Effect of effusion on hip joint stability in the newborn

A postmortal study

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In a postmortal study we found that 1 mL fluid injected through the triradiate cartilage into the hip joint of a newbom child was enough to cause instability. This instability persisted even after aspiration of the fluid. The findings were confirmed by ultrasonography.

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It has been suggested that repeated examinations for hip joint instability in the newborn can be harmful (Bjerkreim 1975, Moore 1989), and it has actually been shown that stretching the joint capsule during Barlow's test can cause instability (Jones 1991). In this postmortal study in the newborn, we examined the effect of hydrops of the hip joint as an alternative mechanism for instability.

Material and methods

In a pilot study of a stillborn girl weighing 3600 g, in whom the visceral organs had been removed during autopsy, a transpelvic route for fluid injection into the hip joint was found to be useful. A 0.6 mm cannula was easily inserted through the triade cartilage, permitting injection of fluid without any leakage. After installation of fluid (Omnipaque 300, Nyegaard, Oslo), it was noted that the hip had become unstable as evaluated by Ortolani's and Barlow's tests.

In another girl who died when 3 days old (3350 g), 0.6 mm cannulas were introduced through the triade cartilage into both hips. The cannulas were connected to 5 mL syringes in a closed system, so that no air could enter the joints. The joint stability was tested by Ortolani and Barlow's tests, and sonography was performed according to Dahlström et al. (1986) and Terjesen et al. (1989). The former technique uses an anterior approach for dynamic examination. The latter technique comprises both a transverse scan for dynamic examination and a lateral approach to measure the bony rim percentage (BRP) (Figure 1). A Siemens Sonoline SL 1 with 5 Mhz and 7.5 Mhz linear probes was used.

To visualize the fluid sonographically, an anterior approach parallel to the femoral neck using Wingstrand's method (1986) was used (Figure 2). The amount of fluid in the joint was increased stepwise by 0.5 mL, with clinical and sonographical examinations after each increase; until the hip became unstable. After that, the fluid was aspirated, and the stability once again was tested. Then the hip joint was filled to estimate the maximal volume that the joint could contain.

Results

Before fluid injection, the hips were stable clinically as well as sonographically, and the BRP was normal (Figure 1). After installation of 1.0 mL fluid, it was visible sonographically (Figure 2). Both Ortolani's and Barlow's tests were then positive. This instability was easily visualized by both ultrasonographic techniques (Figures 3 and 4). The BRP did not, however, change after fluid injection. There were no signs of air leakage into the joints. The fluid was then aspirated in an amount between 0.9 and 1.0 mL, still without air leakage, and the instability persisted both clinically and sonographically.

Finally, the joint was filled with fluid, and a maximum volume of about 3 mL, as was found in the pilot study, could be injected. Thereafter, a rapid increase of resistance was felt, and no more fluid could be injected.

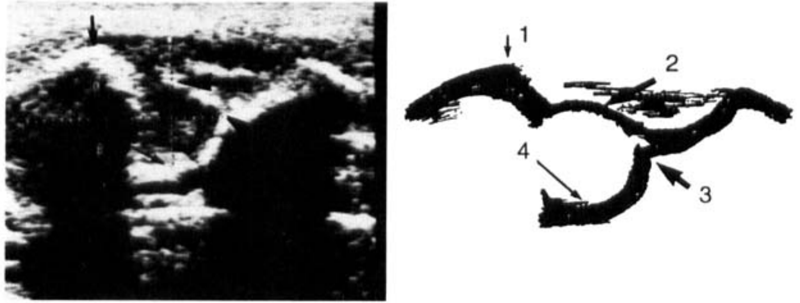


Figure 1. Bony rim percentage (BRP), acetabular rim line (3), joint capsule (2), bottom of acetabulum (4), great trochanter (1). BRP is the depth of the acetabulum in percentage of the caput diameter.

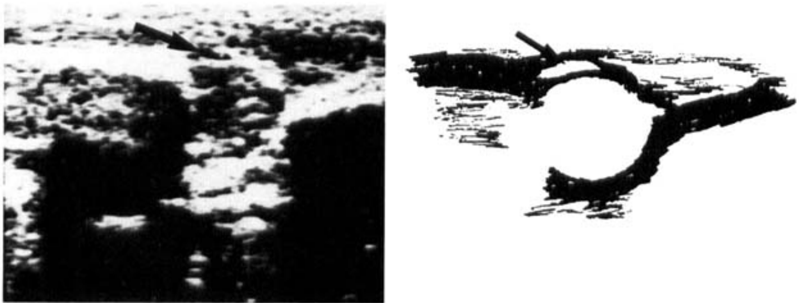


Figure 2. Anterior scan along the femoral neck to show fluid in the joint (arrow).

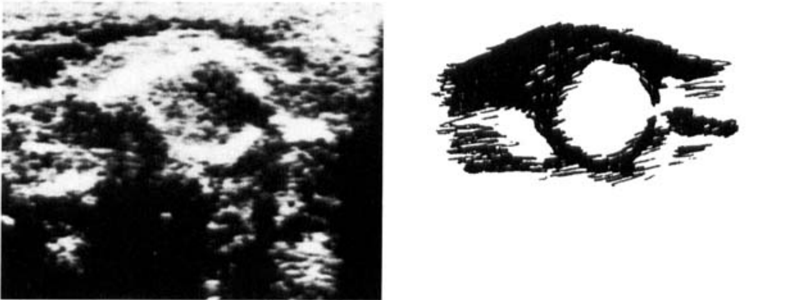


Figure 3. Instability by the Terjesen method.

The head in place.

Dislocated.

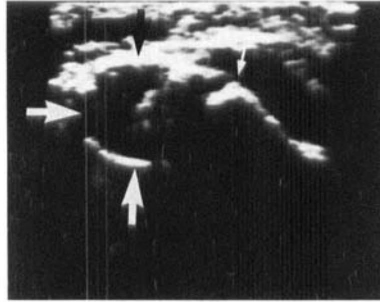
Discussion

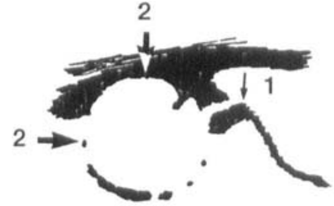
Our study shows that injection of 1 mL fluid into the hip joint of a newborn is enough to cause instability. 1 mL is about one third of the maximal volume that the capsule can contain, and it is therefore a relatively big effusion. It corresponds to about 20 mL in an adult.

Wingstrand (1986) and Wingstrand et al. (1990) have proposed that such instability is due to a disturbed vacuum effect; stability is primarily maintained by the atmospheric pressure. In a postmortal study they found that 200 N traction was necessary to overcome the atmospheric pressure in an adult person with an

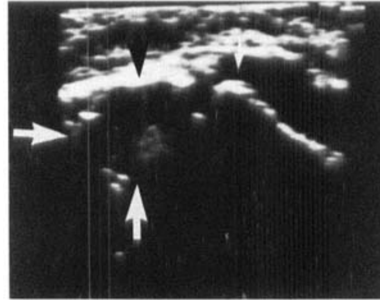
Figure 4. Instability by the Dahlström technique.

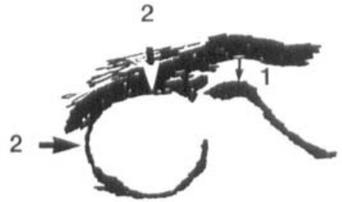
The head in place; anterior acetabular edge (1), femoral head (2).





Subluxated posteriorly.





intact joint capsule. However, if the joint capsule was opened via a small incision, much less force was necessary to obtain the same dislocation.

If there is some fluid between the femoral head and the acetabulum, the atmospheric pressure will be transduced into this interspace and neutralize the vacuum effect. Since there is always some synovia in a joint, the force needed to dislocate the femoral head depends on the viscosity and the amount of fluid or other tissue that can replace the volume of the femoral head within the acetabulum. Thus, the stability that remained in spite of 0.5 mL fluid in the hip joint in the beginning of our experiment, can be explained by the fluid not yet reaching the space between the femoral head and the acetabulum. The remaining instability at the end of the experiment can be due to lack of contact between the femoral head and the acetabulum, i.e., no vacuum effect caused by a small amount of fluid that remained in the joint after aspiration.

However, distension of the joint capsule can also be of importance since in hips with hydrops, movements can considerably increase the pressure (Wingstrand 1986, Wingstrand et al. 1990). This may cause further distension of the capsule, for instance, when checking the hips of newborns repeatedly. Together with the vacuum effect, this mechanism can possibly explain the increased instability that may occur some days after birth (Dahlström et al. 1986).

1 mL fluid was enough to cause hip instability in this study. We do not know, however, if such effusions are common in newborns or if lesser volumes during a longer time and altered viscosity can cause similar instability, especially in cases with other risk factors for congenital dislocation of the hip, such as increased joint laxity or a shallow acetabulum.

In conclusion, this experiment indicates that the maximum hydrops in the neonatal hip of children weighing about 3500 g was 3 mL, and that about 1 mL excessive fluid can be detected ultrasonographically as hydrops, and also can cause instability. Unchanged BRP after maximal fluid injection indicates that this parameter is more related to skeletal anatomy than to stability of the joint.

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