Good Morning

I am honored to be a part of your educational experience

Orthopedics

in the neonate

Kaye E Wilkins D.V.M,M.D.
President’s Council/Dielmann Chair in Pediatric Orthopedics
Professor of Orthopedics and Pediatrics
Department of Orthopedics
University of Texas Health Science Center at San Antonio, Texas

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Goals of this presentation

• To describe those conditions that present in the neonate that should require orthopedic consultation.
• To outline the degree of urgency for which these neonatal conditions need orthopedic management.
• We will discuss only the most common conditions that require orthopedic management.

Usual concepts when using the term “Orthopedics in the Neonate”

Casts, Pins, and bars

Multiple limb deformities
A wide variety of orthopedic conditions can be seen in the neonatal period.

We are going to focus our attention to those orthopedic conditions that require urgent attention.

Categories of Orthopedic Conditions

1. Traumatic
2. Infection
3. Dysplasias of bone.
5. Congenital (generalized) deformities of the soft tissues.
6. Deformities of the upper extremity.
7. Deformities of the hip and proximal femur.
8. Deformities of the lower extremity.
9. Deformities of the foot and toes.

Limits of this presentation

- This discussion will be focused on those conditions which need to be addressed as either emergencies or urgencies to prevent the development of long term sequelae.
- These will be listed as to their categories and
  1. their urgency of treatment

Priority Categories to determine urgency of treatment

- Code I: Needs immediate management, high risk for permanent sequelae.
- Code II: Needs early orthopedic evaluation. Treatment can be initiated in one to two days or with follow-up visits.
- Code III: Needs routine consult. Treatment often not initiated until patient grows and the true nature of the deformity becomes apparent.

The Most Common Categories of Neonatal Conditions that Require Orthopedic Involvement

- I. Myelomeningocele
- II. Bone and Joint Infections
- III. Trauma
  - A. Skeletal
  - B. Soft Tissue
- IV. Dysplasia of the Hip
- V. Limb Deformities
I. MYELOMENINGOCELE

A neurological emergency

The orthopedic management is usually delayed

- While this condition has many orthopedic sequelae, the immediate urgency of the initial closure is usually managed by the pediatric neurosurgeons.
- The primary and secondary orthopedic problems are usually not addressed until the child becomes older.
- The orthopedic management is dependent upon the level of neurosegmental function.

II. Bone and Joint Infections

- Acute Hematogenous Osteomyelitis
- It is essential to remember
- Osteomyelitis is different in the neonate.
- This concept is NOT NEW !!!

For example:

W T Green in 1936 said:

“Osteomyelitis in the Neonate is DIFFERENT!”

There were Originally Three Differences (Ds)

The Three Original Ds

1. Different anatomy
2. Different symptoms
3. Different outcome

#1 How is the Anatomy Different?

Normal child

Infection starts in the metaphysis
There are no blood vessels crossing the physis

Thus, the physis serves a barrier to prevent growth area from being affected

In the neonatal age group?

Neonatal Osteomyelitis

- What is different about osteomyelitis occurring in the neonatal age group?
- The infection can now directly damage the delicate growing cells
#2 How are the Symptoms Different?

Less Clinical Findings

The usual radionucleotide and lab studies are not helpful as well.

How does this affect the morbidity?

This often results in a delay in the initial diagnosis.

#3 The Results are Different

Unfortunately, the damage is often done by the time clinical findings are apparent.

In recent years we have added

#4 Different Organisms

Older child

Staphylococcus coagulase positive

Group A Streptococcus

Neonate

Staphylococcus coagulase negative

Group B Streptococcus

Klebsiella pneumonia

Neisseria meningitidis

Pasteurella multocida

What is the difference as to how various organisms affect the bone?

- Staphylococcus?
- Bone Destruction
- Streptococcus
- Diffuse bone cellulitis

Septic Arthritis

Often it is actually a primary osteomyelitis

Avascular necrosis

Group B streptococcus
**Treatment:**

1. **Drainage of pus**
   a. Repeated aspirations
   b. Surgical incision
2. **Appropriate antibiotics**

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**Examples of the most common fractures in the neonate.**

1. **Clavicle.**
2. **Proximal Humerus.**
3. **Humeral shaft fractures.**
4. **Fractures of the proximal femur (hip).**
5. **Fractures of the shaft of the femur.**

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**1. Clavicle.**

- Often an isolated injury.
- May not be recognized until 1-2 days when neonate demonstrates lack of motion of adjacent extremity.
- Healing callus produces a clinically palpable mass.
- Pin sleeve of arm to chest. Usually can be removed in one week.
- Warning: always check for presence of a Brachial Plexus Injury!!!

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**2. Proximal Humerus**

- Separation often occurs at the physis
- The ossification center is unossified at this age
- Once reduced, callous appears
  - At six months
  - complete remodeling
  - with appearance of secondary ossification center

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**3. Humeral Shaft**

- High incidence associated with Macrosomia
- Breech Presentation
- Difficult delivery
- Treatment: Easily achieved by strapping upper extremity to chest wall.
- This, unfortunately, creates a lateral angulation due to the curvature of the chest wall.

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Fortunately, at this age there is full remodeling

4. Proximal Femur (Hip region)
- May be confused with a dislocated hip
- High incidence with non-accidental trauma.
- Usually managed non-operatively
- The following are some classic examples of the course of this fracture pattern.

In the neonate, the proximal femoral anatomy is unique.

Newborn referred as a congenital dislocated hip.

Subtle finding “Proximal femur appears to be standing out

Congenitally dislocated hips are usually not painful!!!

Non-operative management
**Treated with a Pavlik Harness**

Many go untreated

Victim of child abuse one month post injury

At six months early remodeling

**5. Femoral Shaft fractures**

Treatment often dictated by the residual neonatal contractures

Thus, these factors need to be taken into consideration when managing femoral shaft fractures in the neonate

Three month old with this injury

Definite Spiral Fracture

Always Consider Child Abuse

How Can this suspicion be confirmed?

Three weeks later

Periosteal new bone confirms ? fracture

Proliferative callous indicates neglect prior to treatment

What are the alternatives of treatment for this age?

**Disadvantages?**

- More
- Requires General supportive anesthesia
- Hard to keep clean
- Difficult to apply well
- Parents don’t like

Immediate Spica
Is this appropriate treatment for this age?

Then why not?

Too many reports in the recent literature of complications even when properly applied

Bryant’s Traction

What other treatment is useful in this age group?

In infants and neonates

Probably not!

What are the guidelines for treatment with this harness?

Advantages

1. Simple, Cheap
2. Usually doesn’t require sedation
3. Hips must be hyper-flexed
4. Need to provide lateral support to prevent hyperabduction

Disadvantages

Patient may experience moderate discomfort for a few days

Infants and Neonates

After initial discomfort, treatment well accepted

In infants and neonates

Allows Bonding With Parents

What is the natural posture in these infants?

Hip flexion

The harness places the lower extremities in flexion

Position in harness
Even with displacement healing is usually complete

Types
- Brachial plexus lesions can be divided into three types:
  1. An Upper brachial plexus lesion, which occurs from excessive lateral neck flexion away from the shoulder with loss of the lateral rotators of the shoulder, arm flexors, and hand extensor muscles.
    a. Described as “ERB’s Palsy”
  2. Lower brachial plexus lesion. This rarer one occurs when the shoulder is hyper abducted. The subsequent paralysis affects, principally, the intrinsic muscles of the hand and the flexors of the wrist and fingers. This results in a form of paralysis known as Klumpke’s Palsy.
  3. Less frequently, the Whole brachial plexus lesion

Causes
- Almost always occurs during the birth process
- ERB’s
  - Hyperextension of the neck with shoulder dystocia stretches the upper roots
- Klumpke’s
  - Hyper extension of the shoulder stretches the lower roots

Contributing conditions
1. During Difficult Deliveries such as:
   A. Such as with a large baby,
   B. A breech presentation
   C. A prolonged labor.
   D. This may also happen when a birth becomes complicated and the person assisting the delivery must deliver the baby quickly and exert some force to pull the baby from the birth canal.
   E. The incidence may be decreased with the increased tendency to perform more C-section deliveries now.

Pathology of the location of the nerve lesions
- Review of injuries
  - ERB’s C5-6
  - Klumpke’s C7-8
  - Location of injury for paralysis

Clinical Appearance

**ERB’s**
- Loss of shoulder abduction
- Fixed flexion
- No elbow flexion

**Klumpke’s**
- Upper extremity muscles function
- Some flexion function in hand and wrist
- Loss of hand and wrist function

“Waiter’s tip posture”

Initial Treatment

- Often it is recommended that initially, the extremity be allowed to rest to avoid further irritation to the nerves.
- The treatment often consists of physical therapy to prevent the paralized muscles from developing contractures which may inhibit resumption of joint motion as the muscles re-innervate.
- If therapy does not result in significant progress after three to six months, and evaluation using diagnostic testing reveals a more serious injury surgery may be recommended.

Types of Surgeries

- Nerve Graft replaces damaged sections of nerves
- Nerve Transfer is used when the nerve root is severed from the spinal cord.
- Muscle Transfers may also be necessary if the injury has resulted in muscle atrophy.

CAUTION !!!

It is important that diplomacy be utilized in explaining how this condition occurred to the parents so this secondary method of treatment is not initiated.

Brachial Plexus Palsy

Contact us for a Free Consultation

- If your son or daughter has a brachial plexus injury
- Because a doctor, nurse, or other health care provider
- Failed to provide adequate care during the pregnancy, during the labor and delivery of your baby.
- You should immediately contact an attorney.

IV. Dysplasia of the Hip

How is this condition best described?

- “Congenital Dislocation of the Hip” (CDH)
- “Developmental Dysplasia of the Hip” (DDH)

Degrees of dysplasia

1. **Simple dysplasia with no instability.**
   - May resolve spontaneously
   - Manifest by the famous “Click”
   - Usually a sonographic diagnosis

2. **Dysplasia with instability.**
   - Manifest clinically by the **Barlow Maneuver**
3. Dysplasia with dislocation.

The femoral head lies completely outside the acetabulum.

Manifest clinically by the Ortolani Maneuver

4. Teratogenic Hip dislocation.

Dislocation occurs very early i.e. in the differentiation stages of the fetus.

Manifest clinically by rigid irreducible hips.

Common in syndromic conditions such as arthrogryposis.
DDH
Higher incidence in certain conditions
- First born infants especially females
- History of DDH in the mother or one of the previous siblings.
- Breech presentation
- Severe ligamentous laxity in the parents.

DDH is uncommon in the black and oriental races.

Diagnosis
- Clinical examination essential
- Suspect with
  - Positive Barlow or Ortolani signs
  - Lack of hip abduction
  - Shortening of the affected extremity
- Sonography (indications)
  - Those with clinical instability
  - Routine in those with breech presentations
- Follow up clinical examination in the first office check-up.

Pitfalls
- Beware: bilateral dislocated hips may have equal abduction!
- Unfortunately, some hips with significant dysplasia may not have a clinical findings of hip instability.
- These can present as the late dislocators.

Imaging studies
1. Routine radiographic studies
   - Difficult to evaluate because of unossified femoral head?
   - Special lines
     - Shenton’s
     - Hilgenreiner’s
     - Perkin’s

2. Ultrasonography
   - A dynamic study that outlines both bony and soft tissues
   - Unreliable after the head becomes ossified

Treatment
Varies as to the stage of dysplasia
- In the neonate the primary treatment is non operative.
- Double diapering is not effective
- With the high sensitivity of ultrason, there is a tendency to overtreat these patients.
- Many hips improve spontaneously
Balik’s protocol those with only dysplasia

- Hips with dysplasia that are **clinically stable at birth**
- are re-examined at 6 weeks **clinically with ultrason**.
- Hips with dysplasia that initially are **unstable**
- Re-examine at 2 weeks with ultrason.
- In both of the above situations, if there is no improvement in the ultrasonographic appearance or clinical stability,
- then treatment with the Pavlik harness is initiated.

Dysplasia with clinical dislocation

The femoral head is held in the acetabulum in hyper-flexion and abduction is **more tolerable**

Pavlik harness

Results of treatment with Pavlik harness

- One month later
  - Increase in alpha angle indicates more depth and development of the acetabulum.
  - Remodeled to at least 60 degrees
  - The angulation of the wall of the acetabulum is termed as the **Alpha Angle**

Follow-up studies

- The Pavlik harness is utilized for 24/7 for two to three months.
- It is then used at night for another two to three months.
- By this time the femoral head is usually ossifying and regular radiographs are obtained.
- It is important to emphasize that this follow-up protocol is dependent on the fact that the dysplasia is resolving and the hip is becoming stable.

V. Limb Deformities

- There are many deformities that may present at birth.
- However, the main one that needs to be addressed in the immediate newborn period is the:
  - Congenital Clubfoot
General considerations

1. This condition involves all of the musculoskeletal tissues distal to the knee.
2. It is not due to intrauterine posturing.
3. Commonly in syndromes such as Arthrogryposis and Myelomeningocele.
4. Yet, it can occur as an isolated deformity in an otherwise normal child.
5. The deformity is usually multifactoral with a hereditary tendency.

What Conditions Can Affect The Incidence Of Clubfoot

- Genetic
- Multifactorial with Environmental Influence
- What’s The Incidence Increase If First Degree Relative Is Affected??
- 20–30 Times

The structural components

Multiple osseous and soft tissue deformities

Treatment

In the past, extensive surgery was the standard

- Presently, using the Ponseti technique most of the clubfeet can be managed with serial manipulation and cast application on a weekly basis.
- Minor surgical procedures such as a simple tenotomy of the Achilles tendon may be necessary to obtain a final correction.

Urgency of management

- The correction of this deformity needs to be addressed in the neonatal period.
- Unfortunately, the neonates often have other priorities that may delay the beginning of the treatment process.
- Fortunately, with the Ponseti method, this delay does not seem to have much of an adverse effect on the final outcome.
The progression of correction with the Ponseti serial casts

Full correction usually achieved by six weeks

Night time bracing used for another 4-6 years

Thank you for your attention!!!