

Experimental Bladder Hyperreflexia in Pigs

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Summary. Bladder hyperreflexia was induced experimentally in pigs. As compared to controls 9 out of 10 obstructed pigs developed hyperreflexia. The hyperreflexia was reversible by relief of the obstruction in all cases. No controls developed hyperreflexia within the observation period. It is concluded that obstruction as a single factor can provoke detrusor hyperreflexia. The model is proposed for further morphological and pharmacological studies.

Key words: Infravesical obstruction, Spontaneous bladder contractions, Experimental model.

Introduction

Some neurological diseases, infravesical obstruction and bladder infection are known to cause detrusor hyper-

reflexia [3, 6]. Local bladder and urethral factors as well as cerebral factors seem to be of importance for the condition [5], but there is still a lot to be explored before the pathomechanisms are known.

For a long time infravesical obstruction has been known as one of the factors producing hyperreflexia. During cystometric examination of patients with benign prostatic hypertrophy detrusor hyperreflexia was seen in 60% [1]. After the infravesical obstruction was removed there was a decrease in hyperreflexia to 25%.

In order to examine the possibility of producing hyperreflexia by creating an infravesical obstruction an experimental study in pigs was undertaken. The study was also done to find an experimental model in which a more intensive study of the pathomechanisms of hyperreflexia could be made.

Material and Methods

The studies were made in 14 female pigs of the Danish landrace breed aged 8 to 14 weeks and weighing 15–39 kg. Anaesthesia was



Fig. 1. The Teflon horse shoe ring used for obstruction (inner diameter 6 mm)

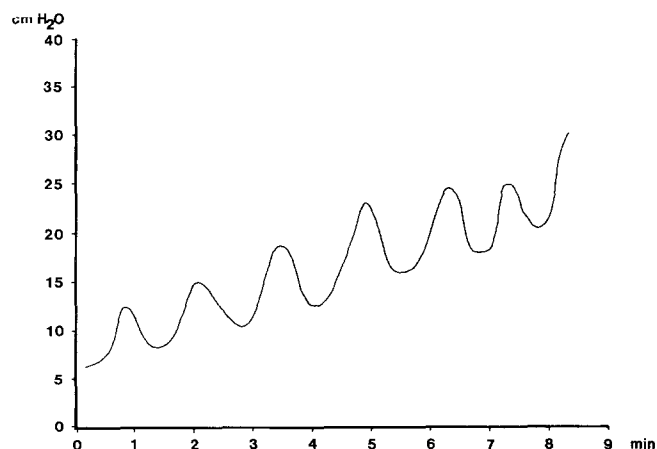


Fig. 2. Redrawing of cystometry in a pig 10 weeks after induction of obstruction. Phasic spontaneous contractions of detrusor are registered from the onset of bladder filling

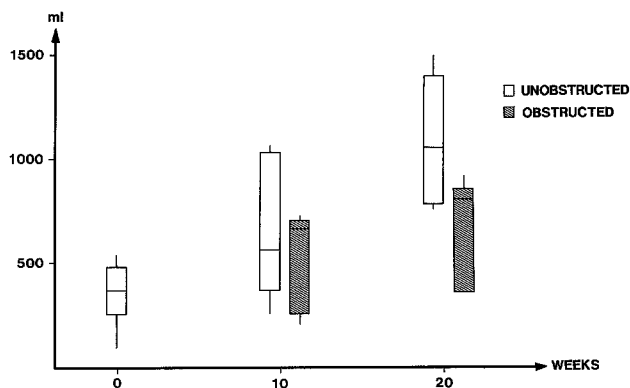


Fig. 3. Bars and whiskers diagram of bladder capacity in pigs with (hatched bars) and without (open bars) obstruction. A gradual increase in capacity is registered with time in pigs without infravesical obstruction, whereas obstruction results in a smaller increase in capacity

induced by intramuscular injection of Phenocyclidine (Sernylan) 2 mg/kg and maintained with Halothane and oxygen in a semi-closed system with the animals breathing spontaneously. The depth of anaesthesia was kept constant and superficial during measurements.

An infusion catheter Ch. 8 and a catheter Ch. 5 for pressure measurements were placed in the bladder transurethraly.

The cystometry was done with bodywarm saline and the infusion rate was 28 ml/min until the bladder pressure had reached 30 cm H₂O or until spontaneous voiding. Then the bladder was emptied.

The bladder pressure was obtained by a Siemens 746 transducer placed level with the urethra and connected to the Ch. 5 catheter. The signal was amplified and recorded on Mingograph 805.

Inducing Obstruction. A horse-shoe of teflon was slipped around urethra just distal to the bladder neck and the ring completed by tying the ends together with a nylon suture. The ring fitted loosely over the urethra. The inner diameter of the ring was 5–6 mm (Fig. 1). The infravesical obstruction was created in 7 of the 14 pigs. All the pigs were examined after 10 weeks and in the obstructed ones the ring was then removed. After a further 10 weeks the final cystometry was done. Before cystometry urine was taken for bacteriology.

Detrusor hyperreflexia was defined as contractions of an amplitude exceeding 5 cm H₂O. The spontaneous activity in the bladder during cystometry in a pig after 10 weeks of infravesical obstruction can be seen in Fig. 2.

Results

None of the pigs were infected. At the primary cystometry no case of hyperreflexia was found. The mean bladder capacity was 345 ml (range 85–530) (Fig. 3).

The examination after 10 weeks showed no hyperreflexia in the 7 non-obstructed pigs which had a mean bladder capacity of 630 ml (range 250–1,065). Of the 7 infravesically obstructed 6 developed hyperreflexia with a mean number of contractions per examination of 4.3 (range 3–6). The mean amplitude of the contractions was 7.5 cm H₂O (range 5–13) and the mean bladder pressure of the first contraction was 12.3 cm H₂O (range 8–16). The mean bladder capacity was 500 ml (200–730).

One obstructed pig did not show hyperreflexia. This pig had a bladder capacity of 1,905 ml and was thus regarded as myogenically decompensated.

At the final examination at 20 weeks no hyperreflexia was found either in formerly obstructed or in non-obstructed pigs. The capacities can be seen in Fig. 3.

The pig with the myogenic uncompensated bladder had a reduced bladder capacity from 1,905 ml to 1,370 ml.

In all cases where infravesical obstruction was created macroscopic examination of the bladder showed gross bladder wall hypertrophy, trabeculation and formation of diverticula except for the one with a myogenically decompensated bladder where the bladder wall was found to be extremely thin and flaccid.

Discussion

The pig was chosen as experimental animal because its urinary tract is similar both anatomically and functionally to that of the human [4].

The study showed that the induction of an infravesical obstruction in young pigs produced detrusor hyperreflexia after 10 weeks of obstruction and that this hyperreflexia disappeared when the obstruction was relieved.

In bladders with hyperreflexia a decreased capacity was found, which could be taken as evidence of increased excitability in the hypertrophic bladder.

In further studies a more specific examination of the importance of myogenic factors in the development of hyperreflexia is undertaken including the exploration of enzymatic defects which follow obstruction in the muscle cell [2].

This experimental model can be used as a pharmacological test model in which the effect of different drug on detrusor hyperreflexia can be examined.

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