

## URINE PRODUCTION RATE AND BLADDER FUNCTION IN THE NORMAL PIG

### Hypothesis / aims of study

The purpose of this study was to investigate the pig as a possible model to study urine production variations between day and night. Previous studies confirmed the pig as a model with analogy level to the human bladder physiology. Here we investigated voiding frequency, relation between urine production rate and bladder capacity and possible circadian variation in rhythm.

### Study design, materials and methods

Ten female Danish landrace pigs (age 9-13 weeks, weight 12-18 kg) were included in this study approved by the Danish ethical committee for animal studies. Cystography, renography and kidney MRI were used to secure that none of the included animals had hydronephrosis or abnormalities of the lower urinary tract. Frequency-volume charts were based on recordings of volume and time of each single voiding during 24 hour in a special designed observation cage placed in a room with a 12 hour dark/light cycle. In addition, the fluid intake was noted. Immediately after the first voiding following the 24 hour examination period, the pig was sedated and the residual urine measured through a transurethral 8 Fr cystometry catheter.

### Results

The mean urine production rate was  $15.7 \pm 4$  ml/kg/h during day-time, as opposed to a night urine production rate of  $8.2 \pm 2.6$  ml/kg/h (Fig.1). A total of 187 voidings were registered giving a mean of  $18.7 \pm 6$  per pig (Fig. 2). The pig voiding frequency had a clear circadian rhythm with the highest hourly frequency around noon. The mean number of day-time voidings was  $15.1 \pm 4.8$  while the mean number of night-time voidings was  $3.6 \pm 1.1$ . The total voided volume was between 572 ml to 8348 ml, giving a mean of  $2845 \pm 900$  ml (day-time mean  $1879 \pm 594$  ml, night-time mean  $967 \pm 306$  ml). The average voided volume was  $110 \pm 35$  ml during day-time and  $222 \pm 70$  ml during night. The average urine flow was  $12 \pm 3.8$  ml/s. The residual urine ranged from 0 ml to 136 ml. The average fluid intake during the 24 hour period was  $4151 \pm 1313$  ml. Two animals displayed slight traces of protein in the urine.

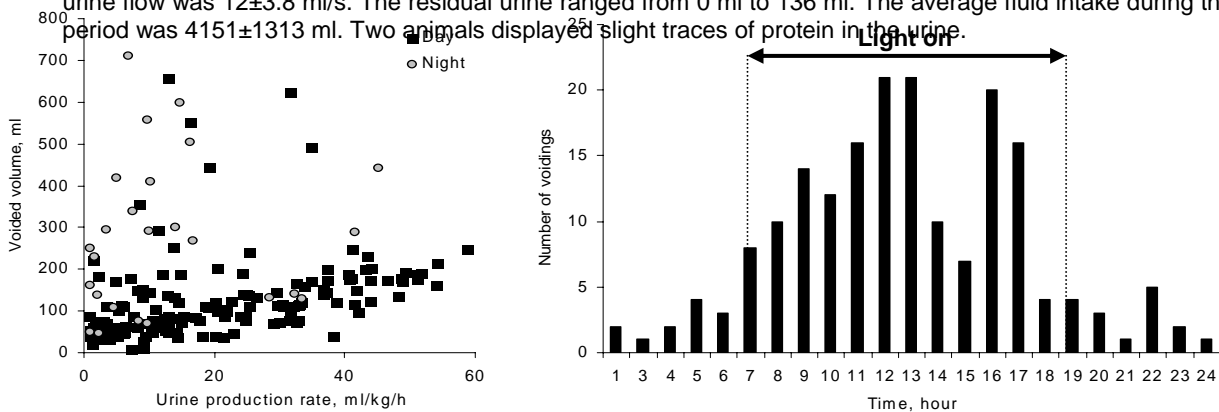


Figure 1: In this plot the relationship between urine production rate and voided volume is shown. Dark rectangles are daytime measurements. Light dots are measurements during night.

Figure 2: To illustrate the circadian rhythm in frequency number of voidings is shown on an hourly basis.

### Interpretation of results

In concert with findings in children at the age 5-7 we found a halving of urine production rate at night which significance that the circadian rhythm of urine production has little or no relation to posture. The study confirms previous observations in humans showing a relationship between filling rate and bladder volume at voiding with difference in relationship between day and night.

### Concluding message

This animal model offers study possibilities for investigation of voiding habits and physiology on a high analogy level to the human.

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**DISCLOSURES:** NONE

**ANIMAL SUBJECTS:** This study followed the guidelines for care and use of laboratory animals and was approved by Aarhus council animal committee