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HYPERACTIVE BEHAVIOR AND DETRUSOR OVERACTIVITY IN CONSCIOUS SPONTANEOUS HYPERTENSIVE RATS OBSERVED BY SIMULTANEOUS REGISTRATIONS OF INTRAABDOMINAL AND INTRAVESICAL PRESSURE

Hypothesis / aims of study
Spontaneously hypertensive rats (SHR) possess phenotypic characteristics of hyperactive behavior as well as hypertension, compared with control Wistar-Kyoto (WKY) rats. This hyperactive behavior is usually accompanied by detrusor overactivity (DO). Movement-induced changes of intravesical pressure can cause misinterpretation of cystometric recordings in SHR, since such changes can be classified as DO. In human cystometry, intraabdominal pressure (IAP) is recorded to eliminate the impact of abdominal pressure changes on intravesical pressure [1]. This principle was applied in the current study to discriminate hyperactive behavior and true DO during awake cystometry in SHR and WKY rats.
Study design, materials and methods
Age-matched six male SHR (281.0±22.9 gr) and six male WKY rat (331.7±63.7 gr) were used.
For the cystometric investigations, a catheter (PE-50) with a cuff was inserted through an abdominal incision into the dome of the bladder and held in place with a purse-string suture. To record IAP, we made a 0.05 mL balloon on the tip cuff of a PE-50 catheter. The balloon catheter was inserted and attached with a silk tie to the posterior side of the bladder-pressure recording catheter [2]. Three days after bladder catheterization, continuous cystometry was performed by infusing saline (0.9 % NaCl) (10 ml/h) into the bladder to obtain pressure- and volume-related urodynamic parameters. The intravesical pressure rises (IVPRs) during the filling phase were defined as increments of intravesical pressure that exceeded 2 cmH_2O from baseline. We recorded the time of the filling phase and counted the IVPRs, and determined which were caused by abdominal straining or DO. The values from three reproducible micturition cycles were used.
Results
Compared with WKY rats, SHR showed no significant differences in urodynamic parameters except for a shortened micturition interval ($p=0.037$) (Table1). SHR had a shorter filling phase ($p<0.05$), greater frequency of IVPR ($p<0.01$), greater frequency of abdominal strainings ($p<0.01$), but showed no difference in amplitude of intravesical or detrusor pressures on abdominal straining compared to WKY rats. SHR, but not WKY rats, showed detrusor overactivity. The IVPRs in SHR consisted of 60% abdominal straining and 40 % DO (Table 2).
Interpretation of results
Cystometric recordings in SHR are complicated by the frequent IVPRs caused by movement compared to WKY rats. SHR exhibit DO and increased abdominal straining.
Concluding message
The current study demonstrates that behavior and bladder function differ between SHR and WKY rats. Cystometric recordings are characterized by DO and an increase in abdominal straining. In conscious SHR, variations in IAP due to hyperactive behavior may cause misinterpretation of pressure parameters and result in false reports of DO. Thus simultaneous registration of IAP and IVP is needed for accurate recording of DP.
References
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TABLE 1. Cystometric parameters in awake, freely moving SHR and WKY rats

	BP. cm. H_2O	TP. cm. H_2O	MP. cm. H_2O	BC. ml	MV. ml	RV. ml	MI. Min^{-1}
WKY (n=6)							
IVP	**12.1 ± 1.2**	**33.3 ± 1.9**	**64.7 ± 11.3**	**1.21 ± 0.07**	**1.17 ± 0.07**	**0.04 ± 0.04**	**7.16 ± 0.51**
DP	**9.7 ± 1.2††**	**28.4 ± 1.5††**	**62.1 ± 11.3††**				
SHR (n=6)							
IVP	**14.7 ± 2.5**	**36.4 ± 2.7**	**61.5 ± 8.8**	**0.99 ± 0.1**	**0.94 ± 0.09**	**0.04 ± 0.04**	**5.49 ± 0.48***
DP	**12.7 ± 2.5††**	**32.7 ± 2.7††**	**59.2 ± 9.0††**				

BP: Basal Pressure, TP: Threshold Pressure, MP: Micturition Pressure, BC: Bladder Capacity, MV: Micturition Volume, RV: Residual Volume, MI: Micturition Interval, IVP: Intravesical pressure, DP: Detrusor pressure. Results are expressed as mean ± standard error of the mean. Comparisons are made between SHR and WKY: *****$p < 0.05$ (unpaired Student's *t* test), between IVP and DP: $^{\dagger}p < 0.05$, $^{\dagger\dagger}p < 0.01$ (paired Student's *t* test).

TABLE 2. Characteristics of IVPRs during filling phase in conscious SHR and WKY rats.

	Time of Filling Phase. min	Total No. of IVPRs	Total No. of abdominal straining	Total No. of detrusor overactivity	Percentage of abdominal straining in total IVPRs. %	Percentage of detrusor overactivity in total IVPRs. %
WKY (n=6)	**6.7 ± 0.5**	**10.2 ± 1.2**	**10.2 ± 1.2**	**0**	**100**	**0**
SHR (n=6)	**4.9 ± 0.49***	**26.9 ± 5.0****	**14.6 ± 2.2**	**12.3 ± 4.5***	**60.1**	**39.9**

	Frequency of IVPRs. min^{-1}	Frequency of abdominal Straining. min^{-1}	Frequency of detrusor overactivity. min^{-1}	IVP of IVPRS	DP of IVPRS
WKY (n=6)	**1.5 ± 0.2**	**1.5 ± 0.2**	**0**	**16.2 ± 1.1**	**11.7 ± 1.4**
SHR (n=6)	**5.3 ± 0.6****	**3.0 ± 0.3****	**2.3 ± 0.7****	**19.7 ± 2.4**	**16.2 ± 2.5**

IVPR: intravesical pressure rise, No: number, IVP: Intravesical pressure, DP: Detrusor pressure. Results are expressed as mean ± standard error of the mean. Comparisons are made between SHR and WKY: *****$p < 0.05$ (unpaired Student's *t* test).

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