Traumatic Lumbar Punctures in children and contributory factors:

A 10 year retrospective study

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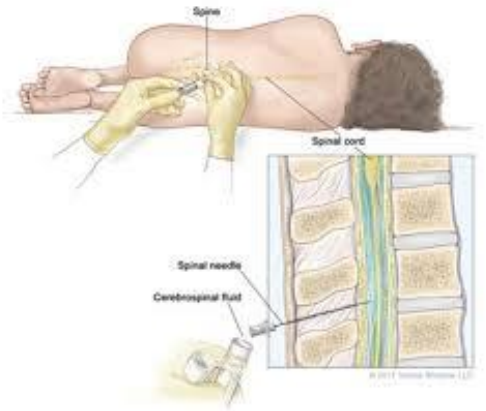
Background



- Lumbar puncture (LP) is a procedure done to acquire cerebrospinal fluid (CSF), which is important in the diagnosis of a variety of infectious and non-infectious neurologic conditions.

- Haemorrhagic/Traumatic lumbar puncture (TLP) occurs due to puncturing venous plexus or vessels along the corda equina, causing bleeding in subarachnoid space (1).

- **TLP may cause diagnostic uncertainty, unnecessary antibiotic use, prolonged hospital stay and harm to patients (2-4).**

Aim

- The study reviewed the lumbar punctures performed at the QCH (formerly known as LCCH) and RCH over a ten year period.
  - Primary aim was to find the identifiable risk factors related to TLP.
  - Our secondary aim was to then possibly identify the modifiable factors contributing to TLP in order to reduce the number of TLP.

Factors associated with TLP

- Patient, physician and procedural factors have been highlighted in the literature

  - Anaesthesia vs no anaesthesia - Studies found decrease proportion of TLP with anaesthesia and a qualitative decreases the pain (3)

  - Needle type (gauge and length) and technique (stylet vs no stylet) - no significant association (4)

  - Effect of age – LP 3 times more likely to be successful (adequate CSF and <1000 RBC) if the infant was >12months (3)

Methods

- A retrospective study of LP's conducted at two tertiary pediatrics centers in Brisbane., QCH (formerly known as LCCH) and RCH Brisbane.
- Data was collected from Queensland Pathology (AUSLAB)
- Study duration: 1/1/07 to 30/6/16. (10 years)
- Non-identifiable data e.g. sex, age as well as variables related to the lumbar puncture including CSF cytology, location and time of the lumbar puncture was extracted.
- Age range 0- 18 years.

Methods

Analysis

- Stata software 15.0
  - Categorical variables were described in proportions with 95% confidence intervals (CI).
  - Continuous variables were presented in means and standard deviations if normally distributed or medians with interquartile ranges if non-parametric

Definitions used in the study

- Varying definitions of TLP in the literature ranging from >400 to >10,000 red blood cells (RBC) in the cerebrospinal fluid (CSF) (2-4).

In our study

- A TLP was defined as a LP with >400 RBC present.

- Alternative definition: of >1000 RBC and gross blood appearance was also considered.

RESULTS

Frequency of TLP

- We analysed a total of 491,771 lab records over 10 years data from RCH and QCH There were **16,196** LPs performed during the study period.

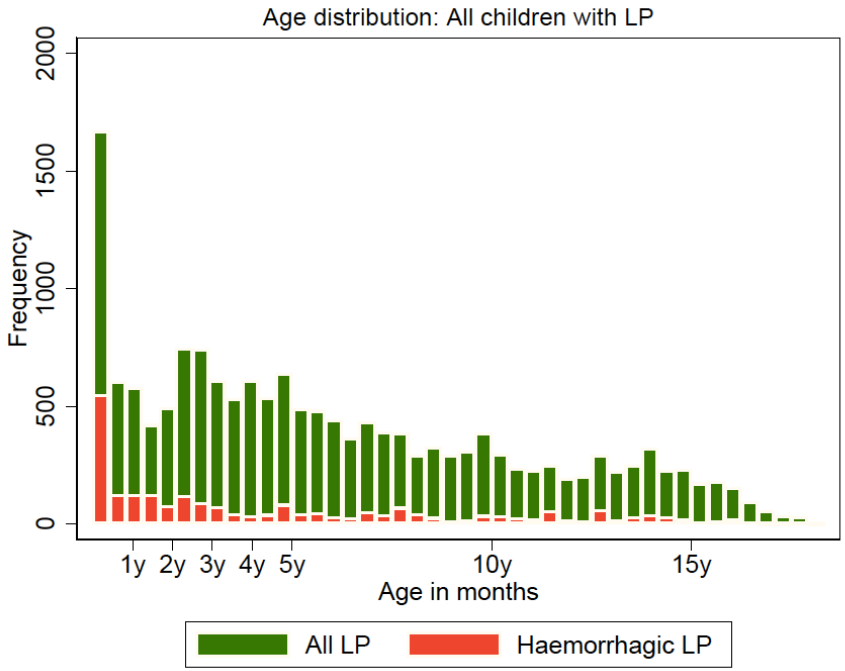
- Table 1: Breakdown of LP types based on the definition of traumatic

	Freq	%
Grossly blood stained (GBS)	2219	13.70 (CI 13.67-14.75)
>400 + GBS	3083	19.04 (CI 18.43-19.65)
>1000 + GBS	2301	14.21 (CI 13.17-14.24)

?

Association of AGE with Traumatic LP's

Age distribution: All LP's



Bivariate regression analysis

Association of AGE at different months with TLP (overall)

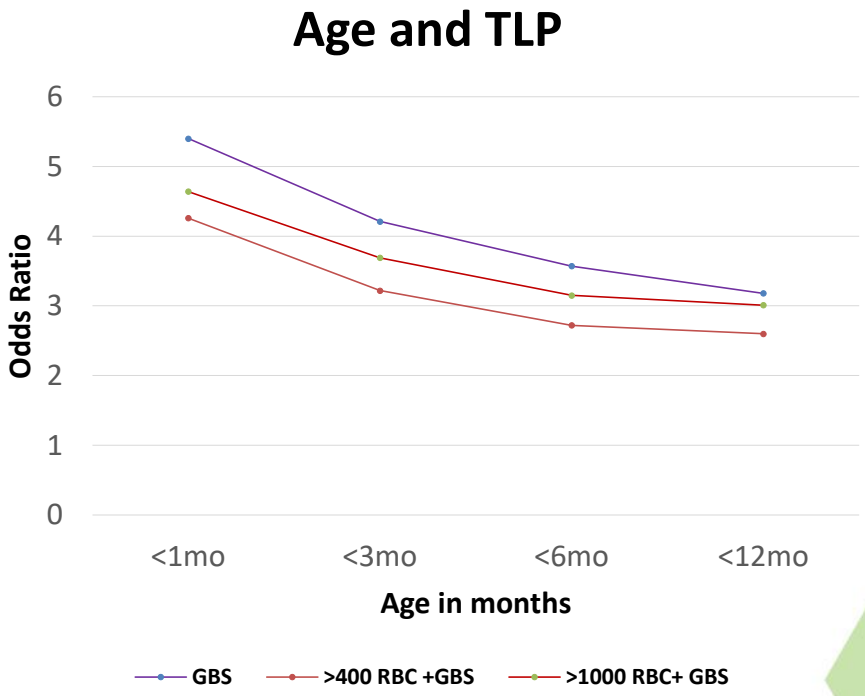
Traumatic lumbar puncture (Grossly blood stained) - OVERALL				
Statistic	**<1mo**	**<3mo**	**<6mo**	**<12mo**
Odds ratio (95%CI)	5.4 (4.53-6.44)	4.21 (3.72-4.76)	3.57 (3.19-3.99)	3.18 (2.87-3.53)
P value	0.00	0.00	0.00	0.00
Traumatic lumbar puncture (>400 RBC + GBS)- OVERALL				
Statistic	**<1mo**	**<3mo**	**<6mo**	**<12mo**
Odds ratio(95%CI)	4.26 (3.58-5.06)	3.22 (2.86-3.63)	2.72 (2.45-3.03)	2.60 (2.36-2.86)
P value	0.00	0.00	0.00	0.00
Traumatic lumbar puncture (>1000 RBC + GBS)- OVERALL				
Statistic	**<1mo**	**<3mo**	**<6mo**	**<12mo**
Odds ratio (95%CI)	4.64 (3.89-5.54)	3.69 (3.25-4.17)	3.15 (2.82-3.53)	3.01 (2.72-3.33)
P value	0.00	0.00	0.00	0.00

Bivariate regression analysis

Association of age at different months (overall) with TLP

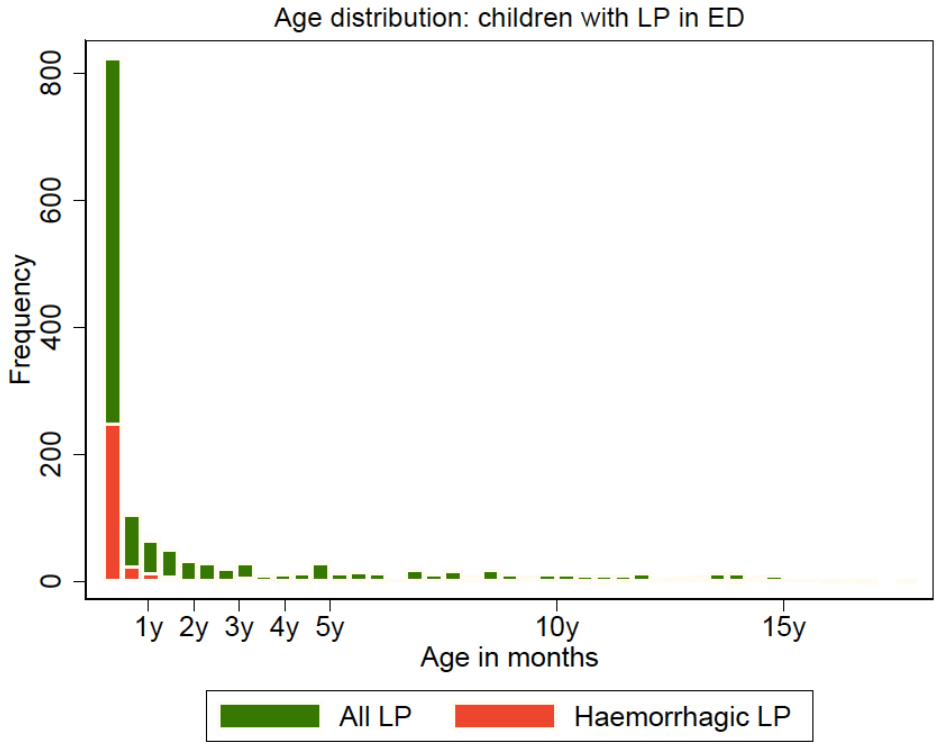
- What was most significant in our findings was the highest OR was 5.4 in the <1m age group.

- There were still significant OR or 2.6- 3.18 for <12 m age group showing an increased association for TLP with this <12m age group.

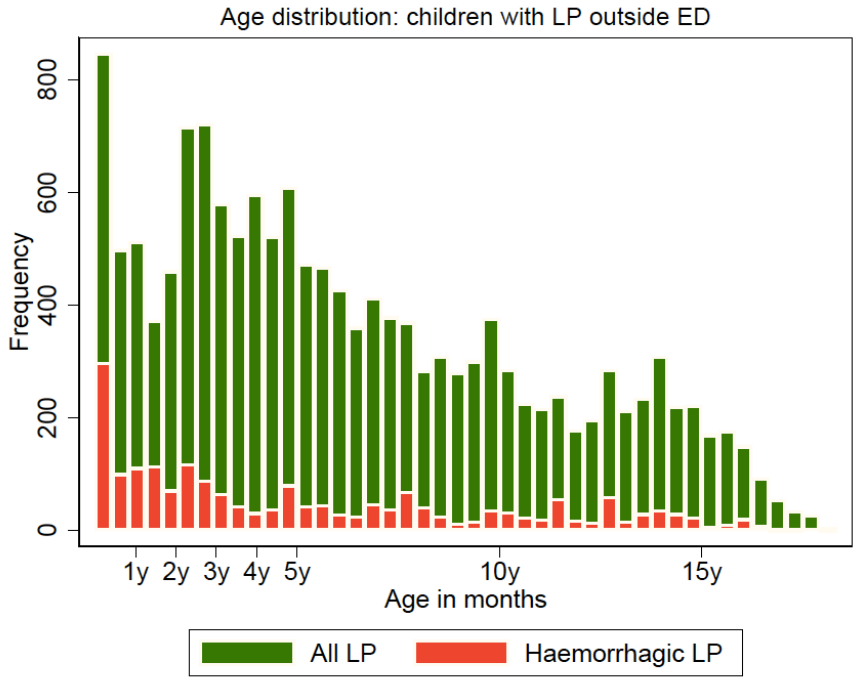


Association of AGE with traumatic LP's – In ED vs not in ED

Age distribution: LPs in ED



Age distribution: LPs outside ED



Bivariate regression analysis

Association of AGE at different months with TLP (for LPs in ED only)

Traumatic lumbar puncture (GBS) - In ED				
Statistic	**<1mo**	**<3mo**	**<6mo**	**<12mo**
Odds ratio (95%CI)	2.63 (2.01-3.43)	2.63 (2.08-3.33)	2.55 (1.99-3.27)	2.98 (2.27-3.90)
P value	0.00	0.00	0.00	0.00

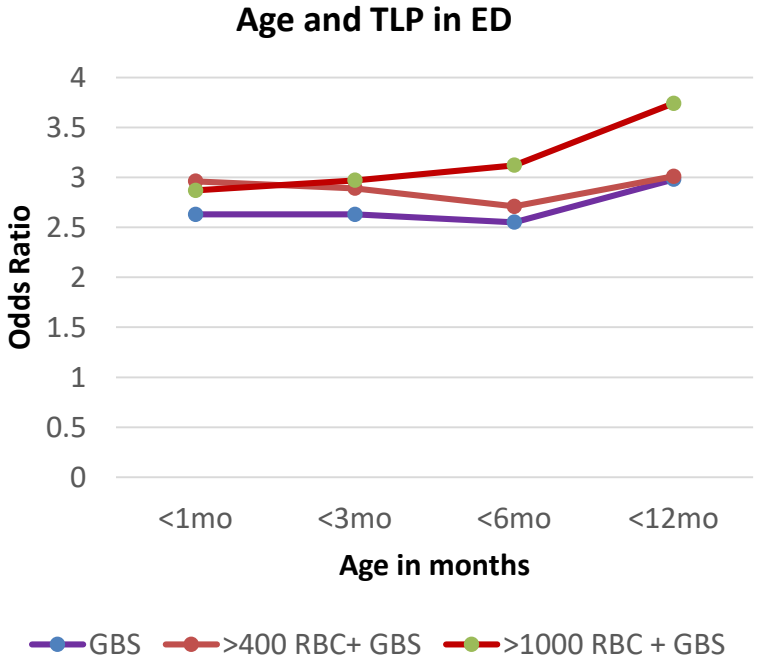
Traumatic lumbar puncture (>400 RBC + GBS)- in ED				
Statistic	**<1mo**	**<3mo**	**<6mo**	**<12mo**
Odds ratio (95%CI)	2.96 (2.27-3.85)	2.89 (2.28-3.65)	2.71 (2.12-3.47)	3.01 (2.31-3.92)
P value	0.00	0.00	0.00	0.00

Traumatic lumbar puncture (>1000 RBC + GBS)- in ED				
Statistic	**<1mo**	**<3mo**	**<6mo**	**<12mo**
Odds ratio (95%CI)	2.87 (2.18-3.77)	2.97(2.30-3.82)	3.12(2.37-4.10)	3.74(2.76-5.07)
P value	0.00	0.00	0.00	0.00

Bivariate regression analysis

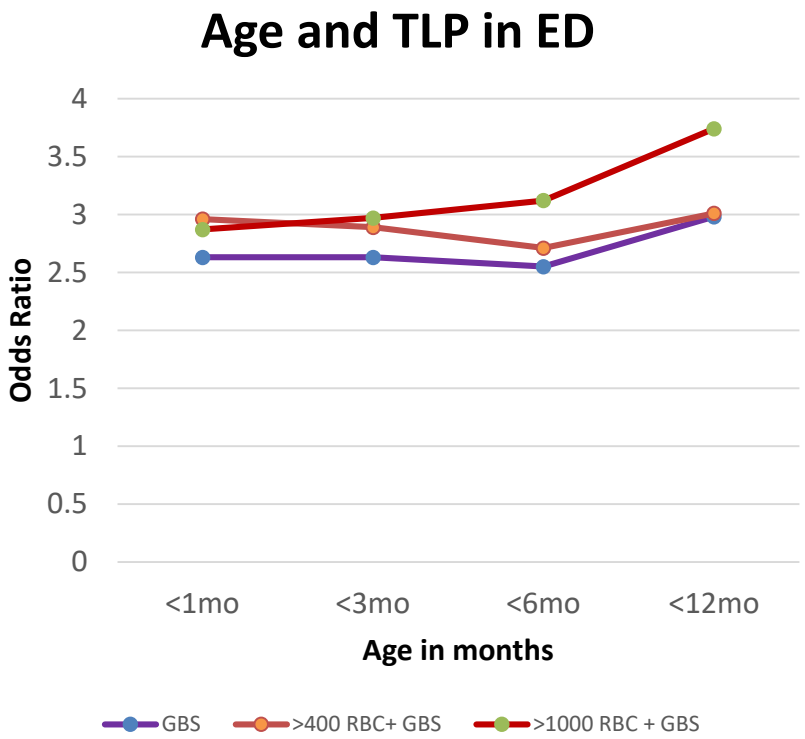
Age at different months (for LPs in ED only)

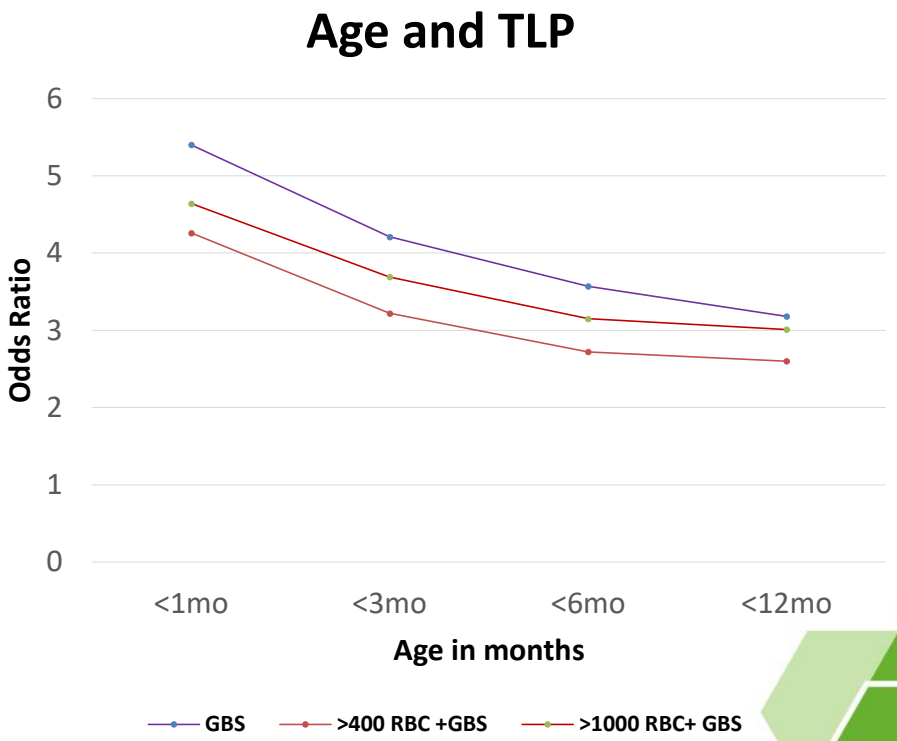
- When compared to total LP's the OR were smaller overall.
- The highest OR were in <12mo and a fairly small difference between age groups, unlike the previous graph which showed a the highest OR in the <1mo.



Bivariate regression analysis

Age at different months (for LPs in ED only VS overall)





Association of Location with Traumatic LP’s

Bivariate regression analysis

Association of ED with TLPs

Variables	Non-ED (T=14667)	ED (T=1529)	OR (ED) + 95%CI	P value
GBS	1821	398	2.5 (2.2-2.8)	<0.001
>400 RBC or Gbs	2667	416	1.7 (1.5-1.9)	<0.001
>1000 RBC or GBS	1961	340	1.9 (1.6-2.1)	<0.001

Association of LOCATION and AGE with Traumatic LP's

Association of LOCATION and AGE on Traumatic LP's

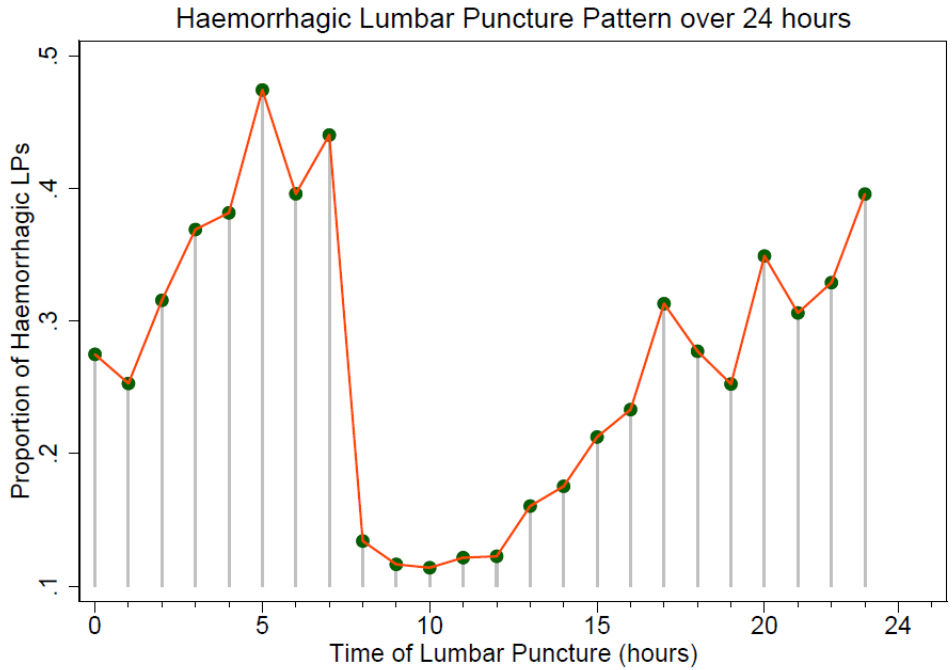
- Stratified for age (**age < 1 month**) No effect of ED in stratified analysis

Variables	Non-ED (T=244)	ED (T=298)	OR (ED) + 95%CI	P value
GBS	111	127	0.9(0.6-1.3)	0.50
>400 RBC or GH	124	138	0.8(0.6-1.2)	0.30
>1000 RBC or GH	109	116	0.8(0.6-1.1)	0.18

Association of TIME OF DAY with Traumatic LP's

Association of TIME OF DAY with Traumatic LP's

Frequency of Traumatic LPs: spread over 24 hours



Association with TIME OF DAY with Traumatic LP's

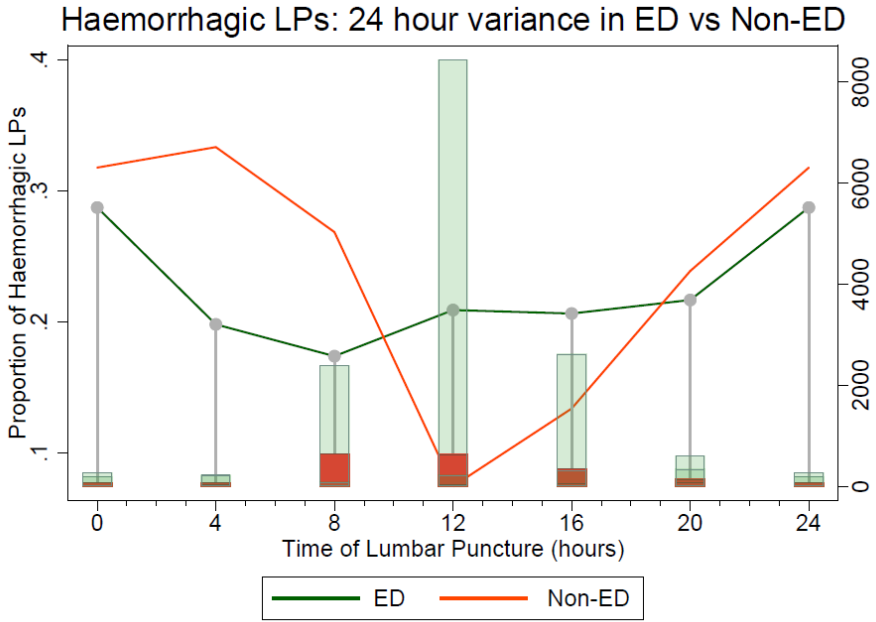
Bivariate Regression analysis of association of TIME OF DAY with Traumatic LP's

Variables	In hours (T=12599)	After hours (T=3597)	OR (Afterhours) + 95%CI	P value
GBS	1188	1031	3.9(3.5-4.2)	<0.001
>400 RBC or GH	1755	1328	3.6(3.3-3.9)	<0.001
>1000 RBC or GH	1221	1080	4.0(3.6-4.4)	<0.001

Multi variate analysis

Traumatic LPs: spread over 24 hours Emergency vs Outside Emergency

- In order to see if there were any confounders, we looked at 2 variables together **timing of LP** and the **location** to see again if ED vs non ED had an effect.



Multi variate analysis –

Traumatic LPs spread over 24 hours: Summary of affect of all variables- <1 mo

GBS	OR (CI 95%)	P value
Age	3.7 (3.07-4.55)	0.000
ED	1.12 (0.98-1.32)	0.069
Afterhours	3.47 (3.15-3.84)	0.000

Strength and Limitations

- **Strengths**
- Large study
- Small Confidence intervals and significant OR
- Significant impact of afterhours, age and location of ED in children over 1 month – aspects we would like to target as possible areas of change to minimize the number of traumatic lumbar punctures.

- **Limitations**
- Retrospective audit.
- Limited information on clinical factors which may have an impact on the outcome.
- Multivariate analysis – find some specific confounders which we would like to explore further.

What is to come

- To analyse per service area and especially in specialist areas of the hospital i.e. oncology unit
- To analyse for temporal trends over the last 10 years.
- To analyse for the seasonal trends (with increased acuity and demand in the winter months; and change of the registrar changeover times, as the guidelines for management of sepsis have changed)
- To evaluate the WBC: RBC ratios and compare them to the WBC:RBC ratios in the CSF fluid of the TLPs

Conclusion

- TLP's proportion changes with the age, with younger than 1 year old children at higher risk and the proportion of TLPs increase afterhours with peak after 8pm.
- Age <12mo, location (for >1mo) and timing of the LP (if outside of ED) are all associated with Traumatic LP
- Contributory factors need to be explored further however these will likely strengthen our preliminary findings.
- TLPs are also likely to be different in proportion in different service areas of the hospital due to multi-factorial reasons which need to be explored further.

Thank you

- Acknowledgement: Thanks to Dr Vishal Kapoor and his contribution to the research process, statistical analysis and presentation.

References

1. Shah KH, Edlow JA. Distinguishing traumatic lumbar puncture from true subarachnoid hemorrhage. J Emerg Med. 2002 Jul;23(1):67–74.

2. Glatstein MM, Zucker-Toledano M, Arik A, Scolnik D, Oren A, Reif S. Incidence of traumatic lumbar puncture: experience of a large, tertiary care pediatric hospital. Clin Pediatr (Phila). SAGE Publications; 2011 Nov;50(11):1005–9.

3. Nigrovic LE, Kuppermann N, Neuman MI. Risk factors for traumatic or unsuccessful lumbar punctures in children. Ann Emerg Med. Elsevier; 2007 Jun;49(6):762–71.

4. Schreiner RL, Kleiman MB. Incidence and effect of traumatic lumbar puncture in the neonate. Dev Med Child Neurol. 1979 Aug;21(4):483–7.