

## Purple Urine - An Interesting Misnomer

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### 1. Abstract

Purple Urine Bag Syndrome (PUBS) is a rare condition observed in patients with long-term catheterization, often manifesting as a purple discoloration of urine within the catheter bag. This discoloration is typically linked to the presence of bacterial infections that produce enzymes breaking down urinary indoxyl sulfate into red and blue pigments. These pigments react with the plastic of catheter bags, resulting in a purple hue. The condition is primarily seen in elderly, bedridden patients, or those with significant comorbidities such as diabetes. We describe a case involving a 60-year-old woman with poorly controlled diabetes and chronic catheterization, who presented with high-grade fever and a purple-colored catheter bag. Lab analysis confirmed a urinary tract infection with *Escherichia coli*, sensitive to ciprofloxacin. After catheter replacement and antibiotic treatment, the patient's symptoms resolved, and the urine color returned to normal. This case emphasizes the importance of recognizing PUBS to avoid misdiagnosis and highlights the effectiveness of appropriate antibiotic therapy and meticulous management of underlying conditions. Timely intervention led to the resolution of symptoms and normalization of urine color.

### 2. Introduction

Purple Urine Bag Syndrome (PUBS) is a rare clinical phenomenon associated with urinary tract infections (UTIs) due to long-term indwelling use of catheters, predominately occurs among elder patients and bedridden patients [1-3]. The purple color occurs hours

or days after the catheterization [1-4]. This hue occurs due to the indoxyl sulfatase enzyme which is produced by bacteria found in urine which causes the red and blue chemicals indirubin and indigo to be produced from indoxyl sulfate in the urine [1,4-9]. Moreover, these changes commonly occur in the urinary catheter or in the bag, as these compounds react with the plastics of the polyvinylchloride (PVC) containing catheter bag to form the purple colour, while the color of urine does not actually change to purple [7-10]. While a variety of hues of urine have been linked to frequently occurring etiologies, [1,4-9] purple urine is still a peculiar and startling phenomenon that has no clear differential diagnosis and might result in incorrect diagnosis and treatment. Here we represent the case of PUBS in an elder woman with the history of neurogenic bladder secondary to uncontrolled diabetes who required a catheterization for the longer duration along with the chronic history of constipation.

### 3. Case Presentation

A woman in her 60's, a known case of poorly controlled diabetes for more than 15 years, on insulin therapy with complications of diabetic neuropathy, nephropathy, and retinopathy. Later she developed a neurogenic bladder secondary to uncontrolled diabetes for which she was on chronic catheterization with a 16Fr catheter for approximately two years. She had complaints of four-day history of high-grade fever associated with chills which had resolved symptomatically with tab. Paracetamol (500mg). Patient's attenders noticed purple coloration of the catheter bag and tubing and brought the patient to the

hospital. On history taking, she had a chronic history of constipation for more than six months. She had no history of vomiting, burning micturition, and supra-pubic pain.

On examination, the patient was febrile with tachycardia (heart rate (HR) 118 beats per minute, blood pressure (BP) of 100/60 mmHg, temperature 101°F, respiratory rate (RR) 20 breaths per minute, and SpO<sub>2</sub> was 98% in room air. Systemic examination was done for respiratory system, cardiovascular and central nervous system and found to be normal. On abdominal examination, supra pubic tenderness was noted with no renal angle tenderness. Immediately the patient got admitted for further investigation. During her hospital stay on visual examination, we found the purple urine in the catheter bag, (Figure 1). Blood samples were sent for laboratory analysis. On day one of admission, white blood cells (WBC) counts were 14000 cells/mm<sup>3</sup> with altered neutrophil-to-lymphocyte ratio (NLR). Also, we found raised c-reactive protein (CRP) levels of 46.74 mg/L (normal <0.3 mg/L) and erythrocyte sedimentation rate (ESR) at one hour was 72 mm/hr (normal <10 mm/hr). While other blood parameters and electrolytes were in normal range. Routine urine analysis was done and found that presence of pus cells (6 to 8 cells/ high power field (HPF)), positive for nitrate and leucocyte esterase with alkaline urine was present. Hence, for further investigation, urine culture was done positive for *Escherichia coli* (*E. coli*) with the growth rate of 10<sup>5</sup> colony forming unit (CFU)/ml and found sensitive to nitrofurantoin, Fosfomycin, and ciprofloxacin and resistant to other antibiotics. Immediately, the catheter was replaced, and the patient was started on Inj. Ciprofloxacin 400mg IV Q12th hourly with supportive measures and strict glycemic control. After three doses of ciprofloxacin, the patient was afebrile and the urine color in catheter bag remained yellow in color with complete resolution of her symptoms. As the patient has improved clinically, she was discharged on oral ciprofloxacin for seven days.

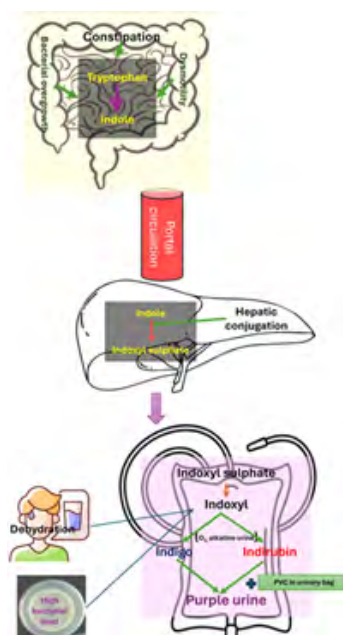


**Figure 1:** During her hospital stay on visual examination, we found the purple urine in the catheter bag.

#### 4. Discussion

In this case study, an uncontrolled diabetic woman in her 60s with all complication of diabetes diagnosed with neurogenic bladder and on catheterization for two years. Recently she developed fever and her urine in the catheter seen as purple color. Following which, culture was positive for *E. coli* which was sensitive to ciprofloxacin. She was followed up and as the patient has improved clinically, she was discharged. PUBS is a rare visually striking medical phenomenon where the purple discoloration of the urine in the urinary catheter or in the bag [1,4–9]. Despite its startling appearance, PUBS is generally considered benign clinically, but for the patients it may be alarming [1–3]. It was first described by Barlow and Dickson in 1978 [11]. It is primarily observed in elder females with prolonged concurrent urinary catheterization with multiple comorbidities including uncontrolled diabetes [1,2,7–9]. It is linked with high level of alkaline UTIs, where the bacteria produce sulfatase and phosphatase enzyme [4,8]. In UTI, the majority of bacteria are gram negative, that have been linked to the development of indicans such as *Pseudomonas aeruginosa*, *E. coli*, *Proteus mirabilis*, *Providencia rettgeri*, *Klebsiella pneumoniae*, group B streptococcus and *Proteus vulgaris* [9,10,12,13]. In our patients, indwelling catheter is present for two years due to neurogenic bladder, a complication of uncontrolled diabetes and also culture showed *E. coli* in urine culture. The prevalence of these bacteria in urinary systems, coupled with alkaline urine and the presence of dietary tryptophan, fosters the development of this syndrome. Studies, including those by Lin et al, [12] and Su et al, [14] provide a detailed analysis of the biochemical pathways involved in the synthesis of these pigments. The pathogenesis of PUBS is due to the bacterial breakdown of dietary tryptophan in the gut lumen to indole, pyruvic acid, and ammonia. Indole enters the liver and is converted to indoxyl sulphate, which the kidney filters. It is further metabolized to indigo (indicans) with exposure to genitourinary bacteria containing sulphatase and phosphatase enzymes [13]. Although indicans by individually do not give urine a purple color, when they are exposed to air, they oxidize to produce both indigo (blue) and indirubin (red), which then react with the plastics in the catheter bag that contains PVC to give the urine the observed purple color [6,7,11]. (Figure 2) Similar pathophysiology also can be seen in Drummond syndrome which is the “Purple diaper syndrome” [15]. Moreover, PUBS commonly associated with constipation, dehydration, poor nursing care in institutionalized patients where they are considered a key factor in this process, as it prolongs bowel transit and therefore tryptophan metabolism leading to elevated levels of urinary indole [1–3,14]. Chronic constipation is also considered as the prominent risk factor for PUBS, as it alters the gut motility which leads to more bacteria breaking down tryptophan and more pigments being released into the urine, which gives urine its purple hue [2,3,8]. Our patient presented with chronic constipation, which supports the above findings. Due to a variety of comorbidities, patients having prolonged catheterization might not exhibit

typical symptoms of a UTI; therefore, PUBS may be an informative indicator of a UTI in these patients [9]. Medical management does not require special process, as it mostly relies on the treatment of underlying condition, in our patient it is constipation, treatment of UTI, and good catheter care including exchange in order to not only to prevent PUBS but also bring about its resolution. Antibiotic therapy should be directed towards the causative organism. In our patient, we treated *E. coli* with ciprofloxacin, again which is considered as the empirical therapy for the PUBS treatment [7,8]. Thus, as per the literature review maintaining proper hydration, ensuring regular bowel movement, increasing mobility and employing safe and hygienic measures during catheterization, are crucial preventative measures that can mitigate the likelihood of acquiring PUBS [1,2,7,8,14]. By addressing all these factors, it significantly reduces the PUBS recurrence, as emphasized by Tasi et al [7,9].



**Figure 2:** which then react with the plastics in the catheter bag that contains PVC to give the urine the observed purple color.

## 5. Conclusion

PUBS, while visually alarming, is a treatable and often invariably benign condition that is more common in elderly individuals who have indwelling urinary catheters and constipation and frequently associated with an infection. Understanding its underlying biochemical processes and clinical associations helps in managing the condition effectively and reassuring patients and caregivers. Future research should focus on the long-term outcomes of patients with PUBS and the development of targeted therapies to prevent its occurrence.

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