Clinical Approach

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Low Back Pain in Children and Adolescents: an Algorithmic Clinical Approach

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Abstract

Low back pain (LBP) is common among children and adolescents. In younger children particularly those under 3, LBP should be considered as an alarming sign for more serious underlying pathologies. However, similar to adults, non specific low back pain is the most common type of LBP among children and adolescents. In this article, a clinical algorithmic approach to LBP in children and adolescents is presented.

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Introduction

Low back pain (LBP) is a relatively common complaint among children and adolescents [1,2]. A linear increase of LBP prevalence has been reported by age from 4 to 65 years[3] The one year prevalence rate of low back pain in children has been reported from 7% to 58%[2]. It has been reported that the life time prevalence of LBP by age 20 is up to 80 percent[1]. The study performed in Iran[4] showed that the point prevalence of LBP in children 11 to 14 years old is 15% with an annual prevalence of 17.4%.

Spending long time for watching television, psychosocial difficulties, sports participations, obesity, positive family history of LBP and sedentary life have been reported as possible risk factors for LBP among children [5-7]. Incidence of low back pain in those with positive family history of LBP is almost two times more than those without positive history of back pain [3]. More importantly, it has been reported that those with LBP in childhood are at higher risk of LBP in adulthood [8]. As standard diagnosis and management protocols for children with LBP have not still been well defined, the aim of current review is to debate on finding appropriate approach to children with the chief complaint of LBP.

Definition of Low Back Pain in Children

Self limiting non-specific LBP has been found as the most common type of LBP in children [6,9],

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Box 1. Etiologies of low back pain in children and adolescents

I. More Common Musculoskeletal and mechanical etiologies

A) Nonspecific low back pain

- Muscular strain

B) Special diagnosis

- Spondylolysis/ spondylolisthesis
- Malalignment
  - ✓ Scheuermann disease
  - ✓ Scoliosis
- Intervertebral disk herniation

II. Other etiologies

A) Vertebral column fractures

B) Infectious diseases

C) Inflammatory

- Ankylosing spondylitis
- Juvenile idiopathic arthritis
- Arthritis

D) Neoplastic disorders

- Spinal column
  - ✓ Primary neoplasms
  - ✓ Secondary neoplasms
- Spinal cord
  - ✓ Intramedullary
  - ✓ Extradural tumors
  - ✓ Intradural-extramedullary

E) Congenital and heamatologic diseases

although different diseases such as infection, neoplasm and malignancy might be the cause of LBP in children. Different categories have been reported as possible etiologies of LBP in children [10] (Box 1).

Clinical Approach

We recommend the general practitioners and pediatricians to approach children and adolescents with low back pain on the base of clinical algorithm which is shown in Fig. 1.

History Taking and Physical Examination

Similar to approach to other medical complaints, a complete and accurate history and physical examination play important role in proper diagnosis and well management of LBP in children. The physician should ask the patients regarding the onset of symptoms, description of the pain characteristics including location, duration, presence or lack of radiation and also exacerbating and alleviating factors. To differentiate between mechanical and inflammatory types of pain, the physician should ask the patients whether they have morning stiffness or reduction of pain after activity. Inflammatory type of pain normally increases after prolonged rest and reduces by physical activity. Therefore, increase of pain intensity after walking for a long period of time more implies on mechanical pain. In the history taking the physicians should also think on some familial conditions and ask for family history of neurological and rheumatologic diseases as well as congenital abnormalities.

The intensity of pain in the first and follow-up visits should be recorded. This can be used to evaluate the effectiveness of the prescribed treatments. Recently some new standard scales for assessment of pain intensity in children with acceptable validity and reliability have been developed [11,12]. However, Visual Analogue Scale (VAS) seems to be still the most practical scale for measurement and follow-up of the intensity of pain in children. On this basis, the children should

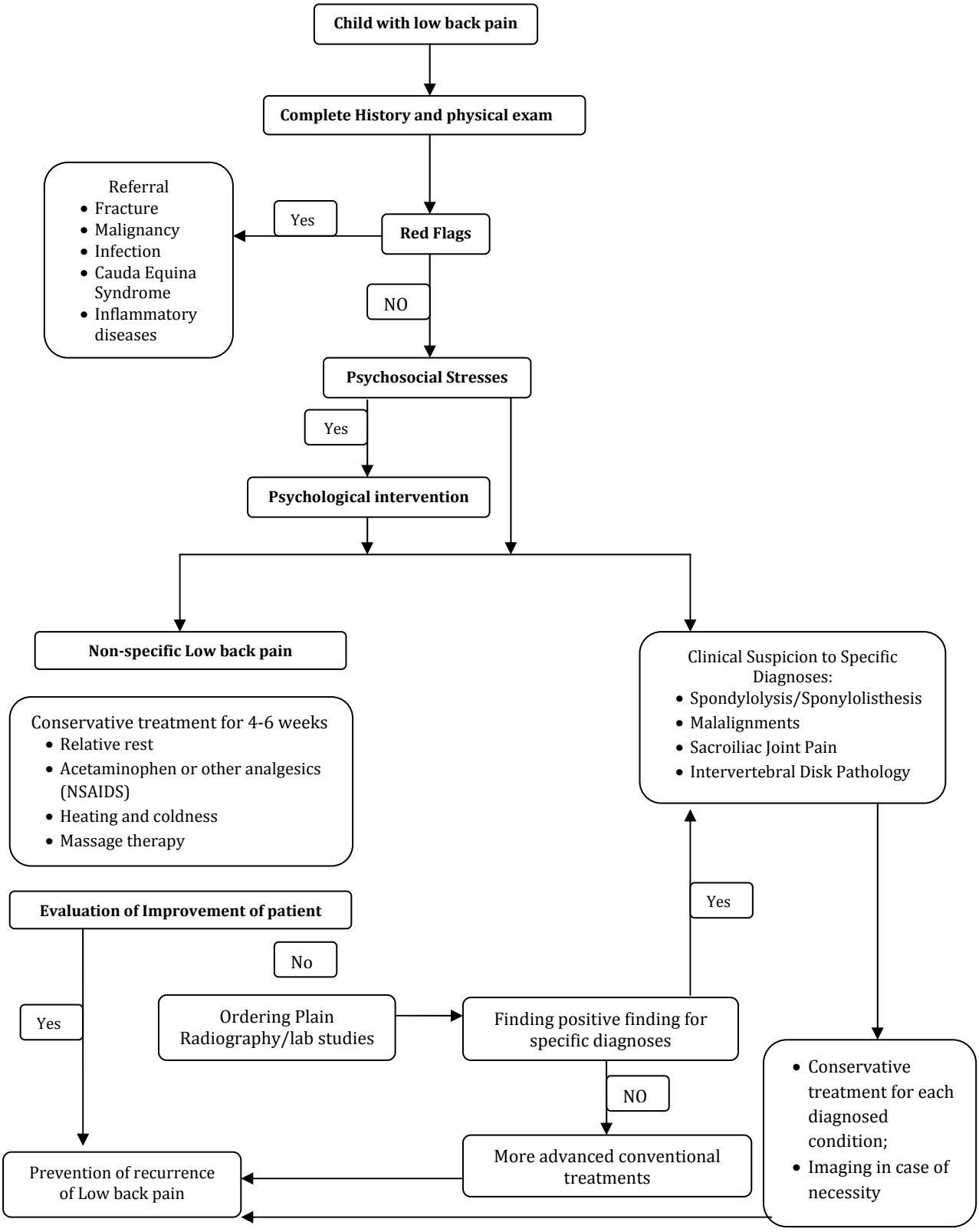

Fig. 1: The algorithmic approach to low back pain in children

choose how much pain they have signifying a point on a 100 mm solid horizontal line which is confined by two smaller vertical lines. The left line indicates no pain; while the right line points out the most intense pain the patient can imagine. The pediatricians can use this scale to document the intensity of low back pain in children particularly in follow-up sessions.

FACES Pain Rating Scale [11,12] which works on base of the facial expressions and has been quantified in recent studies can also be used by the pediatricians to measure the intensity of the pain in children.

FLACC (Facial expression, Leg movement, Activity, Cry, Consolability) is another pain scale which should be filled out by the nurses according to behaviors of the children. The scale has been validated for children under 7 years and older than 2 months [12]. The level of functional disability of the children should also be recorded by the physicians.

Although it is preferable to perform a complete neurological exam in all the children with LBP, necessarily deep tendon reflex (L2, 3, 4 and S1), strength and sensation in lower extremities should be examined in all children with LBP to reveal any possible underlying intraspinal pathologies in these patients. The physicians should also examine the core stability of the children, as in case of any weaknesses and lack of coordination in paraspinal and lateral abdominal muscles; the therapeutic plan for these patients should be performed on base of core stability exercises. Also, the major clinical examination that should be performed in the children with LBP, are shown in Fig. 2 and described in Table 1.

Lumbar lateral rotation, flexion and extension should also be examined to find any movement limitations and to evaluate the effect of these movements on patient's pain [13]. As the next step the clinicians should examine the points of maximal tenderness of the patients particularly

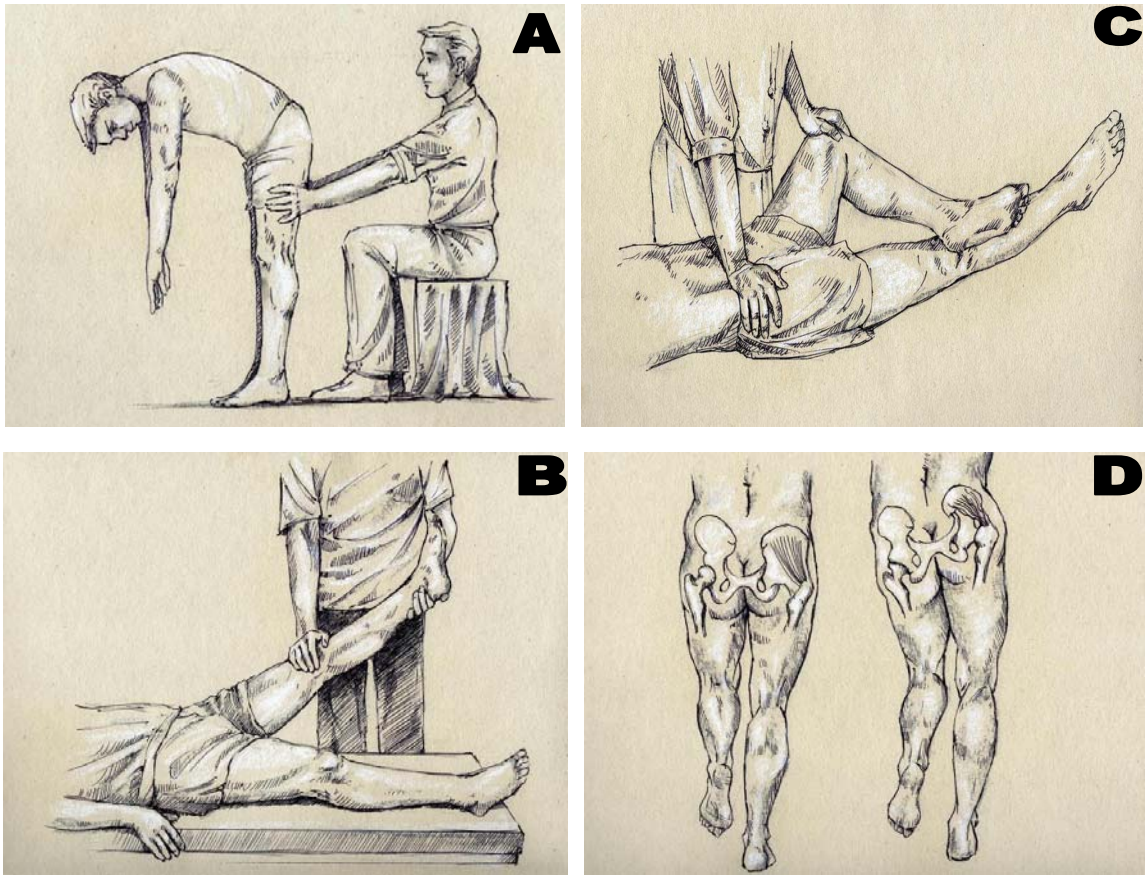

Fig. 2: Clinical tests should be performed on the children with low back pain. A) Adams Forward Bending Test. B) Straight Leg Raise C) FABER Test D) Trendelenburg

Table 1: Clinical tests that should be performed in children with the complaint of low back pain

Clinical Tests	Description
Adams forward bending test	While the feet are together and knees are straight, the child should bend forward; the test is positive if any asymmetry in rib cage or curvature of spinal column were observed.
Straight Leg Raise (SLR) or Lasegue test	In supine position, patient's leg should be raised while the knees are straight. The test is positive if pain was felt by the patient in range of 30 to 70 degree of hip flexion
Patrick or FABER test (Flexion Abduction External Rotation)	In supine lying position, while the knee is 90 degree flexed and hip is abducted and externally rotated, the pelvis should be fixed by one hand and the flexed knee should be pushed toward in a way to externally rotate the leg on hip joint. The test is positive when the pain was felt in buttock, groin or sacroiliac joint.
Trendelenburg	While the patient has been asked to stand on one leg, the position of the pelvis should be checked. The test is positive when the pelvis of the other side drops

the points that are close to important bony, muscular or ligamentous structures such as spinous process of vertebras, anterior superior iliac spines and gluteal muscles. This may reveal the origin of pain and help with diagnosis of the etiology of the pain. Besides, it might lead to finding trigger and tender points particularly in the back muscles of the children. Acupuncture or dry needling of these points might be used to reduce the pain in these children.

Red Flags

Self limiting musculoskeletal pain is the most common etiology of LBP in children and adolescents. However LBP in children under 10 years old and particularly in those younger than 4, should be considered as a red flag for more serious underlying pathologies[14]. In this regard, clinicians should draw more attention to any possible fracture, malignancy, infectious diseases and cauda equina syndrome in children with LBP. The clinicians should be more suspicious to underlying infectious conditions, malignancy and spinal fracture, if patients had any systematic sign including, fatigue, weight loss, loss of appetite or local tenderness on the spinal column. The physicians should also request more investigations in children with LBP at rest or pain that causes night awakening. As risk of malignancy in patients with this kind of pain is higher than in those whose pain is only present with activities[6]. Presence of neurological symptoms including radiculopathy and dysfunction of bladder should also be investigated by the physicians to rule out intervertebral disk herniation and cauda equina syndrome. Based on a complete history taking and physical examination, signs related to red flags of LBP in children would be revealed. Referral of these patients to the related specialists would be required in case of being suspicious to any of the mentioned red flags in children (summary of red flags are shown in Box 2).

Psychosocial issues (yellow flags)

As it has been reported that any history of LBP, smoking or recent psychosocial stress in the family might affect the incidence of LBP in children[15]. Also the children should be asked regarding any probable problems in school with other children or teachers. Family supports and responses to children's pain should also be evaluated. Jackson et al[15] recommended some questions to evaluate the children's response to LBP including "If you had to assign a color to this pain, what would it be? If you had to picture your pain as an animal, what would it be? Why? What do you do to help the pain? What can we do to help your pain?"

In case of finding any positive psychosocial history, proper intervention should be done. Counseling with pediatric psychiatrist might be necessary. However it should be considered by the

Box 2: Red Flags for Low Back Pain	
History	• Malignancy • Unexplained weight loss/ loss of appetite • Recent fever and chills • Recent infection • Immunosuppression • Pain at rest or during the night • Trauma • Recent onset of bladder dysfunction • Morning stiffness
Examination	• Serious or progressive neurologic deficit in the lower extremity • Loss of "saddle" or leg sensation • Anal sphincter weakness • Fever

physicians that according to the algorithm, even in case of finding any positive psychological finding, complete work-up of the patient to find the possible organic etiology should be performed. In other words, improvement of psychosocial condition of the patients should be considered as a supportive and alternative treatment in approach to LBP in children and should not be taken into account as the only therapeutic intervention for the children with LBP.

Specific Diagnoses

Spondylolysis and Spondylolisthesis

Spondylolysis is defined as fracture of pars intercularis of vertebras that mostly occurs in fourth or fifth vertebra.

Spondylolysis is common among adolescents who actively participate in sport activities particularly those who practice repetitive hyperextension and flexion movements such as tennis players and gymnasts[16]. This point shows the importance of asking the children with LBP regarding their sports activities as a part of history taking. In addition, an association between spina bifida and spondylolysis has been reported by some authors[17]; therefore, more attention to probable spondylolysis in children who are known cases of spina bifida can be expected.

Spondylolisthesis is the condition defined by forward slipping of one vertebra on another. The grading of this condition is on base of percentage of movement of the vertebras[18]; where grade one implies on 0-25% forward slipping of the vertebra, grade 2 is defined by 25-50% slippage and grade 3 and 4 defines as 50-75% and more than 75% forward slipping of the vertebra on the underlying vertebra respectively. Spondyloptosis (grade 5 of spondylolisthesis) is defined by complete slippage of the given vertebra over the vertebra below it[10].

Irritation of nerve roots (more often in grade 3 and 4 of spondylolisthesis), hyperlordosis of lumbar spine and spasm of paraspinal muscles along with exacerbation of pain in hyperextension states (particularly in those with history of sports activities) should make the physicians suspicious to diagnosis of spondylolysis and spondylolisthesis.

X-ray radiography in oblique view is helpful in confirming the clinical diagnosis of patients with spondylolysis. Defect in the neck of “Scotty dog” sign (pars intercularis) is the typical radiographic sign that might be seen in oblique view of plain radiographs of patients with spondylolysis. Although CT scan is still the golden imaging method in diagnosis of spondylolysis, MRI is more widely used for diagnosis of spondylolysis in children and adolescents[10]. This might be due to avoiding overexposure of the children to x-ray [14]. CT scan can be used in follow-up of the patients 4 months after the treatment to look whether the healing of pars intercularis has occurred[10]. (Fig 3)

Ordering antroposterior and lateral plain radiography is the initial imaging study for diagnosis of spondylolisthesis. In case of typical

Fig. 3: The fracture in pars intercularis of vertebra (spondylolysis) is shown in the figure

signs in patients with positive history of repetitive extension and flexion sports activities, start of conservative treatment without any more advanced imaging studies seems to be acceptable.

The conservative treatment program includes increase of hamstring muscle flexibility and core muscles stability of patients. Indeed, the patients should be asked to restrict their activities to alleviate the intensity of their pain. In high grade spondylolisthesis (which includes a very low number of patients), surgery is the final therapeutic plan. In patients with spondylolisthesis who have immature skeletal spinal column, follow-up of the patients with lateral plain radiography every 6 months is recommended by some authors [9].

Misalignments

Patients should be observed well to find any possible malalignment in standing, walking or bending positions. Foot and knee should be observed to detect any malalignment such as foot hyperpronation. It is also recommended to observe the patients from the side, to carefully look at the contours of the spine, as any abnormality in cervical and lumbar lordotic and thoracic kyphotic curves might be the etiology of LBP in both children and adults [14]. Any exaggeration in lumbar lordosis due to weakness of abdominal muscles or shortness of hip flexor muscles might lead to LBP in children; in such cases, reinforcement of abdominal muscles with specific exercises might decrease the intensity of pain in children. Shortness of hamstring muscles and any differences between the lengths of lower limbs also need to be examined.

Clinicians should also consider Scheuermann's kyphosis with an incidence rate of 1 to 8 percent [19] as a differential diagnosis of LBP in children. Physical examination of these children reveals a hyperkyphosis of thoracic spine. For diagnosis, the clinicians should ask the patients to bend forward and then look at the spine. Despite of hyperkyphosis of thoracic spine in "postural round back" in which kyphosis will disappear in forward flexion, in Scheuermann's kyphosis, the khyphosis of thoracolumbar vertebras will remain [9].

According to the report by Weinstein et al [20], scoliosis is also relatively common in children with an incidence rate of 1 to 3 percents. Although measurement of Cobb angle is a more accurate method in diagnosis of scoliosis (angle >10 degrees while the radiography is provided in standing position), Adams forward Bend Test (Table 1) is more practical and also helpful in diagnosing scoliosis. Similar to Scheuremann's disease, patients with scoliosis are mostly asymptomatic[21] and only those with symptomatic

malaligments would be treated. Bracing for mild to moderate thoracic Scheuremann might be recommended. Extensor exercises and strengthening of paraspinal muscles can decrease the intensity of pain in some patients. Surgery particularly in case of neurologic deficits can be suggested.

Sacroiliac joint pain

In addition to mechanical etiologies, inflammatory and infectious etiologies of sacroiliac pain should also be considered by physicians in approaching patients with sacroiliac pain. A positive FABERE test (Table 1) with tenderness on buttock of the children which exacerbates with extension, are the typical symptoms of mechanical etiology in sacroiliac region. Trendelenburg test (Table 1) also might be positive in this condition. Strengthening of gluteal and hamstring muscles along with conventional treatment with NSAIDs might be helpful in management of these patients.

Intervertebral disk pathology

Kumar et al [22] reported disk herniation prevalence of 3.5% in children and adolescents with LBP. However a relatively even higher incidence rate has been suggested for protrusion of disk [23]. Pain in buttock with worsening in forward flexion and rotation of hip and increasing abdominal pressure, are the most common symptoms of disk herniation in children and adolescents. On physical examination, positive single leg raise test (Table 1) can be found most of the time. To confirm the diagnosis of the pathology, MRI from lumbar vertebras might be indicated [10]. Conservative treatments including relative rest, drug therapy and Mackenzie exercises should be suggested to the patients and their response to the treatment should be monitored. Surgery and laminectomy should be offered to those patients with progressive neurological deficit and those with severe pain who do not respond to conservative treatments[24].

Juvenile primary fibromyalgia

Juvenile primary fibromyalgia (JPF) as a chronic soft tissue pain disorder which is characterized by chronic widespread pain and the presence of tender points should also be considered as a potential differential diagnosis of LBP in children and adolescents [25]. According to published studies, the prevalence of this disorder is between 1 and 2 percent in children and adolescents [26,27]. According to these epidemiologic studies, girls are more likely to develop fibromyalgia than boys [25]. The Yanus criteria for diagnosis of JPF differ from the one used for diagnosis of fibromyalgia in adults. As major differences, in Yanus criteria, only 5 tender points are required while according to American college of rheumatology criteria for fibromyalgia in adults, 11 tender points in 18 potential sites are required [28]. Therefore it can be suggested that in approach to children with LBP, particularly in girls with widespread musculo-skeletal pain, diagnosis of JPF according to Yanus criteria should be considered.

Nonspecific Low back Pain

When no specific problem or underlying disease can be found as to the cause of the back pain in patients, their LBP is defined as non-specific. The cause of pain in non-specific LBP cases might be sprain of ligaments or muscles, or other causes such as minor problems with intervertebral discs or facet joints. However, it is not possible to identify the exact source of the pain in these patients. In acute non-specific LBP, conservative treatment of the patients for 4-6 weeks and observation of their response to the treatment should be tried. In this regard, using acetaminophen, NSAIDs, relative rest, coldness, heating and massage therapy can be used to decrease the intensity of pain in patients. The follow-up of the patients should be planned from the first visit to evaluate the trend of pain and functional status of the patients in the course of treatment. In clinical approach to non-specific LBP in children, the clinicians should consider that it is preferred to involve parents in the treatment of the patients. In addition, appropriate care might also speed up the pain relief through decrease of fear or anxiety. In adults with non-specific LBP it has been shown that extended bed rest (i.e. more than 2-3 days) and use of opiates could lead to more pain and disability in patient in the future [29,30]. This needs to be considered in older children as well.

Imaging and Laboratory Studies in Case of Necessity

In case of no improvement in clinical symptoms of the patients with non-specific LBP after 6 weeks, plain radiography and laboratory tests should be ordered by the physician to search for any specific pathology in vertebral column of the patients. Over imaging with limited outcome in management of LBP in children has been reported in previous studies [31,32]. Therefore in children with suspected non-specific LBP, it is preferred to only order plain radiographs after 6-week follow-up[6,33]. It should be noted that as it was listed before, in case of being suspicious to specific diagnosis proper imaging according to the most probable diagnoses can be ordered.

With regard to laboratory tests, complete blood count (CBC), erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) are the preliminary laboratory tests to be requested [33]. Although rheumatologic diseases would be mostly clinically diagnosed, anti nucleotide antibody, rheumatoid factor and HLA-B27 might be useful in follow up or finding proper therapeutic plan. Iran as a Mediterranean and Middle East country is known as an endemic region for brucellosis. After two control programs in Iran, the prevalence of this leading zoonotic infection reached 1.3% in animals which is still considerably high [34,35]. Therefore it seems rational to investigate brucellosis in children particularly when related symptoms were found in the history or physical examination of the patients [36,37].

More Advanced Interventions

In case of finding any specific pathology in plain radiograph or laboratory studies, proper treatments for the mentioned pathology should be offered. If no positive findings were achieved in imaging and laboratory tests, more advanced therapeutic programs should be used to control the symptoms of the patients with non-specific LBP.

Posture correction and core strengthening exercises should be a part of therapeutic plan for treatment of children whose back pain is due to mechanical stresses such as bad posture and inactivity or not appropriate rehabilitation after traumatic injuries. In this regard, strengthening of abdominal and back muscles has been recently more highlighted in treatment of patients with LBP [38-40]. Spinal decompression and rebalancing the muscles to re-stabilize the back muscles along with finger pressure to adjusted connective tissues of the spine have also been recommended for treatment of LBP due to instability of spine [41].

Flexibility of hamstring and hip abductor and flexor muscles should also be checked and be treated if there is any shortness or tightness [42]. Some investigators showed the efficiency of yoga as a core conditioning task in treatment of chronic non-specific LBP through improving the back and abdominal muscle functions [43,44]. Acceptability of yoga by children and positive outcomes of this regimen on both physical and psychosocial aspects of patients with back pain have been reported before [45-50].

For management of LBP as in other types of pain syndromes, acupuncture and massage therapy can be used[51]. The effectiveness of these treatments and acceptability of these treatments by children have also been shown in previous studies [52-55]. Multidisciplinary approach to treatment of chronic low back including biopsychosocial rehabilitation with functional restoration has been effective in adults and might be employed in children with persistence LBP [56]. In this approach physical, psychological, and social or occupational factors are addressed by a multidisciplinary team.

Preventive Advices

After finishing the therapeutic procedures recurrence of LBP should be prevented in the children. Lack of good scientific evidence in prevention of LBP in children is a limitation in this area. There are controversial data regarding the role of education and back schools in prevention of LBP in children, however, appropriate biopsychosocial education should be considered [4,14]. Poor life style habits and prolonged static sitting in bad posture might lead to LBP in children [4]. Education programs might be effective in improving posture of the children. However it is not clear whether this has an effect on back pain of the children in their later life. Physical activity and specific exercises also might be recommended

both for their effects on physical and physiological health of children and their local effects on strength and coordination of back muscles. Smoking and obesity have been shown as risk factors of LBP among adults and children[57-59]. Therefore weight loss of the overweight children who have the history of LBP and decreasing of patients' exposure to smoke should be considered as one of the major advices to prevent recurrence of back pain in children and adolescents. The children should be advised to avoid carrying heavy backpacks (not heavier than 15 percent of their weight). The straps of the bags should also be wide.

Conclusion

In children younger than 7 years and particularly in those younger than 3, as a rule, back pain should be alarming for a hidden underlying pathology until proven otherwise. Commonly LBP in children is non-specific and will be managed by simple conservative treatments in short term. However in some groups especially those involved in sport activities other reasons such as Spondylolysis and Spondylolisthesis need to be considered. The role of psychosocial factors in treatment of the children with back pain should never be forgotten particularly in teens with positive family history of anxiety.

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CME Questions

1. What is the most common etiology of low back pain in children
   A) spondylolysis B) spondylolisthesis
   C) Disk herniation D) Non-specific LBP

2. In children with non-specific back pain, which imaging study is preferable?
   A) Oblique Plain radiography B) CT-Scan
   C) MRI D) No imaging is required

3. To diagnose primary Juvenile fibromyalgia in adults, how many tender points are required?
   A) 18 points B) 11 points
   C) 8 points D) 5 points

4. Which one is not a red flag in approach to LBP in children?
   A) History of recent Fever B) Morning Stiffness
   C) Trauma D) Pattern of mechanical pain

5. Which clinical test is not necessary in approach to patients with back pain?
   A) Trendelenburg test B) FABER test
   C) Straight Leg Raise (SLR) test D) Schober's test

You can find correct answer in page