the temperature of the tube outside the body. This may be attributable to bacterial fermentation in the PVC drainage bag and foley which requires oxidation. The absence of oxygen in the upper reaches of the drainage tube prevented such a reaction to take place there.

From a thorough review of the literature, it appears that most of the patients who presented with PUBS were, largely, asymptomatic.[8,12] It is apparent that PUBS is not a disease *per se*, nor does it appear to represent any real danger to patients' health, and some authors go so far as to even advocate that it is unnecessary to treat PUBS-affected patients aggressively.[3,12] In order to prevent the occurrence of the discoloration of urine-bag contents or the development of certain malodors, drainage bags and indwelling long-term catheters may need to be changed for catheterized patients on a more regular basis in order to reduce the likelihood of this problem arising. Although if a possible underlying urinary infection is suggested, as was the case for two of our patients, from our clinical experience, the administering of appropriate empirical oral antibiotics such as ciprofloxacin is suggested, due to the typically high resistance rate of such infection-related bacteria to first-line antibiotics.

In conclusion, from our observations, PUBS seems to be associated with gender, bed-ridden status, living location, alkaline condition of urine, constipation particularly with Bisacodyl via suppository and possibly PVC plastic catheter usage, but is not associated with the route of feeding, individual's consciousness state, or type of PVC urine bag used. If antibiotics are indicated, ciprofloxacin appears to be the drug of choice.

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某社區醫院長期照護中心之紫色尿袋症候群病例分析

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背 景： 紫色尿袋症候群 (purple urine-bag syndrome) 是一種極少見的症狀，發生時會使得尿管及尿袋的顏色變成藍色或紫色。這樣的情形通常會帶給照顧者極大的煩惱，所以我們研究紫色尿袋症候群的流行程度和造成老年病人發生此症狀的原因。

方 法： 在 157 個置放導尿管的病人當中，其中有 13 個發生了紫色尿袋症候群，佔 8.3%。我們分析了他們的年齡、置放導尿管的時間、例行服用的藥物、居住環境、飲食習慣、腸胃道的習性及導尿管中的尿液樣本。而在發生紫色尿袋症候群的病人身上也採集了尿液作爲細菌培養的依據。

結 果： 我們觀察到其中 2 個有膀胱造瘺口的男性和 11 個置放導尿管的女性有發生紫色尿袋症候群現象。而在年齡、置放導尿管的時間、例行服用的藥物和飲食習慣這些方面和紫色尿袋症候群的發生與否並沒有什麼關聯。在紫色尿袋症候群的病人當中有 69.2% 居住在護理之家，不同於沒發生紫色尿袋症候群的 43.1%。84.6% 紫色尿袋症候群的病人有便秘情形，不同於沒發生紫色尿袋症候群的 66%。72.7% 紫色尿袋症候群的病人當中顯示出要使用通便的栓劑，不同於沒發生紫色尿袋症候群的 41%。92.3% 紫色尿袋症候群的病人使用塑膠製的導尿管，不同於沒發生紫色尿袋症候群的 70.8%。13 個紫色尿袋症候群病人中有 12 個人的尿液當中酸鹼度 (pH 值) ≧ 7。而大腸桿菌 (*Escherichia coli*)，變形桿菌 (*Provendicia* spp.)，奇異變形菌 (*Proteus mirabilis*)，肺炎桿菌 (*Klebsiella pneumoniae*) 等病原體則在發生紫色尿袋症候群的病人尿液當中被培養出來。

結 論： 紫色尿袋症候群的發生和女性，鹼性的尿液，便秘，安置在機構中及使用塑膠的導尿管這些較有相關性。而一些被確定的菌種如變形桿菌，大腸桿菌，奇異變形菌，肺炎桿菌也有其關聯。

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關鍵字： 紫色尿袋，導尿管，胰化氨基酸，引朵靛藍。

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