Alterations in the urinary tract after spinal cord injury —
diagnosis, prevention and therapy of late sequelae

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Summary. The life expectancy and quality of life of pa-
tients with injuries to the spinal cord greatly depend on
the condition of the urinary tract. It is hence necessary
that specially trained urologists participate in the treat-
ment of these patients from the beginning. In the last 15
years, excellent diagnostic methods have been developed
(especially urodynamic procedures), resulting in the feasi-
bility of individual therapeutic measures on the basis of
urodynamic findings. Conservative and surgical methods
to improve bladder emptying and thus to reduce the dan-
ger to the upper urinary tract are presented and critically
evaluated with reference to a large patient population
comprising >3000 spinal cord-injured patients in the
course of 13 years. Conservative measures such as the
specific use of reflex activity, pharmacotherapy, intermit-
tent self-catheterization, as well as graduated operations
to lower bladder outlet resistance to a physiological level,
were sufficient to attain a compensated situation in
>90% of the patients. A part of the remaining problem
control and patients with spinal cord injuries can receive sufficiently
definitive treatment with regard to both their life expec-
tancy and their quality of life, with relatively little materi-
al effort and inconvenience, even over long periods of
time.

In West Germany, 9399 new cases of spinal cord injury
were registered between January 1, 1978, and December
31, 1987. Of these cases, 74% resulted from accidents;
70% were men, 28% were women and 2% were children.
Tetraplegia was present in 38% and paraplegia, in 62%[
11]. Apart from measures of urinary drainage, which are
routinely necessary in almost all patients for weeks to
months in the early postoperative period, 26% of the
readmissions that later become necessary (1822 patients
for the same period) are attributable to diseases of the
urinary tract in the further course. Urological outpatient
follow-up examinations carried out once yearly are not
considered in this context.

Intensive surveillance of these patients by neurologi-
cally specialized physicians has led to an appreciable im-
provement in life expectancy and quality of life in recent
years [1, 6, 14, 17]; thus, a current definition of the state
of the art appears to be reasonable. Experience with our
3112 patients over 13 years and a present frequency of
1400 complete urodynamic investigations per year show
that the development or urological sequelae largely de-
dpends on the state of bladder emptying, and this depends
on the level of the transverse lesion. The effect of spinal
cord injury of varying level and intensity is shown in the
scheme of Bors and Comarr [1], modified according to
Burgdörper [4] (Table 1). In principle, two basic patterns
can be found for appraisal of the clinical situation and
these necessitate different therapeutic strategies.

In upper lesions, a high-pressure system with different
degrees of detrusor hyperreflexia arises (Fig. 1). The de-
gree of the nonphysiological hypertonic situation is es-
sentially determined by the detrusor hyperreflexia and the
spasticity of the pelvic floor, as well as by the degree of
detrusor-sphincter dysfunction. With increasing spasticity,
a reactively rising detrusor pressure and thus a low-
compliance bladder with massive detrusor hypertrophy,
low capacity and a rapidly increasing impairment of uri-
nary passage in the upper urinary tract occur. In unfavor-
able cases, irreversible damage to the upper urinary tract
can be demonstrated as early as 1–2 years after the in-
jury.

The second basic type corresponds to a hypo-areflex-
ive detrusor behavior in which there is frequently an inad-
equate or absent opening of the bladder neck, mainly
with large amounts of residual urine (Fig. 2). Progress
follow-up of patients with a low-pressure system that has
not been treated urologically shows an overextended,
large bladder (initially with trabeculation and later with
pseudodiverticulae and reflux into the upper urinary
tract) over a period of years. Ectasia and reduction of the
renal parenchyma result from the high pressure in the up-
per urinary tract. The development of late sequelae is ini-
tially slower than in the high-pressure system.

The present possibilities of appropriate urological di-
gnostics and therapy to avoid complications in the uri-
nary tract in patients with spinal cord injuries are de-
scribed and critically evaluated below.
<table>
<thead>
<tr>
<th>Lesion</th>
<th>Incontinence</th>
<th>Detrusor</th>
<th>Sphincter</th>
<th>Residual urine</th>
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* According to Burdorfer [4], based on the classification of Bors and Comarr [1]

**Phases of urological rehabilitation**

The phases of urological rehabilitation are illustrated in Table 2. Phase I extends from the beginning of inpatient admission to the first discharge from the hospital. Urinary drainage is initially of major importance [15]. In the ideal case, this is accomplished by sterile, intermittent catheterization carried out up to six times. In multiple-trauma patients under intensive care, suprapubic drainage is the method of choice. Early infections can much better be avoided with this method than with the transurethral indwelling catheter. In addition, early complications at the urethra such as strictures, diverticulae (Fig. 3) and fistulae can be avoided. Since the rate of infection also rises steeply after 4 weeks with this kind of urinary drainage, as we could show in our patients, the suprapubic catheter should immediately be removed when intensive establishment of balances is no longer necessary (Table 3). Intermittent catheterization is continued as long as patients cannot adequately empty their bladders spontaneously. We have the patients carry out their own catheterization when the function of their arms allows it. This is a reasonable procedure for didactic and staffing reasons. Patients with a well-functioning reflex bladder may also later arrive at a situation in which intermittent self-catheterization is necessary.

If detrusor activity may be expected after the shock phase, stimulation of the reflex activity of the detrusor should be attempted in the first weeks by triggering. Later, emptying can be regulated well by this method in many cases, provided that detrusor activity in the physiological range as well as complete emptying can be achieved in this way [13, 14].

The flaccid bladder should not be pressed with brute force, since the upper urinary tract is endangered by the resultant abnormally high pressures. The least dangerous method of urinary drainage in patients without detrusor activity is likely to be intermittent catheterization. In the normal daily routine, it is mostly sufficient to catheterize four times a day. The material effort and inconvenience should be as small as possible to ensure that the patient