Should screening ultrasound of central nervous system and abdomen in infants >35th weeks of pregnancy be recommended?

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Research target
- Evaluation of frequency of disorders occurrence in Central Nervous System and abdomen ultrasonography in population of physiological neonates

Research method
- Preformed at I degree of neonatal care unit (*)
- Preformed on neonates born over 35 weeks of gestational age
- Indications had been widened
- Clinical state and indications was evaluated by neonatologist
- Ultrasound of CNU and abdomen was preformed by radiologist
- Both scans was preformed at all shorted neonates
- Scans preformed averagely over 48 h after birth
- Scans was preformed with LOGIQ 7 Ultrasoundograph (GE Healthcare) with microconvex probe (8–11 MHz) and linear probe (8–12 MHz).

(*) Neonatal Unit, marshal J. Piłsudski Hospital, Płońsk, Poland
Polish Neonatal Society Standards
Algorithm of imaging examinations

- **Neonate <32 weeks of gestation**
  - CNS damage risk factors
  - USG to 3th day
  - USG to 7th day, if normal no further diagnostics
  - Incorrect prenatal USG and pregnancy disorders
  - Early and late onset sepsis
  - Haematocrit fall

- **Neonate 32-35 weeks of gestation**
  - CNS damage risk factors
  - USG examination
  - Indiscriminative image or neurological symptoms, prefer in MR

- **Neonate >35 weeks of gestation**
  - Apgar scale <8 points
  - Cord blood pH <7.0
  - Selective hypothermia
  - Repeat USG, preform MR if neurological symptoms

Indication for ultrasound examination

**GENERALLY ACCEPTED**
- Gestation age <32 weeks
- Weight at birth <1500 gram
- TORH
- Apnea (APGAR <6 over 5')
- Intrauterine infection
- Congenital malformation
- Neurological symptoms
- Diabetic mother
- Haematocrit fall

**ASSUMED IN RESEARCH**
- Apgar scale at birth <8 points
- Resuscitation
- Respiratory and/or cardiovascular disorder
- Cord blood pH <7.2
- Perinatal injury
- Incorrect fetus alignment
- Early and late onset sepsis
- Hyperbilirubinemia/pathologic jaundice early and late
- Gestation age <38 weeks
- Weight at birth <10 pc and >90 pc
- Congenital malformation
- Incorrect prenatal USG and pregnancy disorders
- Jaundine
Central nervous system USG

- Standard preformed thru frontal fontanelle
- If needed preformed thru different acoustic windows
- Obtain min. 6 coronal sections thru:
  - lateral ventricle anterior horn
  - Monro foramen
  - dorsal part of third ventricle
  - quadrigeminal cistern
  - lateral ventricle dorsal horn
  - parietal and occipital lobe
- And 5 sagittal sections thru:
  - median plane (cerebellar falx)
  - thalamo-cadate fissure
  - body of lateral ventricle

Central nervous system USG protocol & norms

- During examination evaluated was
  - ventricular system
  - choroid plexus
  - subdural space
  - deep cerebral structures
  - cerebral hemispheres
  - cerebellum
- Posterior cranial fossa

<table>
<thead>
<tr>
<th>Structure</th>
<th>norm</th>
<th>probe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lateral ventricle</td>
<td>≤ 5 mm</td>
<td>microconvex</td>
</tr>
<tr>
<td>Third ventricle</td>
<td>≤ 3 mm</td>
<td>microconvex</td>
</tr>
<tr>
<td>Corpus callosum</td>
<td>Length 4.2mm (+/-3.3mm)</td>
<td>microconvex</td>
</tr>
<tr>
<td>Cerebellum</td>
<td>Surface 31–62 mm²</td>
<td>microconvex</td>
</tr>
<tr>
<td>Subdural space</td>
<td>Width 2-3.8 mm</td>
<td>linear</td>
</tr>
</tbody>
</table>
Abdominal cava USG

- During examination evaluated was
  - Liver
  - Gall bladder
  - Gall ducts
  - Pancreas
  - Splean
  - Adrenal gland
  - Kidneys
  - Urinary bladder
  - Abdominal vessels

<table>
<thead>
<tr>
<th>structure</th>
<th>parameter</th>
<th>norm</th>
<th>echogenicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liver</td>
<td>ALL MCL</td>
<td>55-77 mm 56-7 2mm</td>
<td>Lower than kidney</td>
</tr>
<tr>
<td>Gall bladder</td>
<td>Length Width</td>
<td>25 mm 9 mm 2 mm</td>
<td>aneognmic</td>
</tr>
<tr>
<td></td>
<td>Wall thickness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pancreas</td>
<td>Head Body Tail</td>
<td>10 mm (+/-4) 6 mm (+/-2) 20 mm (+/-4)</td>
<td>Lower than liver</td>
</tr>
<tr>
<td>Spleen</td>
<td>Length</td>
<td>7-60 mm</td>
<td>Lower or equal to liver</td>
</tr>
<tr>
<td>Kidneys</td>
<td>Length</td>
<td>L(cm)= 0.057 x A + 2.646 (V-1.529)</td>
<td>Cortex higher than liver Core lower than liver</td>
</tr>
</tbody>
</table>

Research material
- In period 01.01.2014 to 02.12.2014 - 501 newborns in unit
- 249 (49.1%) newborns with recognized indications to USG
- Retrospective data from patient documentation

Data analysis method
- Great variety of diagnosis
- USG diagnosis was divide in to 2 groups
  - I group – minor diagnosis – observation only
  - Discreet changes in structure and dimensions
  - Echogenicity changes without other pathology
  - II group – major diagnosis – high level diagnostics and/or treatment needed
  - IVH I-III
  - Ischemic changes
  - Hydronephrosis
  - Vesicoureteral reflux
  - Doubled pelvicycal system
  - Vascular changes
  - One septum pellucidum cyst has been counted separately because it was combined with other disorders
Results

- 36 newborns with at least one diagnosis (7,19%)
- 15 newborns with at least one abnormality in CNS (2,99%)
- 21 newborns with at least one abnormality in abdomen (4,19%)
- 13 major pathologies was found (2,59%)
- Often abnormalities was found in different systems than indication to USG suggested
- Mainly asymptomatic

Numerical and percentage statement ultrasound abnormalities

<table>
<thead>
<tr>
<th></th>
<th>Numerical Value</th>
<th>Percentage from all newborns</th>
<th>Percentage from all indication</th>
<th>Percentage from all abnormalities</th>
</tr>
</thead>
<tbody>
<tr>
<td>All newborns</td>
<td>501</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>All indications</td>
<td>246</td>
<td>49,10%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>All abnormalities</td>
<td>36</td>
<td>7,19%</td>
<td>14,63%</td>
<td>-</td>
</tr>
<tr>
<td>Abnormalities in CNS</td>
<td>15</td>
<td>2,99%</td>
<td>6,10%</td>
<td>41,67%</td>
</tr>
<tr>
<td>Abnormalities in abdomen</td>
<td>21</td>
<td>4,19%</td>
<td>8,54%</td>
<td>8,54%</td>
</tr>
<tr>
<td>Major abnormalities</td>
<td>13</td>
<td>2,59%</td>
<td>5,28%</td>
<td>36,11%</td>
</tr>
</tbody>
</table>
### Numerical and percentage statement ultrasound abnormalities - CNS

<table>
<thead>
<tr>
<th>Abnormality</th>
<th>Numerical Value</th>
<th>% of all newborns</th>
<th>% of all indications</th>
<th>% of all abnormalities</th>
<th>% of abdominal abnormalities</th>
<th>% of CNS abnormalities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Singly count abnormalities</td>
<td>21</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CNS – control needed</td>
<td>16</td>
<td>3,19%</td>
<td>6,50%</td>
<td>44,03%</td>
<td>76,19%</td>
<td>-</td>
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<tr>
<td>Cyst of septum pellucidum</td>
<td>1</td>
<td>0,20%</td>
<td>0,41%</td>
<td>2,56%</td>
<td>2,56%</td>
<td>-</td>
</tr>
<tr>
<td>IVH I-III(c)</td>
<td>3</td>
<td>0,60%</td>
<td>1,22%</td>
<td>7,69%</td>
<td>14,29%</td>
<td>-</td>
</tr>
<tr>
<td>Ischemic changes</td>
<td>1</td>
<td>0,20%</td>
<td>0,41%</td>
<td>2,56%</td>
<td>4,76%</td>
<td>-</td>
</tr>
</tbody>
</table>

### Numerical and percentage statement ultrasound abnormalities - abdomen

<table>
<thead>
<tr>
<th>Abnormality</th>
<th>Numerical Value</th>
<th>% of all newborns</th>
<th>% of all indications</th>
<th>% of all abnormalities</th>
<th>% of abdominal abnormalities</th>
<th>% of CNS abnormalities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Singly count abnormalities</td>
<td>18</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Kidney – control needed</td>
<td>9</td>
<td>1,80%</td>
<td>3,66%</td>
<td>23,08%</td>
<td>50,00%</td>
<td>-</td>
</tr>
<tr>
<td>Liver – control needed</td>
<td>1</td>
<td>0,20%</td>
<td>0,41%</td>
<td>2,56%</td>
<td>5,56%</td>
<td>-</td>
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<tr>
<td>Hydronephrosis</td>
<td>4</td>
<td>0,80%</td>
<td>1,63%</td>
<td>10,26%</td>
<td>22,22%</td>
<td>-</td>
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<tr>
<td>Vesicoureteral reflux</td>
<td>1</td>
<td>0,20%</td>
<td>0,41%</td>
<td>2,56%</td>
<td>5,56%</td>
<td>-</td>
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<tr>
<td>Doubled pelvilyceal system</td>
<td>2</td>
<td>0,40%</td>
<td>0,81%</td>
<td>5,13%</td>
<td>11,11%</td>
<td>-</td>
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<tr>
<td>Vascular changes in liver</td>
<td>1</td>
<td>0,20%</td>
<td>0,41%</td>
<td>2,56%</td>
<td>5,56%</td>
<td>-</td>
</tr>
</tbody>
</table>
Encountered problems

- Different scans performers
- No consistent USG protocol
- Descriptions without accurate measurement results (slightly, in/out of norm)
- No information on the results of control and evolution of changes

Conclusions

- Screening ultrasound of Central Nervous System and abdominal cavity may not be reasoned
- It may be reasoned to extend standard indications on neonates both near to estimated birth term and with mild adaptive ventilation disorders
- There is insufficient data to recommend extending indications to other clinical states – more studies needed

Conflict of interest

- There is no conflict of interest

Financial support

- There is no financial support

Thank you for your attention