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Dahl/SS (SS/JrHsdMcwiCrl) Rat & SS-13^{BN} (SS-Chr 13^{BN}/McwiCrl) Consomic Control

Summary

The Dahl/Salt Sensitive rat exhibits many of the abnormal maladies that occur with high blood pressure, i.e. hypertension, salt sensitivity, insulin resistance, and hyperlipidemia.

Origin and History

In 1962 Lewis Dahl developed the Dahl Salt-Sensitive (S) and Salt-Resistant (R) rat strains from Sprague Dawley rats which were bred on the basis of their blood pressures after being fed a high salt (8% NaCl) diet[3]. These strains developed by Dr. Dahl were designated as the Dahl Salt-Sensitive (S) and Salt-Resistant (R) Brookhaven outbred strain[2]. The inbred strain of Dahl Salt Sensitive and Dahl Resistant rats were developed in 1985 by John Rapp from these Brookhaven rats[11]. They are designated as Dahl/SS/Jr. The inbred Dahl/SS/Jr animal model provided from Charles River is from a congenic control group of Dahl/SS/JrHsd rats obtained from Dr. Theodore Kurtz (UCSF, CA). These rats from Dr. Kurtz were originally derived from animals from the Harlan SS/Jr colony. Animals from Dr. Kurtz colony were transferred to and have been maintained at the Medical College of Wisconsin since 1991. Animals from the Medical College of Wisconsin colony were transferred to Charles River in 2001. This strain has undergone considerable marker-selected breeding to eliminate residual heterozygosity and genetic contamination. To confirm homozygosity, the strain was tested with 200 microsatellite markers by a genome-wide scan at 20cM. All genes were homozygous for all regions tested[4].

Charles River recommends the use of the SS-13^{BN} consomic as the control, not the Dahl/SS or the Dahl Resistant rat. It does not develop elevated blood pressure on high salt diets as the Dahl/SS does. The SS-13^{BN} rat was developed at the Medical College of Wisconsin[4]. This consomic SS-13^{BN} rat is 98% identical to Dahl/SS rats. It differs only by the subset of genes (including the renin gene) present on chromosome 13 that are carried from the parental Brown Norway strain. Consomic rat nomenclature references the recipient parental strain and the chromosome donor strain.

The SS-13^{BN} indicates that chromosome 13 in the Brown Norway was transferred to, and used to replace, chromosome 13 in the Dahl/SS rat.

Pathophysiology

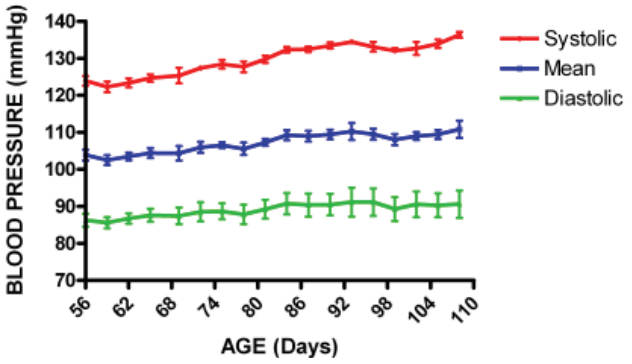
The Dahl salt sensitive rat is a rodent model of hypertension that exhibits many phenotypic traits common with hypertensive disease observed in human populations. Similarities include sodium sensitivity of hypertension, reduced renal function, elevated urinary excretion of protein and albumin, and a low plasma renin activity. Tubulointerstitial injury and the loss of Nitric Oxide Synthase (NOS) occur after birth and parallel the development of hypertension. It is suggested that the structural and functional changes that occur with renal injury in the Dahl/SS rat may contribute to the development of hypertension[5].

It has been demonstrated that the development of hypertension is accentuated in genetic models of hypertension depending on the diet being fed and it has been recommended that a AIN-76A diet with 8% salt works well in producing hypertension and kidney disease in a timely manner in the Dahl/SS rat[10]. Additionally Mattson, *et al,*[7] have shown that the source of protein, carbohydrate, fat, and/or other dietary components can have a significant impact on the disease produced in experimental models of hypertension and renal disease. **This was shown by the use of AIN-76A diet[10] and can be seen in Graphs 1 and 2 on the following page.** These results are consistent with human epidemiological data that have demonstrated an association between protein, carbohydrate, and fat intake and the level of arterial blood pressure in humans.

Data

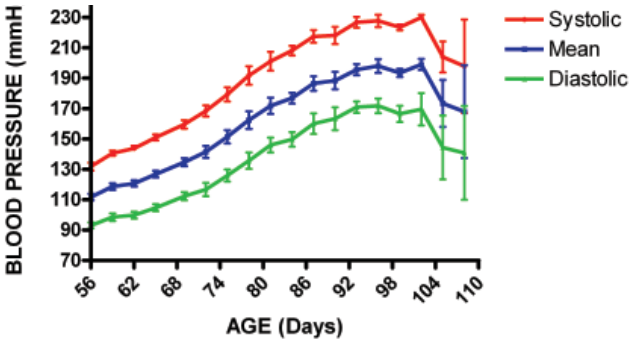
Charts showing Systolic, Mean and Diastolic blood pressure in the Dahl/SS (SS/JrHsdMcwiCrl) Rats on two different diets.

Graph 1: Blood Pressure, Male Dahl/SS Rats on CRL (5L79) Diet



Blood pressure values in male Dahl/SS rats fed a standard Charles River (5L79) diet since weaning. (N = 4), data presented as mean ± SEM. The direct blood pressure was measured using DSI telemetry technology. Date: 6/2008.

Graph 2: Blood Pressure, Male Dahl/SS Rats on 8% Salt AIN-76A Diet



Blood pressure values in male Dahl/SS rats fed a 0.3% salt AIN-76a diet since weaning. Starting at 8 weeks of age, the animals were fed an 8% salt AIN-76a diet. (N = 4), data presented as mean ± SEM. The direct blood pressure was measured using DSI telemetry technology. Date: 6/2008.

Frequently Asked Questions (FAQ)

1. What rat strain is used as the control for the Dahl/SS rat?

The SS-Chr 13^{BN} consomic rat (strain code 334).

2. What diet is recommended for studies using the Dahl/SS rat?

The AIN-76A .3% NaCl diet is fed to the Dahl/ SS rat from the time it is weaned until it is sold or a preconditioning project is initiated. We recommend this diet be used prior to placing them on a study diet utilizing salt. Charles River recommends the AIN-76A diet with either 4% or 8% for your studies.

3. Will the Dahl/SS rat maintain a normal blood pressure on a low salt diet?

Yes, on low salt diets the Dahl/SS rat will have normal blood pressure (i.e. <140 mmHg systolic blood pressure).

4. How closely related are the Dahl/SS and the consomic SS-Chr 13^{BN} rat?

They are 98% identical. They differ only in the subset of genes on chromosome 13 that includes the renin gene.

5. Does the diet fed the Dahl/SS rat affect the development of hypertension?

Yes, the source of the protein, carbohydrate, and fat in the diet has a profound effect on the severity of hypertension and renal disease that develop in the model.

6. What form of hypertension is found in the Dahl/SS model?

The Dahl/SS rat has a low renin salt sensitive form of hypertension. It is associated with declining renal function.

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technical sheet

Charles River Disease Models

As the prevalence of certain disease conditions continues to increase worldwide, the need for new ways to explore the mechanism of disease has become paramount. Charles River's portfolio of research animal models, which includes cardiovascular, metabolic, renal, and oncologic disease models, helps ensure that you will have the right resources available to you in your chosen therapeutic area.

Characteristic	THE POUND MOUSE™	OP-CD	OR-CD	Dahl/SS	SS-13^{BN}*	SHR	Stroke Prone
Insulin Resistance	+	+	+	+	+	+	+
Hyperinsulinemia	+	+	+	+	+	+	+
Type 2 Diabetes	–	–	–	–	–	–	–
Fasting Hyperglycemia	+	+	+	–	–	–	–
Hypertension	?	+	+	+	–	+	+
Obesity	+	+	–	–	–	–	–
Cardiovascular Disease	–	–	–	–	–	–	–
Hypertriglyceridemia	–	+	+	+	+	+	+
Hypercholesterolemia	+	–	–	+	+	+	+
Nephropathy	–	–	–	+	+	–	+
Leptin Receptor Defect	+	–	–	–	–	–	–
Special Diet Requirements	–	+	+	+	+	–	+
Genetics	I	O	O	I	C	I	I

Characteristic	SHROB	SHROB Lean	GK	ZDF	ZSF1	Zucker
Insulin Resistance	+	+	+	+	+	+
Hyperinsulinemia	+	+	+	+	+	+
Type 2 Diabetes	–	–	+	+	+	–
Fasting Hyperglycemia	–	–	+	+	+	–
Hypertension	+	+	–	–	+	–
Obesity	+	–	–	+	+	+
Cardiovascular Disease	–	–	–	–	–	–
Hypertriglyceridemia	+	+	–	+	+	+
Hypercholesterolemia	+	+	–	+	+	+
Nephropathy	+	–	+	+, 1	+, 2	+, 1
Leptin Receptor Defect	+	–	–	+	+	+
Special Diet Requirements	–	–	–	+	+	–
Genetics	I	I	I	I	H	O

+ = Exhibits the characteristic
– = Does not exhibit the characteristic
? = Unknown at this time
1 = Hydronephrosis (Interference)
2 = Hydronephrosis (Interference) is found infrequently
I = Inbred
O = Outbred
H = Hybrid
C = Consomic
**Dahl/SS control*

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