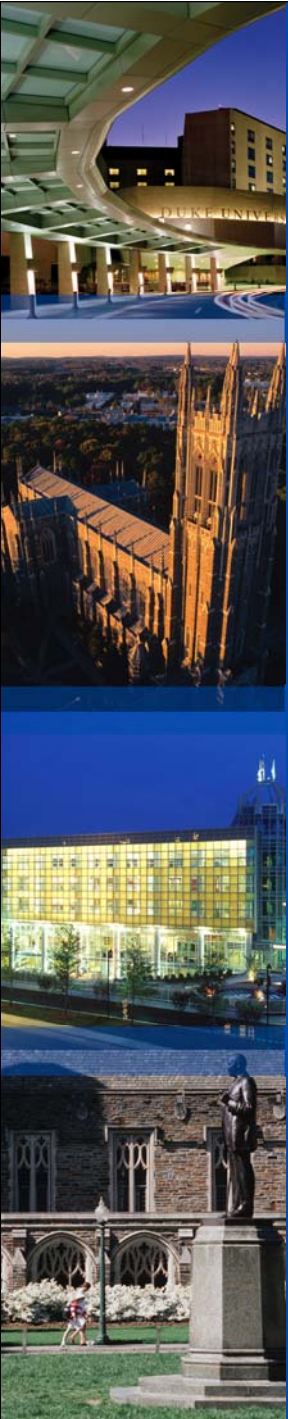




Duke Anesthesiology

Hyponatremia and Liver Transplantation

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Hyponatremia

How
LOW
Will you
GO?



ILTS, Los Angeles 2005

- Association between hyponatremia and central pontine myelinolysis
- CPM is more likely if serum Na^+ is corrected too rapidly
- During OLT it may not be possible to control change in serum Na^+
- Recommended caution in transplanting when serum $\text{Na}^+ < 124 \text{ mmol/L}$



The dilemma

- “We have a patient with Na^+ 121 for liver transplant”
- “We should probably not do that, ... he is at risk of developing CPM”
- “We have not been able to increase his Na^+ , ... and he has been awarded extra points (on the basis of hyponatremia)
- So ... We are damned if we do and damned if we don't



... so what has changed?

An Integrated MELD Model Including Serum Sodium and Age Improves the Prediction of Early Mortality in Patients With Cirrhosis

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LIVER TRANSPLANTATION 13:1174-1180, 2007

Evidence-Based Incorporation of Serum Sodium Concentration Into MELD

SCOTT W. BIGGINS, W. RAY KIM, NORAH A. TERRAULT, SAMMY SAAB, VIJAY BALAN, THOMAS SCHIANO, JOANNE BENSON, TERRY THERNEAU, WALTER KREMERS, RUSSELL WIESNER, PATRICK KAMATH, and GORAN KLINTMALM

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GASTROENTEROLOGY 2006;130:1652-1660

- There is a statistical interaction between MELD and Na⁺
 - That is, the effect of hyponatremia is greater in patients with low MELD scores



Hyponatremia predicts reduced survival following transplantation

The Impact of Serum Sodium Concentration on Mortality After Liver Transplantation: A Cohort Multicenter Study

Muhammad F. Dawwas,^{1,2} James D. Lewsey,^{2,3} James M. Neuberger,⁴ and Alexander E. Gimson¹

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- 5100 patients, 10% Na⁺ < 130 mEq/L
- 15% mortality in hypoNa⁺ vs 8% at 90 days, complications more likely
- Efforts to correct Na⁺ prior to surgery need to be addressed



Demographic and Clinical Data

Londono et al. Gastroenterology 2006;130(4)

Variable	Hyponatremia (n=19)	No hyponatremia (n=222)	P value
Age	52 ± 13(24-65)	55 ± 9(24-69)	ns
Ascites (# patients)	19 (100%)	143 (64%)	<0.01
Encephalopathy (# patients)	4 (21%)	11 (5%)	0.01
MELD score	20 ± 7(9-40)	17 ± 5(6-30)	0.04
Serum sodium (mEq/L)	125 ± 4(114-129)	138 ± 3(130-146)	<0.01

Values are mean ± sd (ranges)

Frequency of complications and death post OLT

(Londono et al. Gastroenterology 2006;130(4))

Complication	Hyponatraemia, n(%) (n=19)	No hypo- natraemia,n(%) (n=222)	OR (95% CI)	P value
Death <3 months	3 (15)	11 (5)		P<0.05
Any complication	14 (74)	113 (51)	2.7 (1-8)	0.05
Neurological disorders	7 (37)	25 (11)	4.6 (1.6-13)	P<0.01
CPM	2 (10)	0		

MRI diagnosis of CPM

Study	# cases, CPM	# cases, Na<130	Mean change in Na (mEq/L)	Encephalo-pathy, preop	Death
Londono et al, Barcelona	2	2 (2/19)	16 (16 and 16)	Not known	1 (other causes)
Abbusoglu et al, Baylor	3	3 (3/12)	20.7 ± 8.1	1x3, 2x2	3
	1	132	-2	2	No
Jun Yu et al, Zhejiang	5	2 (130.6 ± 5.5)	19.5 ± 6.5	Not known	5

Duke Hyponatremic OLT data

Age M/F	Diagnosis	Serum Sodium (mmol/L)	Encephalo- pathy grade	Diuretic therapy	Ascites (L)
20/M	Pulmonary HT	119	0/ inPat	Yes	? vol
54/M	EtOH	121	2/ inPat	Yes	1
48M	EtOH	124	2/ home	Xdays, hypotens	5
56F	Hep C	124	1/ home	Xdays, inc Cr	6
51F	Hep C	126	0/ home	Yes	0.5
60M	Crypt cirr	126	1/ home	Yes	12
43M	Hep C	121	1/ home	Xdays, fluid restr	4
33M	Hep C	116	3-2/ home	Xdays, fluid restr	9
58M	Autoimm/ etoh	118	3-2/ home	X72hrs, inc Cr	9
53M	Crypt cirr	117	2/ home	X48hrs, inc Cr	8

Duke demographic and clinical data

Variable	Hyponatraemia (n=09)	No hyponatraemia (n=104)	P value
Age	50.7 ± 8.4	51.1 ± 8.0	ns
Ascites (# patients)	9		
Encephalopathy Grade 2 or worse (# patients)	5		
MELD score	27.7 ± 4.4	22.6 ± 5.6	P<0.01
Serum sodium (mEq/L)	121 ± 3.8(116-126)		

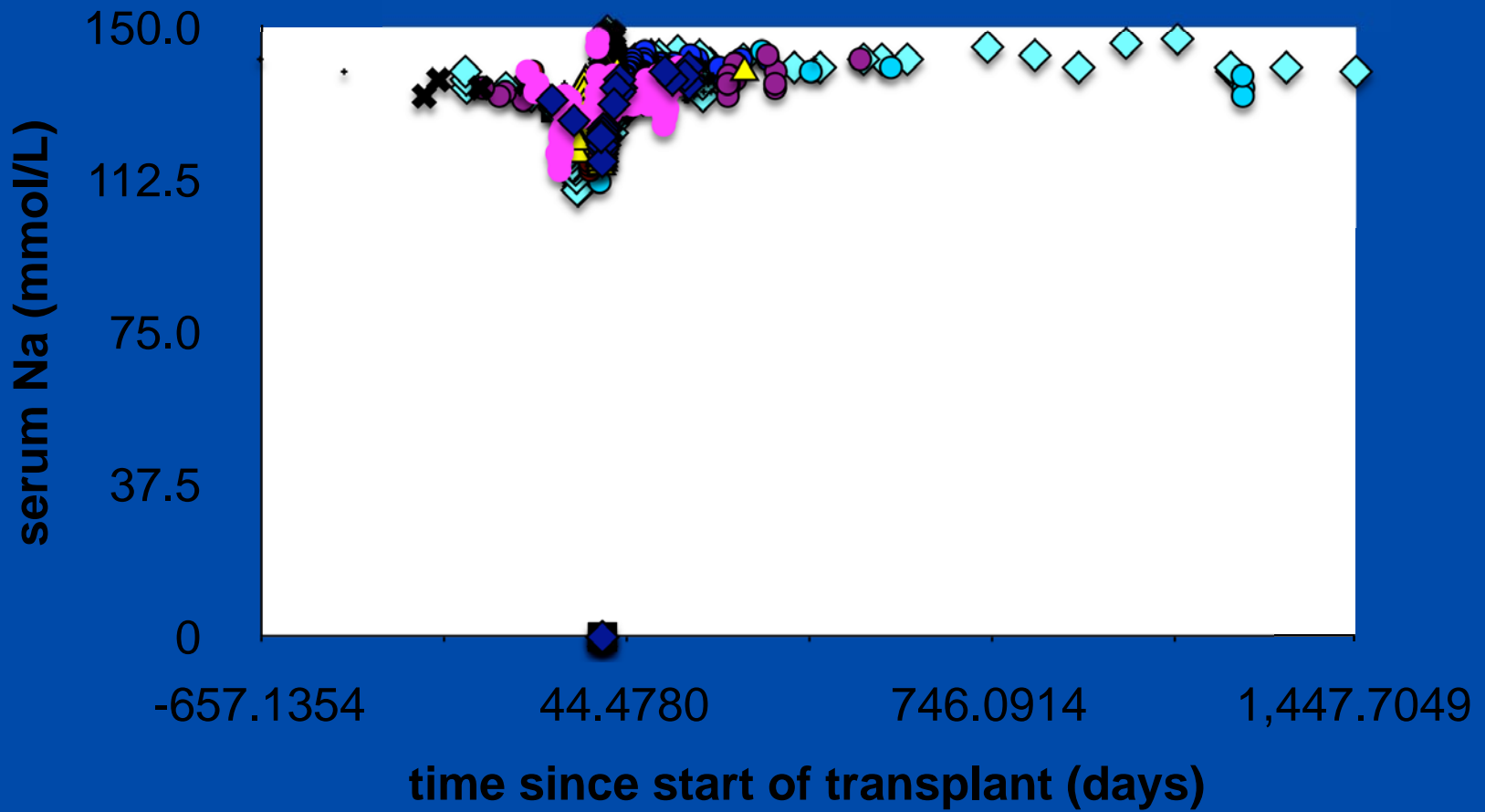
Values are mean ± sd (ranges)

Duke hyponatremia outcomes

Complication	Hyponatraemia, (n=9)	No hyponatraemia, (n=104)	P value
Death <3 months (#)	0	7	
Neurological disorders (#)	4		
Length of stay (days)	23.2 ± 16.0	14.1 ± 11.2	P<0.05
Mean sodium rise, 24hrs-pre (mmol/L)	6.7 ± 3.7 (2-14)		

Values are mean ± sd (ranges)

Perioperative changes in serum sodium



THAM

- Tromethamine is a highly alkaline, Na free solution for treatment of metabolic acidosis
- Mostly used in neonates in the setting of either hypernatremia or resp acidosis
- Rehm/Udilo, A and A 4/2003, THAM vs Bicarb for Intraop Hyperchloremic acidosis
- Na^+ decreased by 2mmol/L in THAM group vs an increase of 5mmol/L in bicarb group

Perioperative management

- Low salt diet
- Diuretic therapy
- ? Fluid restriction
- Avoid rapid correction
- ? Role of vasopressin antagonists
- Informed patient
- ? Intraoperative dialysis

Hyponatremia Summary

- Increase risk of death with and without transplant
- Increase risk of complications, in particular CPM
- Need to avoid rapid increases in serum Na⁺, which can be unpredictable.

Discussion points

- Have we got lucky?
- Comments on the use of THAM
- Should we continue to recommend a cut off ?
- “Too sick to transplant or too sick not too transplant?”

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