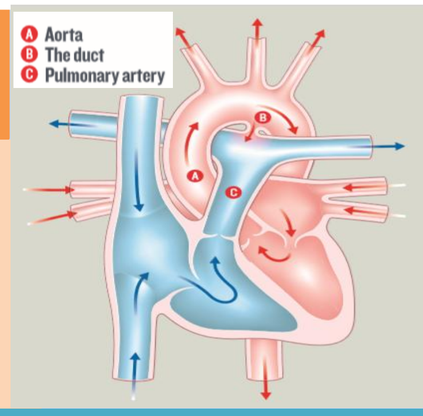
Using Resistivity Index (RI) as a Predictor of PDA Closure in Extreme Preterm Infants

A King, L Yianni, R Kachroo - Queen Alexandra Hospital, Portsmouth

Background [1-3]

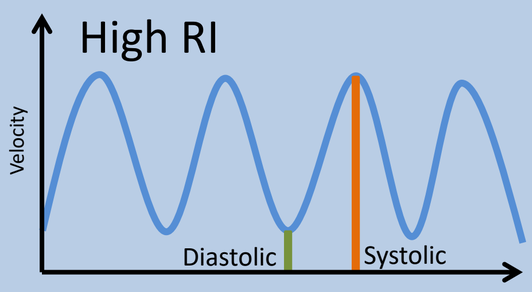


PDA is a common problem in preterm neonates, especially under 28 weeks. Medical treatment options are limited and currently include ibuprofen and/or paracetamol, with surgical ligation as a last resort if medical treatment fails. Echocardiographic assessment of the duct forms a key to this decision making process. There is no consensus on what parameters are best to assess haemodynamic significance or predict response to treatment, but measurement of velocity using continuous doppler has been shown to be a more reproducible parameter than measurement of just size.

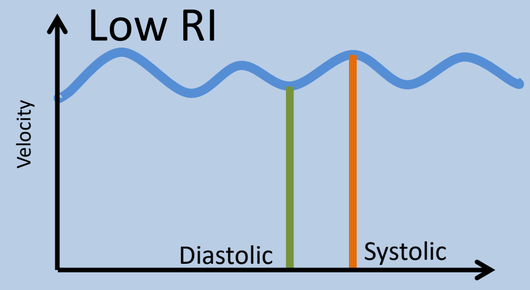
Study Design [4]

This is a retrospective study that analysed flow characteristics within the PDA in babies less than 28 weeks that received medical treatment. All babies less than 28 weeks born in the calendar year 2015 in a level III neonatal unit were identified from the BadgerNet database. Data was collected on systolic and diastolic velocities across all echocardiograms before and after medical treatment or until surgical ligation.

The velocity measurements of blood flow across a PDA was used to calculate the Resistivity Index (RI) as a measure of relationship between systolic and diastolic velocity. The RI was then analysed to see if it could better prognosticate medical management for PDA closure.

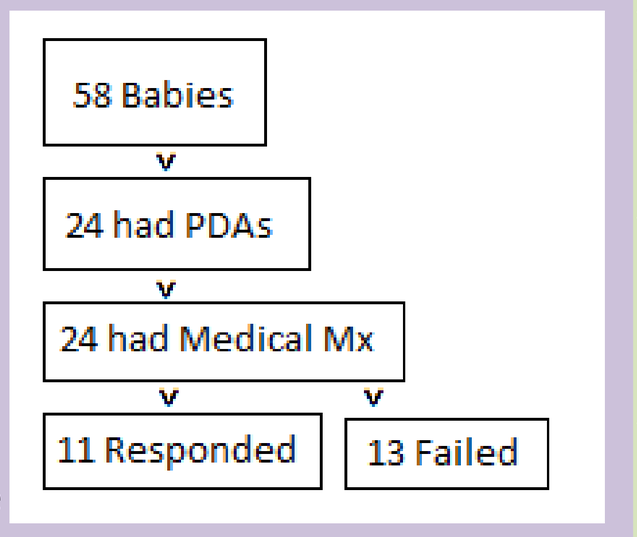


$$RI = \frac{\text{Systolic velocity} - \text{Diastolic velocity}}{\text{Systolic velocity}}$$



Results

58 babies were born 23+0 to 27+6 weeks gestation. Of these, 24 had a diagnosis of PDA, and all had at least one course of medical treatment as first line. These included ibuprofen or paracetamol.



There was no statically significant differences in the RI between those who responded to medical treatment, and in those where it failed (p=0.49), and so subgroups were analysed.

Population Characteristics

Parameter	Median	Range
Gestation	25+1	23+0 – 27+5
Birth weight	663g	409 – 995g
RI	0.57	0.35 – 0.82

A breakdown in RI was looked at for babies above and below 25 weeks completed gestation, and based on birth weight around the medians for each of these parameters. The results of the subgroup analysis are shown below:

Subgroup Analysis of RI

Parameter	Responded to Medical Rx	Failed Medical Rx	p Value
< 25/40	0.47 (0.44-0.51)	0.71 (0.66-0.82)	0.002
< 650g	0.47 (0.44-0.51)	0.71 (0.57-0.82)	0.02

For babies born under 25 weeks gestation, a low RI is a significant predictor for response to medical treatment. The same is true for babies born under 650g.

For babies who are under 25 weeks, *and* under 650g, the RI is significantly lower (p=0.003) in those that respond to medical therapy.

Discussion

This study has shown the feasibility of using flow parameters, such as RI to predict if a baby under 25 weeks gestation or under 650g will respond to a course of medical treatment for their PDA.

This information would have an impact on managing parental expectations of medical treatment, as well as expediting referral for surgical ligation if the RI suggests that treatment failure is probable.

The incidence of PDA was around 40%, which is comparable with other studies in similar population groups.

One limitation of this project is that the courses of medical treatment were not uniform. There were different combinations of paracetamol and ibuprofen used over a different number of courses. These patients were grouped together because of the population size available. With only 24 patients in the target population, breaking them down further into receiving paracetamol or ibuprofen would put them into groups of 1 or 2, and no meaningful conclusions could be drawn.

The population sample was identified from a single tertiary centre; and within a reasonable time frame, where clinical practice is likely to be similar in deciding a management strategy. This increases the validity of the results, despite being small in absolute number.

With data on more babies, this initial proof of concept could be bolstered, and with more data, a threshold for RIs could be suggested to make a range for likely response to medical treatment.

References

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2- Daubert MA, Yow E, Barnhart HX, Rabineau D, Crowley AL, Douglas PS. Quality Improvement Implementation: Improving Reproducibility in the Echocardiography Laboratory. J Am Soc Echocardiogr. 2015 Augl 28(8): 959-68
3- Pees C, Walch E, Obladen M, Koehne P. Echocardiography predicts closure of patent ductus arteriosus in response to ibuprofen in infants less than 28 week gestational age. Early Hum Dev. 2010 Aug;86(8): 503-8
4- Clevermed 2018. Image available at www.clevermed.com/badgernet/badgernetmaternity [Accessed October 2018]