Surgery
Orthopedics (40)

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Lec. 9

Scoliosis

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مكتب اشور للاستنساخ
Spine deformities
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Aim :
Scoliosis: diagnosis and treatment
Kyphosis: diagnosis and treatment

Ortho = straight
To make deformed children straight = Orthopedic
To treat Scoliosis = Orthopedic

Nicolas Andry from Paris at 1741
Orthopedic symbol
Scoliosis means "a bending"

Paidion = Child

Scoliosis:
is an apparent lateral (sideways) curvature of the spine. (more than 10 degrees)
it is triplanar deformity with anteroposterior, lateral and rotational (axial) components.

Scoliosis can be postural (non structural) or structural.

Postural (non structural) scoliosis:
The deformity is secondary or compensatory to some conditions outside the spine such as short leg, pelvic tilt due to hip contracture.

when the patient sits (canceling the leg length asymmetry) the curve disappears.

Sciatic scoliosis, due to muscle spasm in acute disc prolapse.

Structural scoliosis:
There is non correctable deformity (by posture),
an essential component of which is vertebral rotation.
The spinous processes go towards the concavity of the curve and the transverse processes on the convexity rotate posteriorly.

In the thoracic spine, the ribs on the convex side stand out prominently, producing the rib hump, which is the characteristic part of the overall deformity.

Secondary (compensatory) curves nearly always develop to counterbalance the primary curves, they are usually less marked and more easily correctable, but with time they also become fixed.
Once fully established, the deformity is liable to increase throughout the growth period, thereafter, further deterioration is slight though curves greater than 50 degrees may go on increasing by 1 degree per year.
With very severe curves, chest deformity is marked and cardiopulmonary function is usually affected.
Types (causes):
1- Idiopathic scoliosis: there is no obvious cause
2- Congenital or osteopathic: due to bone anomalies
3- Neuropathic
4- Myopathic: associated with some muscular dystrophy
5- Degenerative (de novo scoliosis)
6- Miscellaneous group of connective tissue disorders

Clinical features:
- Deformity is the usual presenting symptom.
- There may be obvious skew back, rib hump in the thoracic spine and asymmetrical prominence of one hip in thoracolumbar curves.
- Balanced curves sometimes pass unnoticed until an adult presents with backache.

- Pain is a rare compliant (in children) and if present, should alert the clinician to the possibility of a neural tumor and the need for MRI.
- There may be family history of scoliosis.
- On examination, the trunk should be completely exposed.
- Skin pigmentation and congenital anomalies e.g. sacral dimples or hair tufts can be seen.
Adams forward bending test:

Forward bending makes the curve more obvious

The level and direction of the major curve convexity are noted, e.g. right thoracic curve means a curve in the thoracic spine and convex to the right. The hip (pelvis) sticks out on the concave side and the scapula on the convex. The breasts and shoulders may be asymmetrical. In the thoracic scoliosis, rotation causes the rib angles to protrude, thus producing a symmetrical rib hump on the convex side of the curve.

Spine mobility should be assessed and the effect of lateral bending on the curve noted. Side-on posture should also be observed, there may be excessive kyphosis or lordosis. Full neurological examination is important. General examination including the cardiopulmonary function.
**Imaging:**

**X-Ray**: full length PA and lateral view of the spine and iliac crests must be taken with the patient erect, and bending views.

**Note** that PA in relation to patient is not PA in relation to the rotated vertebrae.

The upper and lower **end vertebrae** are the most tilted vertebrae in the upper and lower end of the curve respectively.

**Cobb's angle**: is the angle of the curvature:

measured between the line drawn at the upper border of the upper end vertebra and the line drawn at the lower border of the lower most vertebra.
Sometimes there are multiple primary curves.

**Risser's sign** : to assess skeletal maturity: from zero to 5 grades
This is important because the curve often progresses most during the period of rapid skeletal growth and maturation.

The iliac apophyses start ossifying shortly after puberty, ossification extends medially and, once the iliac crests are completely ossified, further progression of the scoliosis is minimal.

**CT and MRI** : may be necessary to show vertebral abnormality or cord compression.
**Note** : be careful of hazards of radiation, don't order unnecessary CT scan or unnecessary x-ray repetition especially in children.
**Pulmonary function test** : especially in cases of severe thoracic curves.
Patients with muscular dystrophies or connective tissue disorders needs full **biochemical** and **neuromuscular** investigation of the underlying condition.
**Prognosis**: generally the younger the child and the higher the curve the worse the prognosis. ScoliScore™ is a DNA test that can indicate the likelihood of progression into a severe curve for children diagnosed with idiopathic scoliosis (saliva test): the patient's saliva is used.

**Idiopathic scoliosis**: This group forms about 80% of all cases of scoliosis. It is often familial. The age at onset has been used to define three groups:

1. **Infantile idiopathic scoliosis**: occurs in children aged 3 years or under.
   - Most curves are thoracic with convexity to the left (left thoracic). Although 90% of infantile curves resolve spontaneously, progressive curves can become very severe, especially those that have rib-vertebra angle difference at the apex of the curve RVAD > 20 degrees.
   - There is high incidence of cardiopulmonary dysfunction.
   - It is rare and boys are mainly affected.

Curves that are progressive should be treated by applying serial Elongation - Derotation - Flexion (EDF) plaster casts under general anesthesia until the deformity resolves or until the child is big enough to use brace. If the deformity continues to deteriorate, surgical correction may be required. Surgery includes: anterior disc excision and fusion to control the apex of the curve, combined with posterior fusion to prevent posterior overgrowth.
2- **Juvenile idiopathic scoliosis**: occurs at age of **4 to 9 years**
-it is uncommon, its features are similar to those of adolescent group, but the prognosis is worse and surgical correction may be necessary before puberty, however, sometimes the brace can hold the curve until the age of 10 years when fusion may be indicated.

3- **Adolescent idiopathic scoliosis** (AIS) it occurs at age of **10 years or over**
- it is the commonest type of idiopathic scoliosis consists 90% of cases
- it occurs mostly in **girls**
- Primary thoracic curves are usually convex to the right. (right thoracic)
- Primary lumbar curves are usually to the left (left lumbar)
- Thoracolumbar curves and double primary curves also occur
Not all curves will progress, most curves less than 20 degrees resolve spontaneously.

However, once a curve starts to progress, it usually goes on doing so throughout the remaining growth period (and to a much lesser degree beyond that).

Predictors of progression are:
1. Very young age
2. Marked curvature
3. Incomplete Risser's sign at presentation and girls who still not stating menstrual cycle.

Treatment of AIS:
The aims of the treatment are:
1. Prevent a mild deformity from becoming severe
2. To correct an existing deformity that is unacceptable to the patient

Non-operative treatment: indicated if ALL of the followings are there:
- if the patient is near skeletal maturity
- if the deformity is acceptable (Cobb's angle less than 30 degrees and well balanced)
- if the sequential x-ray shows NO definite rapid progression

Conservative treatment consists of **Exercises** and **Bracing**

**Exercises**: have no effect on the curve but they do maintain the muscle tone

**Bracing**: used for curves between 20 and 30 degrees
They should be worn 23 hours out of 24
The child can do daily activities including sports while wearing brace
These braces will **NOT** improve the curve but it may just stop its progression.

Types of braces:
**Milwaukee brace**: thoracic support
**Boston brace**: lumbar or thoracolumbar support
Surgical treatment:

**Indications:**
1. For curves larger than 30 degrees that are cosmetically unacceptable, especially in pre-pubertal children who are liable to develop severe progression during growth spurt.
2. For milder deformity that has rapid progression.

**Note:** balanced double primary curves require operation only if they are larger than 40 degrees and progressing.

**Aims of surgery are:**
1. To stop progression of the deformity.
2. To straighten the curve (including the rotational component) by some form of instrumentation.
3. To arthrodese the entire primary curve by bone grafting.
The surgery can be done by anterior, posterior or combined approach using different instrumentation systems.

**Complications of surgery:**
1. Neurological compromise
2. Spinal decompensation: overcorrection may produce an unbalanced spine
3. Pseudarthrosis
4. Implant failure
Congenital scoliosis: (osteopathic)
Can be caused by:
1- Failure of formation: hemivertebra, wedge vertebra
2- Failure of segmentation: fused vertebrae

Congenital scoliosis may be associated with other congenital malformations like spina bifida, heart or kidney anomalies and diastematomyelia.
Treatment for progressing curves is usually surgery, no response to bracing
3- Both types
Neuropathic and Myopathic scoliosis:
Neuromuscular conditions associated with scoliosis includes:
- Poliomyelitis
- Cerebral palsy
- Syringomyelia
- Friedreich's ataxia

The curve may take some years to develop.
The typical paralytic curve is long, convex towards the side with weak muscles and at first is mobile.
Mild curves need no treatment, severe curves that associated with pelvic obliquity and loss of sitting balance can often be managed by sitting support if no benefit then surgical stabilization is done.

Scoliosis and Neurofibromatosis:
About one-third of patients with neurofibromatosis develop spinal deformity.
Typically scoliosis is associated with skin lesions and the curve is sharp and short.

Kyphosis:
Excessive thoracic curvature may be better described as hyperkyphosis.
Kyphosis can be:
1- Postural: associated with flat feet, or can be secondary to other deformities
2- Structural kyphosis: is fixed and associated with changes in the shape of the vertebrae

Structural kyphosis can be caused by:
- Congenital vertebral defects: failure of formation or failure of segmentation or both
- Skeletal dysplasia such as achondroplasia
- Osteogenesis imperfecta
- T.B of the spine
- Scheuermann's disease in adolescents
- Trauma in adults
- Osteoporosis and compression vertebral fractures in elderly

Adolescent kyphosis: Scheuermann's disease
Scheuermann described this disease in 1920. The characteristic feature was a fixed round back deformity associated with **wedging** of several **thoracic** vertebrae in adolescents. It starts at puberty and affects **boys** more than girls. The patient may complain of **back pain**. This deformity sometimes increases after the end of the growth and becomes severe.

**X-Ray**: Lateral view will show **irregular** and **fragmented** vertebral endplates usually **T 6 - T10**. The changes are more marked anteriorly. Wedging of more than **5** degrees in **three** adjacent vertebrae and an overall kyphosis angle of more than **40** degrees are abnormal.

**Treatment**: Curves less than 40 degrees only exercises and postural training. More severe curves may respond to brace treatment. Young adult with a rigid curve more than 60 degrees may need operative correction and fusion with fixation.
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