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**Refinements in the Puncture  
Methods for Transcutaneous  
Nephrostomy**

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**Summary**

*Transcutaneous nephrostomy is usually believed to be a latest technique although it dates back to more than three decades.*

*But since the last one decade or more there have been gigantic advancements in the number of performance and the techniques of this procedure due to the highly advanced knowledge in the fields of transrenal puncture, ultrasonography, radiology and biocompatible puncture materials*

*Thus percutaneous nephrostomy has opened up new dimensions in urological diagnosis and therapy.*

**Introduction**

In general percutaneous nephrostomy is considered a particularly upto-date procedure which would be inconceivable without the most modern technology and which opens up new dimensions in urological diagnosis and

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therapy. It is, therefore, surprising that the first publications on this subject date back as far as thirty six years<sup>3,10</sup>. These puncture pyelostomies were performed exclusively under radiological control, aiming directly at the dilated pylon. Transrenal puncture was regarded as dangerous due to the possibility of haemorrhage. The negligible number of publications<sup>2</sup> on this subject upto 1978 indicates the difficulty and the time-consuming nature of this percutaneous pyelostomy and suggests that there was a lack of success. Transrenal puncture<sup>4</sup>, increased knowledge in the field of sonography, and the development of biocompatible puncture materials that are simple to handle provided the basic reasons why, in the meanwhile, percutaneous nephrostomy has extensively taken over from operative nephrostomy.

### **Puncture Systems**

The foundation stone of almost all the sets available at present are the usual 1-2 mm puncture needles alongwith mandrin and guide wire originating from angiography (Seldinger technique), which is atraumatic due to its soft point. The fine needle is used for the primary puncture of the renal pelvis and makes the positioning of the guide wire possible. Over this the definitive drainage system is pushed in after adequate dilatation of the puncture canal. Differences between the various individual puncture sets lie in the material of which the drainage catheters are made (natural rubber, polyvinylchloride (PVC), polyethylene or polytetrafluorethylene respectively, polyurethane, silicon rubber). The quality of the definitive drainage system is of specific significance in so far as it is exposed to changes in situ through enzymatic decomposition, for example of softeners present in the tube (PVT)<sup>11</sup>. Moreover, depending on the quality of the urine in the punctured cavity and the basic material of the drainage system a biosecretion deposit or a layer of crystals and bacteria respectively are formed. Finally the mechanical stress upon the material as a result of the patient's movement deserves mention. Of necessity there result from these various demands on the quality of the catheter system. It should be chemically stable and electrostatically neutral, elastic yet at the same time able to keep its form, and it should be as in-compressible as possible. With regards to its morphology, surface smoothness, water-repellence and non-adhesion are desirable qualities. Simultaneously the material should be bacteriostatic or have a bactericide

effect, and should promote flow and drain ideally<sup>11</sup>. The basic materials mentioned fulfill these requirements to very differing degrees. Silicon rubber has the smoothest surface, thus irritating the urethra least, and shows only minimal encrustation even after long-lasting contact with infected urine. But its high compressibility and lack of structural stability speak against its use as a basic substance for a nephrostomy tube. In this respect polyurethane catheters give better results as they are somewhat harder. However, with variations from manufacturer to manufacturer, they often show surface fissures and inhomogeneities in the material which favour deposits. Simultaneous firmness and elasticity, and a surface texture approaching that of silicon rubber speak in favour of the use of polyethylene or polytetrafluoroethylene catheters.

Table 1 summarises essential characteristics of the most common puncture sets. In addition to the details mentioned regarding materials, information on the catheter strengths now available is to be found here. Six Charriere catheters (Angiomed, Surgimed) are of particular importance in paediatric urology. It is just in this case that the following factors play an important role: the reduction in size of the puncture equipment to guarantee the least amount of trauma, and the drainage-function of the system which is optimal despite its small size. This is especially true where long term drainage becomes necessary in order to examine the recovery from a hydronephrosis.

The drainage systems of large diameter (Angiomed) should be used, above all, in the case of renal or pararenal abscess, pyelon tamponade, pyelonephrosis or planned percutaneous stone manipulation<sup>1,7</sup> to replace the frequently problematic process of dilatation before litholapaxy. For reasons of economy the possibility of also obtaining individual parts of the respective sets for the renal fistula replacement in the case of long term drainage - is not of minor importance in the routine of the urologist. Unused unsterile parts of the puncture equipment can be sterilised with ethylene oxide, but not using heat or glutaraldehyde, and are then reusable.

Two of the sets presented in Table 1 deviate from the principle otherwise followed of introducing the nephrostomy tube via a guide wire<sup>5,6</sup>. With the so-called Otto-set (Angiomed), which is indicated, above all, in the

**TABL-1: DETAILS OF THE MOST IMPORTANT SYSTEMS FOR PERCUTANEOUS  
NEPHROSTOMY AVAILABLE IN THE MARKET**

Manufacturer	Cook-Vance	Cook-Vance	Angiomed	Angiomed	Surgitek	Braun-Melsungen	Surgimed
Author	Rutner	Gunther	Gunther/ Harzmann	Otto	Kahn	Harzmann	Osterling
Bougies	teflon	teflon	teflon	—	teflon	polypropylene	teflon
Fistula- Catheter	soft polyurethane	hard polyethylene	soft poly- ethylene	soft poly- ethylene	poly- urethane	polyurethane	soft poly- ethylene
Charriere	6.3,10,12	6.8	6 to 14 (-20)	6 to 14 (-20)	8.5	8,11,14	6
Availability of single parts	no	limited	yes	yes	limited	yes	limited

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case of severe hydronephrosis or pyonephrosis, the drainage tube, stretched by the puncture needle, is introduced directly into the cavity by means of the puncture needle without the use of a guide wire. The Nephrofix R-System<sup>5</sup> (Braun-Melsungen) facilitates the less experienced puncturist's introduction to the procedure of percutaneous nephrostomies with the use of materials (modified "Braunule", modified "Zystofix"- system) which every urologist is familiar with. Through guide wire, the definitive drainage system is pushed forward into the cavity - system.

As far as the visibility of the puncture needles using ultrasound is concerned there are no major differences between the individual products. Never-the-less three part initial puncture needles made of metal (Cook-Vance, Angiomed) reflect the sound the strongest thus offering increased certainty while puncturing.

#### **Attachment Aids**

The coiled catheter ends (pig tail) to be found in practically all puncture sets do not offer sufficient protection against fistula dislocation. This can most simply be prevented by tying the nephrostomy catheter into a cutaneous suture. There is very simplicity of this technique of fixation. However, because of secondary inflammatory changes, even the attachment suture not rarely results in difficulties which chiefly arise when the attachment suture is placed too close to the puncture canal. One solution to the problem exists in the form of balloon catheters<sup>8</sup>, although their positioning is not always easy due to their large diameter. Elegant and equally simple is the dislocation prophylaxis using bow-catheters (Angiomed), of which the end, analogous with the Zeiss loop can, by means of a pule, be coiled up and attached in the pyelon. Other sets (Cook-Vance, Surgitek, Angiomed) contain elastic plates which can be fixed to the skin with a plaster or by a suture. The fistula tube comes up through these plates and is attached to them. Investigations have led to the development of an attachment plate (disc) made of silcolatex, which is particularly well-tolerated by the skin. It lies flat and over a wide surface on the skin thus contributing decisively to the positional stability of the drainage system. This disc is specially designed for the attachment of nephrostomy catheters (Angiomed).

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**Duration of Use of the Catheter**

The question of the appropriate time to change the fistula system, important for clinic and practice alike, is closely related to the tendency to incrust of the respective catheter materials and to the urine quality. Since systems with initial or complete incrustation can no longer be changed, or only with great difficulty, as it is not possible for the guide wire to pass through, preventive measures against incrustation are especially important. Apart from the treatment of a urinary tract infection and the concern for sufficient diuresis, it is recommended to lower the urine-pH e.g. with Hiprex or L- Methionin. Assuring that this prophylactic measure is consistently adhered to, an interval of 6 weeks for the changing of the tube can be recommended if the drainage material is appropriate. The change itself is most sensibly performed under X-ray control since all the nephrostomy catheters on the market can be screened by X-ray.

**Patients' Information**

Just as important as informing the patient pre-therapeutically concerning the procedure and its possible complications (incorrect puncture, haemorrhage, infection among others) is giving the patient information on how to live with the fistula. The most important late complication of nephrostomy is catheter dislocation which can be recognised as the patient suffers pain accompanied by lack of urinary excretion. The incomplete or complete closure of the drainage system, which produces the same symptoms, can be prevented with adequate certainty assuming appropriate guidance of the patient (medication, pH-value, diuresis, change-intervals). Over and above this, any explanation to the patient and his environment about percutaneous nephrostomy must include clear information on accessories like connecting mechanisms and urine bags and how to change them.

Percutaneous nephrostomy using ultrasound accompanying or replacing an operation, in preparation for a litholapaxy or as a diagnostic procedure has led to a crucial increase in diagnostic and therapeutic possibilities in the field of urology. Of similar importance is the great reduction of the patient's burden offered by this technique compared to those used

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up till now. The advantages of this procedure can, however, only be fully exhausted when the range of instruments available are employed critically, and their function optimised through adequate metaphylaxis or prophylaxis respectively. In this case the choice of the correct puncture needles and drainage systems, the right calibre strength, the technique for attaching the catheter, among other, are as important as the visualisation of the puncture needle and target and precise guidance to the target, which require the use of imaging techniques such as ultrasound, fluoroscopy or, in selected cases, CT scanning<sup>9</sup>.

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