Purple urine bag syndrome: an overview

Linda Nazarko

Purple urine bag syndrome (PUBS) is reported to be a rare condition that occurs in people who have catheters, chronic constipation and bacterial urinary tract infection (UTI). While in most cases it is harmless, the purple colour of the urine (a result of the breakdown of tryptophan, an amino acid found in food, in the intestines by gut bacteria) can be alarming. The priority is to address any underlying infection and maintain good catheter hygiene. Much of the literature focuses on symptomatic treatment. This paper, based on a case history, uses a more holistic approach to explain what PUBS is, why it occurs, and how it can be treated.

KEYWORDS:
■ Urinary catheterisation ■ Catheter-associated urinary tract infection ■ Medication review

Purple urine bag syndrome (PUBS) is a condition in which the urine drainage system turns purple due to a reaction involving tryptophan metabolism and certain bacteria (Pandey et al, 2018).

It is reported to be uncommon (Vallejo-Manzur et al, 2005). However, a brief literature search by the author found 400 case reports, so it may be that it is under-recognised in clinical practice. Indeed, there are reports that it can occur in almost 10% of people who have long-term catheters and live in long-term care (Lin et al, 2008).

Risk factors associated with PUBS are being an older female — 70.7% of people with PUBS are women and have an average age of 78 (Sabanis et al, 2019). Almost half of cases, 45.1%, have a long-term urinary catheter, and most, 90.1%, have chronic constipation (Sabanis et al, 2019). Urinary tract infection (UTI) that leads to alkaline urine affects 91.3% of cases. Most incidents, 76.1%, are reported to be bedridden patients, 42.8% have dementia and 14.1% have chronic renal failure (Sabanis et al, 2019; Worku, 2019). *Table 1* outlines risk factors and possible causes.

'... it is a common misconception that PUBS causes discolouration of the urine, whereas, as said, it is the urine drainage system that is discoloured or changes colour.'

WHY DOES PUBS DEVELOP?

Tryptophan is an amino acid that is found in food. It helps keep nitrogen levels in balance and also helps make serotonin, a hormone that regulates mood, sleep patterns, and appetite, which also converts into melatonin, a hormone that helps to regulate the body clock, i.e. sleep–wake cycles.

Tryptophan is found in both plant and animal proteins. Animal-based proteins like meat, poultry, fish, eggs, cheese, and yoghurt are called complete proteins because they have all nine of the essential amino acids, including tryptophan (Sheik, 2024). Some plant-based proteins, such as quinoa, soy, and buckwheat, are also complete proteins that have tryptophan (Sheik, 2024). Other foods high in tryptophan include prunes, bananas, apples and chocolate. Tryptophan is converted into indole (indigo and indirubin pigments) in the gut. Constipation leads to increased gut transit time, which results in an increase in tryptophan and indigo and indirubin pigments (Jappi and Hadi, 2023).

Indole is absorbed and reaches the liver through the portal vein (Tennoune et al, 2022). The liver conjugates indole to produce indoxyl sulphate, which is secreted into the urine. Certain bacteria in urine produce phosphatases and sulphatases, which convert indole to indoxyl. Indoxyl is then oxidised to indigo (blue pigment) and indirubin (red pigment). These pigments react with the catheter, catheter tubing and the plastic urine bag to cause the purple discolouration seen in PUBS (Bhattarai et al, 2013). *Figure 1* illustrates the process.

INFECTION AND PUBS

PUBS develops in the presence of infected urine and a high urinary pH. Common bacteria that produce an alkaline environment are *Providencia, Klebsiella, Proteus,* and *Enterobacteriaceae* (Shaeriya et al, 2021). Chong (2020) points out that it is a common misconception that PUBS causes discolouration of the

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Table 1: Identified risk factors for PUBS (based on Sabanis et al, 2019; Worku, 2019)

Risk factor	Possible causes
Increased tryptophan in diet	Increased substrate for metabolism, i.e. more food to fuel the transformation into indole, the pigment producing substances
Female gender	Increased risk of UTI
Severe constipation	Impaired indoxyl sulphate clearance
High bacterial load	Often causes alkaline urine
Chronic indwelling urinary catheter	
Renal failure	

urine, whereas, as said, it is the urine drainage system that is discoloured or changes colour. A search of 23 papers published in 2018–2019 found that only 26% correctly noted that the urine is not coloured purple (Chong, 2020). Urine is usually of normal colour, or it may be a muddy brown.

TREATMENT AND MANAGEMENT OF PUBS

It is important to be clear what is being treated. Is the clinician proposing to treat the phenomena of a discoloured urine bag, asymptomatic bacteriuria, or a symptomatic catheter-associated UTI (CAUTI).

Adults with indwelling urinary catheters are at increased risk of developing CAUTIs (Nicolle, 2014). The urinary catheter provides a portal of entry into the bladder. Bacteria can enter the bladder during catheter insertion, through the catheter lumen and along the catheter urethral interface. Infection risks rise the longer a catheter remains in place because the bladder becomes colonised with bacteria. The urine becomes cloudy and malodorous and urine dipstick testing is positive to leucocytes and nitrates. If urine is cultured, a mixed growth of bacteria is often found. In the absence of clinical symptoms of UTI, the presence of bacteria in the urine is known as asymptomatic bacteriuria and antibiotic treatment is not required (National Institute for Health and Care Excellence [NICE], 2018).

The presence of a urinary catheter enables bacteria to form a biofilm. This is a sticky, slimy layer that protects bacteria from both antimicrobial agents and the person's natural immune response (Trautner and Darouiche, 2004; Rubi et al, 2022). When a bladder fills and empties normally, bacteria are flushed away. However, this protection is lost when a person has a urinary catheter on continuous drainage (Rubi et al, 2022).

Some of the literature details administration of intravenous (IV) antibiotics. However, it is unclear if this is for symptomatic CAUTI or asymptomatic bacteriuria (Al Montasir and Al Mustaque, 2013).

Popovic et al (2023) describe a case of an older lady living at home and receiving community caregiver support. The lady had been immobile for some time following a pathological spinal fracture, due to malignant disease that was in remission. She had a history of constipation and a long-term catheter. Popovic et al (2023) carried out a thorough physical examination and found her overall clinical presentation unremarkable. Caregivers reported mild confusion and the patient was slightly dehydrated. She was treated initially with fosfomycin — it was considered that she had an infection as she was reported to be mildly confused — an antibiotic that is highly effective in the treatment of multidrug-resistant bacteria, including *proteus mirabilis* (Banerjee et al, 2017), and increased fluids. Popovic et al (2023) argue that PUBS should be treated in asymptomatic patients, as it is indicative of a heavy bacterial burden that could develop into a serious health threat to the patient. In this patient, caregivers reported PUBS but did not seek medical advice for 14 days as they considered that this might have been caused by consumption of beetroot or rosehip tea. Indeed, medical staff were only consulted when caregivers noted mild confusion.

Many clinicians have a differing view. Kwarciak et al (2024) state that intensive antibiotic treatment is usually not recommended. PUBS is almost always asymptomatic

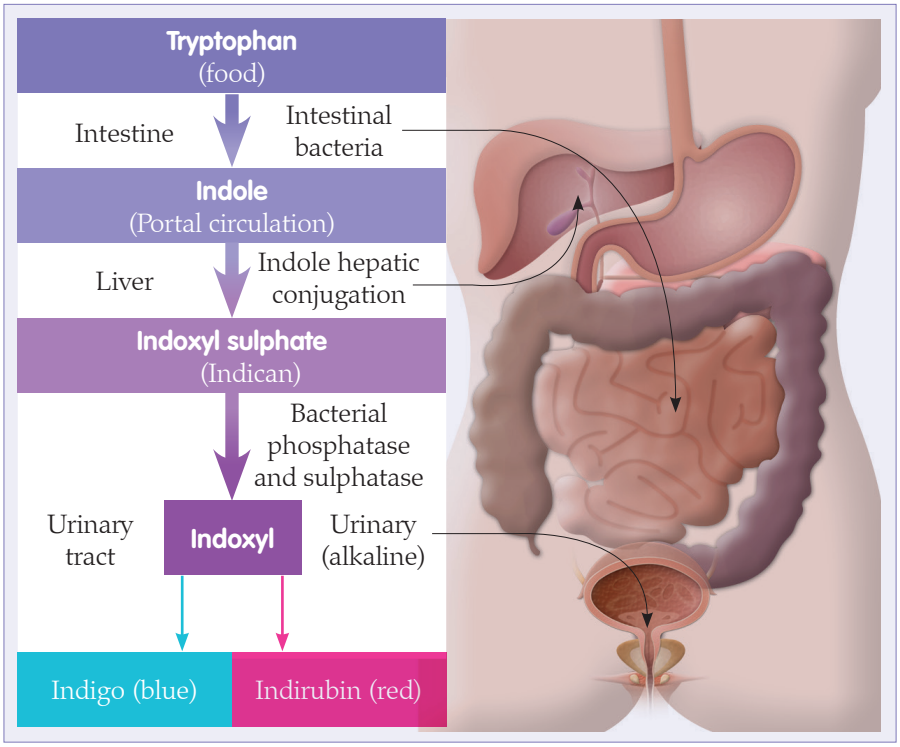

Figure 1.
How PUBS develops.

Mrs Emma Williams is an 82-year-old lady who is resident in a nursing home. She has moderate vascular dementia, hypertension and left-sided weakness following a stroke some years ago. She is doubly incontinent, has had an indwelling urinary catheter since she entered the home some years ago, and uses an incontinence pad. Her catheter, tubing and catheter bag are deep purple and nursing home staff are alarmed. This is known as purple urine bag syndrome (PUBS).

Patient story

and harmless (Hadano et al, 2012), and is not evidence of a UTI. It can also be difficult to elucidate some infective symptoms because the older person may have dementia (Kalsi et al, 2017). Simple steps, such as checking the National Early Warning Score (NEWS2) (Royal College of Physicians [RCP], 2017), asking caregivers if there has been any change in clinical condition, and checking bloods for indications of infection, such as elevated white cell count, can be helpful in the author's clinical opinion.

Indications for antibiotic therapy include symptomatic UTI, sepsis, signs of infection, or if the PUBS occurs in an immunosuppressed patient. Awareness of this condition is needed to avoid unnecessary investigation and antibiotic use (Worku, 2019). There are no clinical benefits in treating asymptomatic bacteriuria (Zalmanovici Trestioreanu et al, 2015). Indeed, inappropriately treating asymptomatic bacteriuria as an infection exposes the individual to a number of hazards. For example, antibiotic use affects the microbiome, and can decrease natural immunity and increase the risk of infections such as *Clostridium difficile* (Amon and Sanderson, 2017). Antibiotic use can also lead to antibiotic resistance, which can affect not only the individual, but also the general population (Zalmanovici Trestioreanu et al, 2015).

INDICATIONS FOR CATHETERISATION

Indwelling urinary catheters are a focus for infection. Over 124,000 people in the UK have long-term indwelling catheters (Gage et al, 2017; Nazarko, 2024). Most long-term catheters are originally inserted in hospital, but documentation regarding the reasons for indwelling catheterisation is often absent (Rasanathan and Wang, 2020). Long-term catheterisation can be fraught with problems — between 50–70% of people who have long-term catheters experience problems with their catheters (Youssef et al, 2023). Commonly reported problems include bladder pain, catheter leakage, blockage and UTI (Khan et al, 2007; Youssef et al, 2023). These complications have a major impact both on the person's quality of life and the health service. Gage et al (2024) found that in a year:

- 63% of people with long-term catheters required GP input
- 43% contacted out-of-hours services
- 33% required additional community nurse support
- 15% attended accident and emergency
- 13.6% were admitted because of problems related to their catheter.

'Most long-term catheters are originally inserted in hospital, but documentation regarding the reasons for indwelling catheterisation is often absent.'

Furthermore, around 30–50% of urinary catheters are inserted without a robust clinical indication (Shackley et al, 2017; Almeida et al, 2020).

When a UTI is identified, the literature (cited) recommends that the catheter is changed. The aim is to reduce the bacterial burden in those with asymptomatic bacteriuria and to enable effective treatment if the person has a symptomatic UTI. Changing the urinary catheter removes the bacteria laden biofilm that lives on the catheter (Jappi and Hadi, 2023; Kalsi et al, 2017). Kalsi et al (2017) reviewed published cases, which appear to have been people admitted to hospital. In some cases the review notes documented that the catheter had been changed, but in others it was unclear. The point Kalsi et al (2017) were making is that if the person has what is considered to be a severe infection, the catheter (with its biofilm) is going to impede treatment and should be changed.

Lin et al (2008) recommend removing urinary catheters if at all possible. They also suggest that:

- Organisations should reduce the use of catheters
- Minimise duration of use
- Improve catheter care.

PATIENT STORY

When Mrs Williams developed PUBS she appeared well and at her normal functional baseline. A thorough physical assessment was carried out, bloods were checked for inflammatory markers, and renal function and a medication review was carried out.

Physical assessment was unremarkable. Mrs Williams had a body mass index (BMI) of 17 and was known to the community dieticians. Care home staff reported that she had a poor appetite.

Blood results indicated that Mrs Williams was mildly dehydrated. Care home staff reported that it was difficult to get her to drink, especially in the afternoon as 'she's exhausted by tea time'.

Her medical records gave no indication of the reason for urinary catheterisation. Mrs Williams' daughter said that she was catheterised when she was admitted to hospital following her stroke.

Medication review revealed that she was on omeprazole, a proton pump inhibitor (PPI), for many years. Her medical records did not provide information about why it was initially prescribed. Mrs Williams had no recorded history of gastrointestinal bleeding, oesophagitis, or any other licensed indication. In up to 70~% of cases, PPIs may be inappropriately prescribed (Gomm et al, 2016). Generally, PPIs are given for eight weeks unless there are indications, such as prophylaxis in patients with a history of non-steroidal anti-inflammatory drug (NSAID)-associated gastroduodenal lesions who require continued NSAID treatment (British National Formulary [BNF], 2024a). Long-term use of PPIs is associated with declining renal function (Hatakeyama et al, 2021), and can be hazardous (Savarino et al, 2018).

Reported adverse events include osteoporosis-related fractures, infections, including *C. difficile*, besides poor absorption of vitamins and minerals such as vitamin B12, magnesium, and iron. There are also reports of increased risk of dementia, pneumonia, myocardial infarction, and stroke (Chinzon et al, 2022).

Mrs Williams was also taking co-codamol 30/500mg two tablets four times a day and had been taking these for years. Co-codamol can cause constipation, drowsiness and nausea (BNF, 2024b). Mrs Williams was prescribed two senna tablets each evening to treat constipation.

Treatment options were discussed with Mrs Williams, her daughter, staff caring for her and her GP. A trial without catheter (TWOC) was successfully carried out and urinary incontinence managed with incontinence pads. The omeprazole and co-codamol were discontinued. Mrs Williams became more alert and food and fluid intake improved. She was less constipated and senna was discontinued, although she still required lactulose.

Practice point

PUBS is a rare and striking clinical condition in which the urine in a catheterised patient turns purple or bluish in colour, which can alarm both patients and carers. However, although this colour change may be concerning, it is typically harmless if managed appropriately.

DISCUSSION

There is a lack of specific guidelines regarding PUBS, but this may well be because it is rare or unusual. However, relevant guidelines and a body of knowledge relating to medication, the risks and benefits of indwelling urinary catheters and bacteriuria are available. In the author's clinical opinion, these can be used in a holistic way to provide the best possible care for people who develop PUBS.

Nurses working at advanced level can support general practitioners (GPs) and care home staff in caring for vulnerable people with complex care needs. They have a higher level of skills than care home staff and more time than GPs, in the author's clinical experience. Some nurse practitioners do this work routinely, while others deal only with acute problems. This may be because of a lack of confidence or concerns that GPs may consider the nurse to be interfering. Older people can benefit a great deal from holistic overviews — something that needs to be developed in primary care. JCN

KEY POINTS

- Purple urine bag syndrome (PUBS) is a rare condition in which the urine drainage system turns purple due to a reaction involving tryptophan metabolism and certain bacteria.
- Adults with indwelling urinary catheters are at increased risk of CAUTIs. The urinary catheter provides a portal of entry into the bladder.
- Infection risks rise the longer the catheter remains in place because the bladder becomes colonised with bacteria.
- Treatment involves prescribing antibiotics if there are clinical signs of infection, changing the urinary catheter and treating constipation.
- Holistic treatment, including reviewing the need for a urinary catheter and medication, can improve a person's quality of life.
- By supporting GPs and care home staff, nurses working at advanced level can improve quality of life for vulnerable people with complex care needs.

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Revalidation Alert

Having read this article, reflect on:

- Why purple urine bag syndrome (PUBS) can occur
- Risk factors for PUBS
- The clinical implications of the condition of PUBS
- Management options which should be put in place.

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