Agreement between Rebound and Applanation Tonometry in Children

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Agreement profiles for rebound and applanation tonometry in normal and glaucomatous children
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IOP measurement

• Goldmann applanation
  – Gold standard
  – Perkins

• In Pediatric age group: (Challenges)

But
Challenges

Sitting at the Slit lamp?
Cooperation????

In office Sedation?
In theatre General anesthesia? (type/stage)

Advantages of I-Care

- Handheld RBT
- **Fine** sensor **tip** (less than 2 mm in diameter)
- **Fast**: Measurements are taken within 0.1 s.
- The force is minimal → **No blink reflex**.
- **No topical anesthesia** is required.
- Awake
So what do we have?

A Gold standard
• Challenges

New promising tool
• Needs validation

PAT  I-Care TA01

Purpose

• To detect the degree of agreement between IOP measurements by RBT and PAT in children with and without PCG

• Test devices’ agreement with varying age and IOP

• Investigate whether there is an IOP limit, above which the degree of agreement changes.
Methods

• A prospective non-interventional comparative study (Jan-June 2017)

• 223 eyes of 115 children (<16 years)
  – 161 normal eyes
  – 62 PCG eyes.

• Excluded patients:
  – 2ry glaucoma, corneal edema, uncooperative

Methods

• IOP measured in upright position
  • First by I-Care (TA01)
  • then topical anesthetic (Benox ® eye drops)
  • then by Perkins applanation tonometer.

• 9 cases required sedation (chloral hydrate) for measuring with PAT
Statistics

• Groups
  – Normal and PCG
  – ≤3 years and >3 years
  – IOP ≤ 15 mmHg and those > 15 mmHg

• The Bland-Altman plot was used to compare the bias, and 95% LOA between I-Care and PAT in each group.

Results

<table>
<thead>
<tr>
<th></th>
<th>Normal</th>
<th>PCG</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y)</td>
<td>6.3 (4mo-14y)</td>
<td>7 (8mo-16y)</td>
<td>0.205</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PAT</th>
<th>I-Care</th>
<th>Difference</th>
<th>p-value</th>
<th>Regression</th>
</tr>
</thead>
<tbody>
<tr>
<td>IOP all</td>
<td>14.6±5.5</td>
<td>15.2±5.5</td>
<td>−0.59 ±2.6</td>
<td>p = 0.001</td>
</tr>
</tbody>
</table>
For all participants

- **Bland–Altman plot** between average and mean difference in IOP by both devices.
- The thin solid line is the mean of difference (-0.59 ± 2.6)
- The dashed line is the 95% LOA -5.67 and +4.49 mmHg
- **Fixed bias** (p = 0.001)
- Dash dotted line is the regression line (r = 0.9 and r² = 0.79 (p < 0.001)

For PCG patients

The regression analysis showed a
strong positive correlation
Correlation coefficient (r) 0.935
Determination coefficient (r2) 0.874
p 0.001

The Bland–Altman plot showed
95% LOA from -6.34 to +4.76 mmHg
Fixed bias
(p = 0.032).
Normal participants

The regression analysis
strong positive correlation with
\((r) = 0.8, (r^2) = 0.64,\)
\(p = 0.001\)

The Bland–Altman plot
95% LOA −5.41 to +4.36 mmHg
Fixed bias
\((p = 0.01).\)

Age ≤ 3 (20%) vs. >3 years

The Bland–Altman plot
95% LOA −4.93 and +4.8 mmHg
Proportional bias \((p = 0.86)\)
?? Corneal biomechanical properties

The Bland–Altman plot
95% LOA −5.83 to +4.39 mmHg
Fixed bias \((p < 0.001)\)
IOP ≤ 15 vs. >15 mmHg

The Bland–Altman plot
95% of LOA −6.38 and +6.46 mmHg
proportional bias (p = 0.914).

IOP ≤ 15 (68%) vs. >15 mmHg

The Bland–Altman plot
95% of LOA −5.1 and +3.32 mmHg
proportional bias (p < 0.001).
Discussion

- Before our study............
- Large-scale studies to compare the two tonometers in patients with PCG are lacking due to relative rarity of the condition.
- Many previous study results have been complicated by the use of a general anesthetic, which can alter the IOP.
- Previous studies have not included children younger than 3 years.
• Our results show that the LOA between both devices decreases with higher IOP measurements

• A similar report by Dahlmann-Noor (2013)
  – Compared GAT to RBT in 102 subjects with glaucoma (mean age 11 years),
  – I-care Pro gave higher readings than GAT.
  – The magnitude of disagreement increased with IOP
  – the LOA went from (−8.6, 3.9) in IOP < 21 mmHg to (−21.08, 10.04) in IOP > 21 mmHg.

• Our results may not be as profound, while
  – The majority of our cases had an IOP < 15 mmHg (68%)
  – Only 38.5% (62) of eyes were glaucomatous
  – TA01 model

In answer of our research questions:

• To detect the degree of agreement between IOP measurements by RBT and PAT in children with and without PCG

• Test devices’ agreement with varying age and IOP

• Investigate whether there is an IOP limit, above which the degree of agreement changes.
Conclusion

• There is a good correlation between RBT (I-Care) and PAT in children with and without PCG.

• RBT overestimates IOP (usually)

• In IOPs >15 mmHg there is less agreement between the two devices.

Recommendations

• RBT is a good screening tool:
  – It tends to overestimate the IOP (not under diagnose glaucoma).
  – Less intimidating (no topical anesthesia/ sedation required)
  – Easier to use especially in infants with small palpebral fissures

• It is a suitable follow-up method
  – Detect IOP changes in glaucoma patients

• If IOP ++ ⇒ PERKINS (diagnosing/initiating treatment).

• An assessment involving corneal biomechanics may add further understanding and explanation for age variations
References


Thank You

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