MODERN NEONATAL TRANSPORT: SOUND AND VIBRATION AND THEIR EFFECT ON PHYSIOLOGIC STABILITY

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BACKGROUND

- Transported infants are vulnerable and lack the physiologic reserves to handle stress
- Morbidity and mortality is higher in out-born infants
- Excess noise and vibration are known physiologic stressors of the neonatal transport process
- The data on noise and vibration has not been updated to reflect the technological advances in modern transport vehicles
- Sound and vibration levels have never been correlated with changes in the physiologic stability of the infant

OBJECTIVE

- To measure sound and vibration in modern transport vehicles and evaluate their impact on the physiologic stability of neonates comparing rotary-wing air transport (RWAT) to ground ambulance transport (GAT) and comparing results to current recommendations

METHODS

- Prospective Cohort Observational Study
  – each subject served as its own control
- Included transported infants ≤ 7 days of age
  – excluded those with known neurological conditions
  – 10/31/2015 – 6/30/2016
- Sound and vibration were continuously measured throughout transport in both RWAT and GAT
- Standardized physiologic measurements recorded every 15 min during transport were used for calculation of Transport Risk Index of Physiologic Stability (TRIPS) scores to assess for changes in physiologic stability related to sound and vibration

Statistics:

- Area Under the Curve for all biometrics were computed using the trapezoidal method for all subjects over given time points
- Comparisons between air and ground transport were made using Student's t-test for parametric data and Wilcoxon-Mann-Whitney test for non-parametric data
- Data was assessed for normality using the Shapiro-Wilk test

METHODS CONT'D.

TRIPS Variables	Points
Temperature (C)	
< 36.1° or > 37.6°	8
36.1° – 36.4° or 37.2° – 37.6°	1
36.5° – 37.1°	0
Respiratory Status	
Severe (apnea, gasping, intubated)	14
Moderate (RR >60/min and/or O^2 sat < 85%)	5
Normal (RR ≤ 60/min and/or O2 sat ≥ 85%)	0
Systolic Blood Pressure	
< 20 mmHg	26
20 – 40 mmHg	16
> 40 mmHg	0
Response to Noxious Stimuli	
No response, seizures, on muscle relaxants	17
Lethargic, no crying	6
Crying and withdrawal	0

TRIPS Value	Risk Category
0 – 10	Low Risk
11 – 20	Moderate Risk
21 – 30	High Risk
> 30	Very High Risk

International Standards Vibration Comfort Zone For Healthy Adults

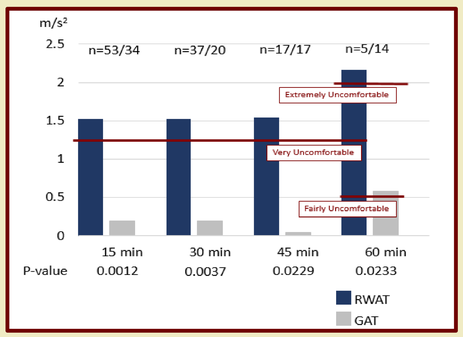
Comfort Level	Acceleration (m/s^2)
Not uncomfortable	**< 0.31**
A little uncomfortable	0.315 – 0.63
Fairly uncomfortable	0.5 – 1.0
Uncomfortable	0.8 – 1.6
Very uncomfortable	1.25 – 2.5
Extremely uncomfortable	**> 2.0**

American College of Occupational and Environmental Medicine Noise and Hearing Conservation Committee (ACOEM) recommendation:

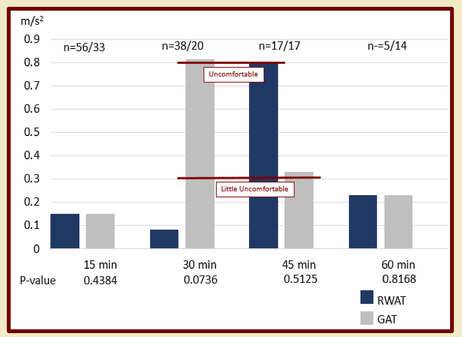
- Sound levels during neonatal transport should not exceed 60 dB

RESULTS

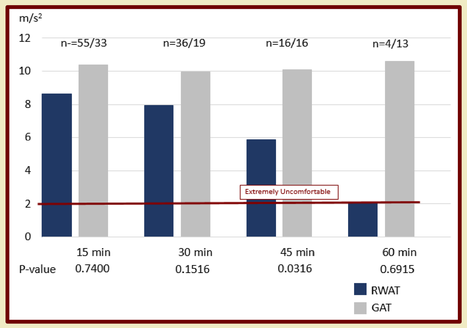
Mean Vibration – X Axis in m/s^2



Mean Vibration – Y Axis in m/s^2

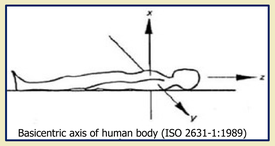


Mean Vibration – Z Axis in m/s^2



Mean acceleratory forces on all 3 axes at 15 minute intervals.

- *"X" Axis: Exceeded comfort levels at all time points in RWAT and was significantly higher than GAT*
- *"Y" Axis: Exceeded comfort levels at some time points, but without significance between the two groups*
- *"Z" Axis: Exceeded extremely uncomfortable level at all time points with GAT transport significantly higher at the 45 min time point*

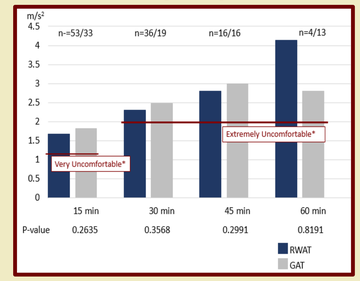


Basicentric axis of human body (ISO 2631-1:1989)

"X" from back to chest, "Y" from right side to left side, "Z" from buttocks to head

RESULTS CONT'D

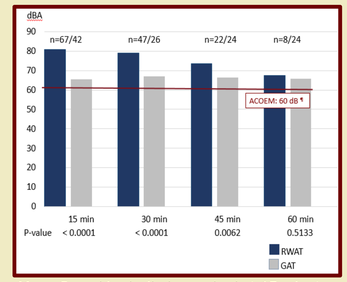
Mean Whole Body Vibration (WBV) In m/s^2



WBV increases with duration of exposure.

- *Exceeded recommendations at all time points, but without significant difference between the two groups*
- ** International Standards Comfort Zone for Healthy Adults*

Mean sound in dBA



Mean Sound in decibels graphed at 15 minute intervals.

- *Exceeded recommendations at all time points, significantly higher in RWAT at the 15, 30, and 45 minute time-points*
- *¶American College of Occupational and Environmental Medicine*

Transport Type							
	RWAT			GAT			
	n	Median 25%-75%	Mean (SD)	n	Median 25%-75%	Mean (SD)	P-value
TRIPS score Δ	65	0 (-1.00,1.00)	0.14 (6.43)	40	0 (-0.50, 0.50)	0.43 (6.00)	0.8946

Change in TRIPS scores represent the infants physiologic response to the stress of noise and vibration.

CONCLUSIONS

- Neonates transported via RWAT experienced significantly higher levels of sound and vibration than GAT
- Sound levels exceed the ACOEM recommendations for neonatal transport
- Vibration levels in transported neonates exceed the "extremely uncomfortable" range for healthy adults
- Despite high levels of sound and vibration, measures of physiologic stability did not change during transport in either RWAT or GAT

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NEONATAL-PERINATAL MEDICINE