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THE SHENTON PARK URODRAIN—A URINE COLLECTION BAG FOR CONTINUOUS CLOSED DRAINAGE OF AN INDWELLING CATHETER

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INTRODUCTION

BACTERIA may reach the urinary bladder of a patient with an indwelling catheter in four ways. Firstly, the bladder may become infected during insertion of the catheter

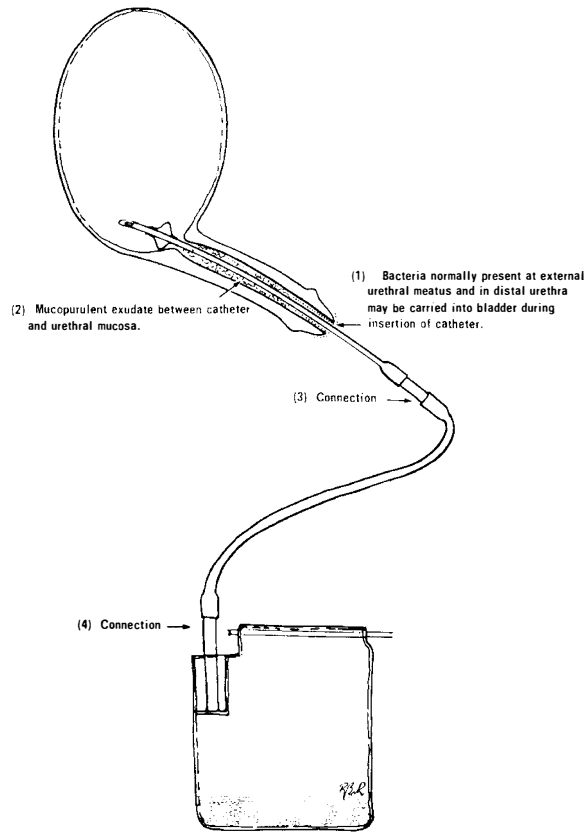
(*a*) by organisms on the catheter itself if it has not been correctly sterilized or has been recontaminated by faulty technique; and
(*b*) by organisms which are normally present at the external urethral meatus and in the distal urethra.

These organisms may be carried into the bladder during passage of the catheter (Guze & Beeson, 1956) (portal of entry 1 in fig. 1). The second route of bacterial entry is from the external urethral meatus by way of the thin space between the catheter and the urethral mucosa which almost invariably becomes filled with muco-purulent exudate (Beeson, 1955; Kass & Schneiderman, 1957; Linton & Gillespie, 1962) (portal of entry 2 in fig. 1). The transit of organisms to the bladder via the urethral secretion around the catheter is greatly assisted by movement of the catheter. Micro-organisms may also enter the catheter when it is disconnected from the tubing (Gillespie *et al.*, 1967) (portal of entry 3 in fig. 1). Finally, bacteria may enter the collection bag and drainage tubing and be carried up the tubing by air bubbles when an open drainage system is used (Linton & Gillespie, 1962) (portal of entry 4 in fig. 1). Contamination of the collection bag and drainage tubing can also occur when the bag is changed.

Infection of the bladder during insertion of the catheter due to contamination of the catheter itself can be avoided by correct sterilisation and a strict non-touch technique. The incidence of catheter-induced bacteriuria due to organisms from the external meatus and urethra may be reduced by injection of a lubricant containing chlorhexidine digluconate into the urethra prior to passage of the instrument (Gillespie *et al.*, 1962). These workers demonstrated that the incidence could be diminished even more effectively by the instillation of a disinfectant solution into the bladder (57 ml. of an aqueous solution of chlorhexidine digluconate, 1 in 5000) at the end of catheterisation. However, we found that if chlorhexidine was used in conjunction with 6-hourly intermittent catheterisation, this frequency of exposure resulted in haematuria. As a substitute we have used a solution of kanamycin and colistin and found it to be reliable and safe when used with frequent intermittent catheterisation (Pearman, 1971). We do *not* use the kanamycin-colistin solution with indwelling catheters because resistant strains of microorganisms rapidly emerge when antibiotics are used with indwelling catheters. After insertion of an indwelling catheter 25 ml. of an aqueous solution of chlorhexidine digluconate, 1 in 5,000, are instilled into the bladder and held there for two hours by clamping

the catheter. The indwelling catheters are routinely changed once a week and the instillation of chlorhexidine solution into the bladder at this frequency has not resulted in haematuria in our experience.

Attempts must be made to prevent external bacteria from entering the urethral secretion around the catheter by creating an antiseptic barrier at the external urethral meatus and by preventing the catheter from moving in the urethra. In this



MAIN PORTALS OF ENTRY OF BACTERIA INTO BLADDER OF PATIENT WITH INDWELLING CATHETER

FIG. 1

respect it is important that the area around the meatus and the external section of the catheter should be cleaned with aqueous* Savlon®, 1 in 60. This should be done at least twice a day and all crusts and mucus should be removed on each occasion. The passage of bacteria between the catheter and the urethral mucosa to the bladder is considerably diminished by immobilising the catheter with a plastic sponge collar which is pushed up against the external urethral meatus (Linton & Gillespie, 1962). This is possible with females and also on males with lower motor

* Aqueous Solution of 0·25 per cent Cetrimide and 0·025 per cent Chlorhexidine digluconate.

neurone bladders who do not have reflex erections. It is not recommended for males with upper motor neurone bladders because of the trauma which may result from anchoring the catheter at both the internal and external urethral meatus with a balloon and pad respectively when these patients have reflex erections. After immobilising the catheter the incidence of urinary infection may be reduced still further by moistening the plastic sponge with chlorhexidine (Hibitane®), obstetric cream twice daily (Linton & Gillespie, 1962).

It is now abundantly clear that closed drainage systems should always be used. The catheter, after insertion into the bladder, is immediately connected to sterile tubing draining into a sterile container which is closed from the atmosphere. The infection rate of patients on closed drainage is significantly lower than in patients on open drainage systems (Linton & Gillespie, 1962). The container should be fitted with an efficient non-return valve to prevent reflux of urine into the drainage tube.

It is also important that the accumulating urine in the bag should be kept sterile by an antiseptic solution, since small numbers of micro-organisms may enter the bladder from the urethra and pass to the bag where they will multiply. Bacteria can multiply just as rapidly in closed as in open drainage containers unless a disinfectant is used. If an antiseptic solution is placed in the collection bag it is essential to have an efficient non-return valve between the drainage tube and the bag to prevent reflux of the antiseptic into the bladder where it could cause extensive damage.

If sterile glass bottles are used for closed drainage they have to be changed when they are filled, and there is always the risk that bacteria will gain access to the inside of the tubing during this change over. The Meredith bag was developed to enable a closed system of drainage to operate without it being necessary to detach the bag from the tube and catheter. This device consists of a sterile plastic bag which has a non-return valve to prevent reflux back into the drainage tube and an outlet distal to the valve through which the bag can be emptied periodically (Gillespie *et al.*, 1967). However, the Meredith bag may become contaminated when the outlet is opened to drain it. Furthermore, we have been unable to find a report in the literature of a disinfectant solution being used to prevent multiplication of organisms in the bag itself. Disinfection of the urine in the bag is very important since bacteria can pass between the approximated surfaces of a non-return valve, even though the valve is effective in preventing the reflux of fluids.

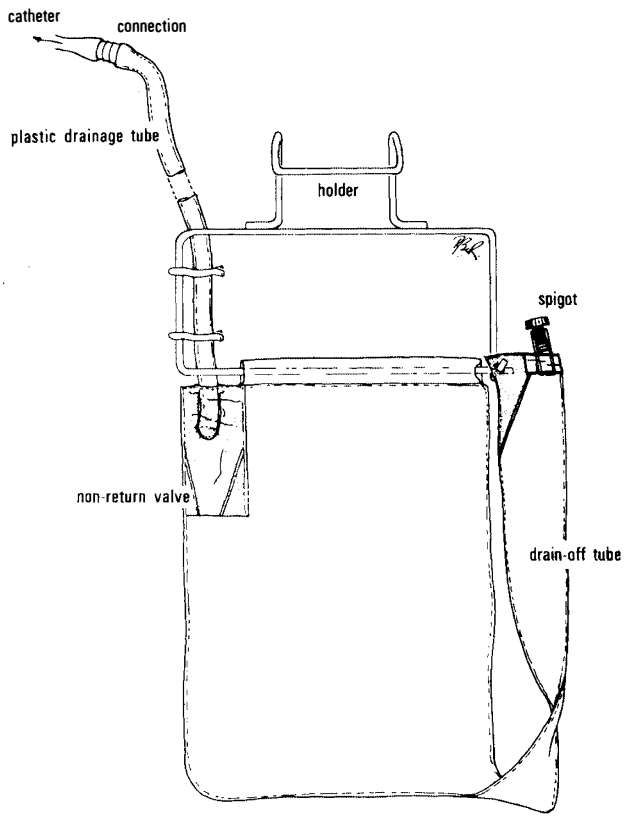
A plastic urine collection bag, which can be easily and completely drained by a tube at the base, has now been manufactured. It has a non-return valve at the inlet and disinfectant solution can be injected into the outlet after each emptying to maintain the sterility of the container. The purpose of this communication is to describe the design and operation of the bag which is called the Shenton Park Urodrain. This device successfully prevents bacteria from entering the closed drainage system by portals 3 and 4 shown in Figure 1, since the catheter does *not* have to be disconnected from the drainage tube nor the drainage tube disconnected from the collection bag in order to empty the bag.

DESIGN OF THE SHENTON PARK URODRAIN

The components of the Shenton Park Urodrain are shown in Figure 2. A plastic drainage tube, 140 cm. in length, is sealed into the top of the plastic bag where it ends in a non-return valve which prevents reflux of urine back into the

tube. A drain-off tube arising from the base of the bag terminates in a plastic tube, with an internal diameter of 6 mm., which is sealed by a plastic spigot. The end of the drain-off tube is hooked onto the holder when the bag is in use. The bag has a hollow cuff along the top which enables it to be hung under the patient's bed by means of a metal holder threaded through it.

We have tested the valves of ten Shenton Park Urodrains and found that they do not permit the reflux of fluid when the bag is compressed. The valves of a



'SHENTON PARK URODRAIN" PLASTIC CLOSED DRAINAGE BAG

FIG. 2

further ten Urodrains were also tested by filling the bag and the inlet drainage tube with water and raising the bag above the end of the drainage tube. This manoeuvre did not result in fluid syphoning from the bag in any of the Urodrains tested.

However, when ten bags were each filled with 1500 ml. of water and laid on a bench without being compressed and the drainage tubes were run over the edge of the bench into separate containers placed on the floor, a slow back-flow was demonstrated in nine of the ten bags tested at an average rate of 8·5 ml. per hour (range nil-22·0 ml. per hour). Provided the bag is kept suspended from the bed *below* the level of the patient's bladder, this slow reflux cannot occur unless the bag

becomes completely filled. Because the bag has a capacity of 3000 ml. it is most unlikely that it will become overfilled if it is emptied strictly every 8 hours. Gillespie *et al.* (1967) also reported a slow reverse flow through the valve of the Meredith bag when it was partly filled and laid gently on the floor, without being compressed.

OPERATION OF THE SHENTON PARK URODRAIN

After insertion into the bladder, the catheter is immediately connected to the drainage tube by means of an adaptor, using an aseptic technique. The horizontal arm of the metal holder is threaded through the cuff along the top of the bag and the bag is hung under the patient's bed. The spigot at the end of the drain-off tube is withdrawn and 20 ml. of a disinfectant solution are injected into the bag using a 20 ml. syringe. We have found that a colourless, aqueous solution of 15 per cent. cetrimide and 10 per cent. chlorhexidine digluconate is satisfactory. The spigot is inserted and the drain-off tube is hooked up to the holder. When the bag becomes filled it is emptied by removing the spigot, lowering the drain-off tube and running the urine into a suitable receptacle. Immediately after the bag has been emptied 20 ml. of disinfectant solution are injected into it, the spigot is replaced and the drain-off tube is hooked on to the holder. It is advisable to replace the Urodrain with a new one when the indwelling catheter is changed.

URINE SPECIMEN COLLECTION

Disconnection of the catheter from the drainage tube should be avoided since bacteria may gain access to the inside of the catheter whenever this is done. If the patient leaves his bed the drainage apparatus must not be disconnected; it should go with him. When a specimen of urine is required for microscopy and culture, it may be obtained from the catheter by a technique similar to taking blood samples by venipuncture. A solution of 0·5% chlorhexidine digluconate and 0·5% cetrimide in 70% ethanol is applied to the catheter distal to the point at which the tube to the balloon joins the catheter, care being taken *not* to swab the genitals. A few seconds are allowed for the disinfectant solution to dry. A sterile 25-gauge needle is inserted obliquely through the catheter and 10 ml. of urine are drawn up into a sterile syringe.

REDUCTION OF WARD CROSS-INFECTION RISKS

The instillation of disinfectant solution into the bag after each emptying ensures that the urine drained off at the next emptying is sterile. This has been particularly advantageous when patients with permanent indwelling catheters (and hence chronic bladder infection) have been admitted to the ward. Use of an antiseptic solution in the Urodrain has sterilised the urine collected from these patients, thereby greatly reducing the cross-infection risks created by them in a ward environment.

BACTERIOLOGICAL STUDIES

A bacteriological survey of the Shenton Park Urodrain is now in progress in some units of the Royal Perth Hospital. This will include patients outside the

Spinal Unit because acute cases of spinal cord injury and paralysis admitted to that Unit are managed by intermittent catheterisation.

SUMMARY

A closed system of urinary drainage using a sterile plastic bag with a non-return valve and a drain-off tube is described. The drain-off tube makes it unnecessary to disconnect the catheter from the collection bag and allows the same bag to be used until the catheter is changed. After each emptying 20 ml. of an aqueous solution of 10% chlorhexidine digluconate and 15% cetrimide is introduced into the bag to maintain sterility. When patients with continuous catheter drainage and chronic urinary tract infection are admitted to the ward, disinfection of the urine collected in the bag greatly diminishes the risk of cross-infection.

RÉSUMÉ

Un système de drainage urinaire à circuit fermé utilisant un collecteur en plastique stérile avec une valve et un tube de décharge est décrit.

Ce tube de décharge rend inutile la séparation de la sonde du sac collecteur et permet d'utiliser ce même sac jusqu'au moment où la sonde est changée. Après que le sac ait été vidé, 10 ml de Savlon concentré sont introduits dans le sac pour maintenir la stérilité.

Quand les malades avec un drainage, portant une sonde à demeure, et avec une infection urinaire, sont admis dans le service, une désinfection des urines collectées dans le sac diminue les risques de propagation de l'infection.

ZUSAMMENFASSUNG

Ein geschlossenes System von Urindränage wird beschrieben. Es besteht aus einem sterilen Behälter von plastischem Material, ferner einen Rückfluss verhindernden Ventil und einem Dränageschlauch. Der Schlauch macht es unnötig, den vom Behälter zu trennen und er erlaubt die Benutzung desselben Behälters bis der Katheter gewechselt wird. Nach der Entleerung werden 10 ccs conzentrierter Salvonlösung in den Behälter eingeführt, um die Sterilität zu bewahren. Wenn Patienten mit Dauer-Katheterdränage und chronischer Infektion der Harnwege zur Aufnahme kommen, Desinfektion des im Behälter befindlichen Urin verringert die Krossinfektion.

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The Shenton Park Urodrain has been designed by Sister L. A. Cox and Domedica Pty. Limited, Sydney, New South Wales, Australia. The design of the bag is registered and the non-return valve patented; both registration and patent have been taken out by Domedica Pty. Limited.

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