Lesson 249: PreAnesthetic Assessment of the Patient With Ehlers-Danlos Syndrome

PREANESTHETIC ASSESSMENT

Dr. Elizabeth A.M. Frost, who is the editor of this continuing medical education series, is Clinical Professor of Anesthesiology at Mount Sinai School of Medicine in New York, NY. She is the author of Clinical Anesthesia in Neurosurgery (Butterworth-Heinemann, Boston) and numerous articles. Dr. Frost is also past president of the Anesthesia History Association and former editor of the journal of the New York State Society of Anesthesiologists, Sphere. She is also editor of the book series based on this CME program, PreAnesthetic Assessment, Volumes 1 through 3 (McKhauer, Boston) and 4 through 6 (McMahon Publishing, New York City).

LEARNING OBJECTIVES

At the end of this activity, the participant should be able to:
1. Summarize the special anesthetic problems presented by a patient with EDS.
2. Describe the systemic changes and symptoms associated with EDS.
3. Apply the appropriate preoperative testing and evaluation of a patient with EDS.
4. Outline the genetic factors associated with EDS.
5. Construct a differential diagnosis.
6. Present an anesthetic and analgesic plan for managing the patient with EDS.
7. List the complications of EDS.
8. Cite the incidence of EDS.
9. Stratify patients with EDS into appropriate subtypes.
10. Identify appropriate medical consultants in the perioperative management of patients with EDS.

CASE HISTORY

A 37-year-old African-American woman known to have vascular-type Ehlers-Danlos syndrome was seen in consultation because of a large inguinal hernia that had resulted in several episodes of incarceration and 6 months in the hospital, she had been discharged with a permanent colostomy. At the time of the consultation, her vital signs and laboratory findings were essentially normal. Her medications included clonidine, 0.2 mg bid; docusate sodium, 100 mg qd; a natural vegetable laxative, and multivitamins.

The patient mentioned that she was very resistant to undergoing surgery because she had experienced a difficult intravenous access and on one occasion had sustained a pharyngeal tear during endotracheal intubation.

The anesthesiologist must be extremely careful when treating the patient with EDS because of the continual risk for causing preventable injuries. Tasks that are common yet necessary (e.g., cannulation of veins, insertion of endotracheal tubes, and intramuscular injections) become interventions with exaggerated and significant risks.

Epidemiology

EDS is estimated to affect 1 in 5,000 people. A higher rate has been reported among the black population. The etiology of the disorder is polygenic; the most common types are autosomal-dominant, but an X-linked-recessive pattern and several autosomal-recessive patterns have also been identified. EDS was first described clinically in 1892 by Tschernogobow, a Russian dermatologist. Edward Ehlers, a Danish dermatologist, and Henri Danlos, a French dermatologist, further delineated the condition. The genetic heterogeneity of EDS was established in the 1960s, and the first molecular defects in collagen biosynthetic pathways were demonstrated in 1972.

Pathogenesis and Molecular Genetics

EDS, as a clinically and genetically heterogeneous group of conditions, was traditionally subdivided into 11 variants.
Lesson 249 continued from page 35

The most recent classification of EDS, the Villefranche nosology, was developed at a consensus conference in 1997. Currently, there are 6 recognized subtypes, which are classified according to clinical symptoms, patterns of inheritance, and underlying biochemical and molecular defects (Table 1). The classic types (EDS I, EDS II) and the hypermobile type (EDS III) occur in 90% of patients; the vascular type (EDS IV) occurs in 3% to 10%. The kyphoscoliosis, arthrochasia, and dermatosparaxis types are very rare. By comparing each subtype of the condition. Principal clinical features are present, to varying degrees, in each subtype of the condition. "Cigarette paper" scars are also a manifestation of tissue fragility.7-9 In areas of repetitive trauma, hemosiderin deposits heal slowly in these patients. Widened, atrophic scars form on the elbows, shins, forehead, and chin. Skin lacerations and incisions heal slowly in these patients. Widened, atrophic scarring, and joint hypermobility (Table 2). These features are secondary to the disruption of tissues rich in collagen, such as skin, ligaments, and joints.2 Easy bruising is typically the initial manifestation of EDS. Bleeding from the gums after the teeth have been brushed and excessive bleeding after minor trauma are common presentations. Vascular fragility may cause nonpalpable purpura. Hemostatic parameters, such as the platelet count, bleeding time, and coagulation status, are usually normal. However, the Rumpel-Leede (or Hess) test result may be positive, indicating capillary fragility. To conduct the Rumpel-Leede test, the physician inflates a blood pressure cuff on the upper arm to a pressure between the diastolic and systolic values. After pressure is maintained for 5 minutes and then released, the petechiae are counted; the presence of more than 10 spots is considered abnormal (i.e., a positive result). Skin hyperextensibility should be tested at a neutral site, such as the volar surface of the forearm, because it is less subject to mechanical forces or stretching. To determine the degree of hyperextensibility, the skin is pulled up until the clinician feels resistance. It may be difficult to assess hyperextensibility in the skin of young children because of large amounts of subcutaneous fat. In patients with EDS, tissue fragility results in splitting of the skin after relatively minor trauma. Areas of skin that are particularly at risk for splitting are those over the knees, elbows, shins, forehead, and chin. Skin lacerations and incisions heal slowly in these patients. Widened, atrophic scars ("cigarette paper" scars) are also a manifestation of tissue fragility. In areas of repetitive trauma, hemosiderin deposition may lead to a dark discoloration of the skin. Hypermobility, which often affects large and small joints, can be assessed by using the Brighton scale (Table 3). A score of 24/9 defines widespread joint hypermobility. The Brighton criteria can also be used to diagnose joint hypermobility syndrome (Table 4). Hypermobility can cause occasional or even frequent dislocations of joints—most commonly

Table 1. Classification of Ehlers-Danlos Syndrome

<table>
<thead>
<tr>
<th>Type</th>
<th>Affected Protein/Enzyme</th>
<th>Inheritance</th>
<th>Diagnostic Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classic (types I and II)</td>
<td>Type V procollagen</td>
<td>AD</td>
<td>Major: hyperextensible skin, widened atrophic scarring, joint hypermobility, Minor: easy bruising, smooth/velvety skin, molluscioid pseudotumors, subcutaneous spheroids, hypotonia, complications of joint hypermobility, surgical complications, positive family history</td>
</tr>
<tr>
<td>Hypermobility (type III)</td>
<td>Unknown</td>
<td>AD</td>
<td>Major: generalized joint hypermobility, mild skin involvement, Minor: recurring joint dislocations, chronic joint pain, positive family history</td>
</tr>
<tr>
<td>Vascular (type IV)</td>
<td>Type III procollagen</td>
<td>AD</td>
<td>Major: severe muscular hypotonia at birth, generalized joint laxity, kyphoscoliosis at birth, scleral fragility and rupture of the globe, Minor: tissue fragility, easy bruising, arterial rupture, marfanoid habitus, microcornea, osteopenia, positive family history</td>
</tr>
<tr>
<td>Kyphoscoliotic (type VI)</td>
<td>Lysyl hydroxylase-1</td>
<td>AR</td>
<td>Major: severe muscular hypotonia at birth, generalized joint laxity, kyphoscoliosis at birth, scleral fragility and rupture of the globe, Minor: tissue fragility, easy bruising, arterial rupture, marfanoid habitus, microcornea, osteopenia, positive family history</td>
</tr>
<tr>
<td>Arthrochasia (types V1A and V1B)</td>
<td>Type I procollagen</td>
<td>AD</td>
<td>Major: severe generalized joint hypermobility with recurrent subluxations, congenital bilateral hip dislocation, Minor: skin hyperextensibility, tissue fragility, easy bruising, muscular hypotonia, kyphoscoliosis, mild osteopenia, occasionally fractures</td>
</tr>
<tr>
<td>Dermatosparaxis (type V1C)</td>
<td>Procollagen N-proteinase</td>
<td>AR</td>
<td>Major: severe skin fragility; sagging, redundant skin; excessive bruising, Minor: soft, doughy skin texture; premature rupture of membranes; large hernias</td>
</tr>
</tbody>
</table>

AD, autosomal-dominant; AR, autosomal-recessive

Table 2. Principal Clinical Features of Ehlers-Danlos Syndrome

- Easy bruising
- Joint hypermobility
- Skin hyperextensibility
- General fragility of connective tissue
- Delayed wound healing and atrophic scarring

Specific mutations in genes that code for collagen, collagens-modifying enzymes, and tenascin have been described for most types of EDS. Collagens—structurally related, extracellular matrix proteins—are essential for development and organogenesis, cell attachment, and platelet aggregation; they also provide tensile strength to connective tissues in bone, skin, ligaments, and tendon. Collagen proteins are homo- or heterotrimeric molecules that share unique, triple-helical domains. The presence of glycine in every third position of each chain is necessary for the formation of a stable collagen helix. The fibrillar collagens, which include collagen types I, II, III, V, and XI, comprise the most widespread and abundant collagens such as skin, ligaments, and tendons. Collagen proteins are homo- or heterotrimeric molecules that share unique, triple-helical domains. The presence of glycine in every third position of each chain is necessary for the formation of a stable collagen helix. The fibrillar collagens, which include collagen types I, II, III, V, and XI, comprise the most widespread and abundant collagens such as skin, ligaments, and tendons. Collagen proteins are homo- or heterotrimeric molecules that share unique, triple-helical domains. The presence of glycine in every third position of each chain is necessary for the formation of a stable collagen helix. The fibrillar collagens, which include collagen types I, II, III, V, and XI, comprise the most widespread and abundant collagens such as skin, ligaments, and tendons. Collagen proteins are homo- or heterotrimeric molecules that share unique, triple-helical domains. The presence of glycine in every third position of each chain is necessary for the formation of a stable collagen helix. The fibrillar collagens, which include collagen types I, II, III, V, and XI, comprise the most widespread and abundant collagens such as skin, ligaments, and tendons.

Precursor molecules, known as procollagens, initiate the biosynthesis of collagen within the fibroblast. Precollagens align and bond from the C-terminus to the N-terminus of the molecule, and through a series of enzymatic modifications, the triple helix is formed. Individual collagen molecules then spontaneously assemble into fibrils that are stabilized by covalent cross-linkage. A disturbance anywhere in this process can lead to connective tissue instability. Collagen types I, III, and V are involved in EDS. Type I collagen is the major type found in the body and has a wide distribution. A mutation that results in a structural abnormality of type I collagen causes the arthrochasia type of EDS, whereas a mutation that leads to the abnormal processing of colla- gen causes the kyphoscoliosis or dermatosparaxis type. In the kyphoscoliotic form, there is deficient activity of the colla- gen-modifying enzyme lysyl hydroxylase-1. In the dermato- sparaxis type, the mutation involves the enzyme procollagen N-proteinase. Type III collagen is an essential component of many connective tissues found in blood vessels, the gastrointestinal tract, uterus, and skin. A mutation in the gene for type III collagen, whether structural or haplo-insufficient, results in the vascular type of EDS. Type V collagen is coexpressed with type I in many connective tissues; a mutation in the gene for type V collagen causes half of EDS cases of the classic type. In rare instances, a mutation that causes the substitution of another amino acid for glycine in the procollagen chain of type I collagen has been identified as a cause of classic EDS.

Previously, EDS was considered solely as a disease of collagen. Recently, however, Zweers et al demonstrated that a deficiency of tenascin-X may also contribute to the pathogenesis of EDS. Tenascin-X, a large extracellular matrix protein that is developmentally associated with collagen fibrils, is thought to maintain homeostasis of the extracellular matrix. A deficiency of tenascin-X is associated with the fragmentation of elastic fibers, reduction of collagen, failure of fibroblasts to correctly deposit collagen type I, and loose packing of colla- gen fibrils. An autosomal-recessive type of EDS resulting from tenascin-X deficiency is associated with some cases of a dominantly inherited hypermobility type of EDS. Moreover, elastic fiber abnormalities in hypermobility-type EDS are specific for tenascin-X deficiency, haplo-insufficient individuals.

Clinical Features

A diagnosis of EDS is based primarily on clinical criteria. Clinical manifestations are present, to varying degrees, in each subtype of the condition. Principal clinical features include easy bruising and generalized connective tissue fragility, skin hyperextensibility, delayed wound healing with atrophic scarring, and joint hypermobility (Table 2). These features are secondary to the disruption of tissues rich in collagen, such as skin, ligaments, and joints. Easy bruising is typically the initial manifestation of EDS. Bleeding from the gums after the teeth have been brushed and excessive bleeding after minor trauma are common presentations. Vascular fragility may cause nonpalpable purpura. Hemostatic parameters, such as the platelet count, bleeding time, and coagulation status, are usually normal. However, the Rumpel-Leede (or Hess) test result may be positive, indicating capillary fragility. To conduct the Rumpel-Leede test, the physician inflates a blood pressure cuff on the upper arm to a pressure between the diastolic and systolic values. After pressure is maintained for 5 minutes and then released, the petechiae are counted; the presence of more than 10 spots is considered abnormal (i.e., a positive result). Skin hyperextensibility should be tested at a neutral site, such as the volar surface of the forearm, because it is less subject to mechanical forces or stretching. To determine the degree of hyperextensibility, the skin is pulled up until the clinician feels resistance. It may be difficult to assess hyperextensibility in the skin of young children because of large amounts of subcutaneous fat.

In patients with EDS, tissue fragility results in splitting of the skin after relatively minor trauma. Areas of skin that are particularly at risk for splitting are those over the knees, elbows, shins, forehead, and chin. Skin lacerations and incisions heal slowly in these patients. Widened, atrophic scars ("cigarette paper" scars) are also a manifestation of tissue fragility. In areas of repetitive trauma, hemosiderin deposition may lead to a dark discoloration of the skin. Hypermobility, which often affects large and small joints, can be assessed by using the Brighton scale (Table 3). A score of 24/9 defines widespread joint hypermobility. The Brighton criteria can also be used to diagnose joint hypermobility syndrome (Table 4). Hypermobility can cause occasional or even frequent dislocations of joints—most commonly
those of the shoulder, hip, and patella. Joint hypermobility causes chronic musculoskeletal pain with the possibility of premature degenerative joint disease.8

Cardiovascular involvement may be asymptomatic, or the manifestations may include arterial aneurysms, arterial rupture without aneurysm, varicose veins, arterial regurgitation, mitral valve prolapse, and conduction disturbances.9,10 Floppy mitral valve syndrome and the combination of mitral and tricuspid insufficiency as a result of redundant chordae tendineae or valve cusps have been reported.9,10 A particular succession of cardiovascular lesions is not apparent.9,10

Other manifestations that are common to all types of EDS are a result of collagen deficiency, including spontaneous pneumothorax, diverticula of the intestine or bladder, megasophagus, megatrachea, and megacolon. Diaphragmatic, umbilical, and inguinal hernias occur frequently.9,10

Some signs and symptoms are more characteristic of certain subtypes, depending on the specific deficiency present (Table 1). For example, in classic EDS (types I and II), the skin is described as very soft and “velvety.”9,10 Molluscoid pseudolipomas and subcutaneous spheroids are present. In addition, premature birth as the result of a premature rupture of membranes occurs more frequently in these patients than in the general population. In severe cases, rupture of the aorta and bowel may occur. In the hypermobility type of EDS (type III), joint hypermobility with recurrent dislocations is a more prominent feature than skin changes.4

The vascular type of EDS (type IV) is the most clinically significant because it presents with the most severe symptoms and is the only type associated with an increased risk for mortality. Whereas complications of the disorder are relatively rare in childhood, 25% of patients experience some type of complication by age 20, and more than 80% experience complications by age 40.11 Manifestations of the disorder that appear early in life include premature rupture of membranes in the mother, congenital clubfoot, and congenital hip dislocation. The median life span of these patients is 48 years.12

The vascular type of EDS results from mutations in the gene for type III collagen, which is abundant in the major blood vessels, skin, and hollow viscera. The diagnosis is based on the presence of 2 of the following: thin, translucent skin; arterial/intestinal/uterine rupture; easy bruising; and characteristic facial appearance.10 The typical features of joint hypermobility and skin hyperextensibility seen in most forms of EDS are relatively unusual in type IV. The connective tissue matrix of the major vessels and viscera is more likely to be affected; in fact, 70% of arterial collagen is type III collagen.13 Arterial rupture can take the form of tears, dissection, or fistula formation. The medium-sized arteries of the thorax and abdomen are usually sized arteries of the thorax and abdomen are usually

Table 3. Nine-Point Beighton Hypermobility Score9

<table>
<thead>
<tr>
<th>Ability</th>
<th>Left</th>
<th>Right</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passively dorsiflex fifth metacarpophalangeal joint to 90 degrees</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Place the thumb on the volar aspect of the ipsilateral forearm</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Hyperextend the elbow to 10 degrees</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Hyperextend the knee to 10 degrees</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Place hands flat on the floor without bending knees</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum possible score:</td>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>

One point may be gained for the ability to perform the first 4 maneuvers on each side, so that the maximum hypermobility score is 9, indicating positivity for all maneuvers. A score of 4/9 indicates widespread hypermobility.

In the arthrochalasis type of EDS (types VIIA and VIB), severe joint hypermobility and congenital bilateral hip dislocation are present.14 The skin is moderately hyperextensible, and there is usually mild to moderate bruising. This presentation is in sharp contrast to that of the dermatosparax- is type of EDS (type VIIC), in which severe bruising and extreme fragility and laxity of the skin are present during childhood. Other characteristic features include large fontanelles, short stature, a typical facies with epicanthic folds, downward-slanting palpebral fissures, puffy eyelids, blue sclerae, and micrognathia.6

Therapy

Although no causal therapy is available for EDS, a series of preventive guidelines based on common sense and clinical experience can be applied to all forms of the disorder. For example, patients with fragile skin should wear protective pads and bandages can help prevent bruises and bandages over the forehead, knees, and shins to minimize lacerations of the skin. Dermal wounds should be closed without tension, preferably in 2 layers. Subcutaneous stitches should be applied generously; cutaneous stitches should be left in place for twice as long as usual. The additional application of adhesive tape (paper) to adjacent skin can help prevent stretching and dehiscence of the scar. Currently, no cases have been reported of adverse outcomes resulting from removal of the tape.4

Protective pads and bandages can help prevent bruises and hemorrhages. Patients with pronounced bruising should avoid contact sports and heavy exercise. The administration of ascorbic acid—a cofactor for the cross-linking of collagen fibrils—as a dietary supplement may decrease the tendency

<table>
<thead>
<tr>
<th>Major criteria:</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Beighton score of 2/9 (either currently or historically)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arthralgia for &gt;3 months in 24 joints</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Minor criteria:

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Beighton score of 1/9 to 3/9 (0/9 to 3/9 if age ≥250 y)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Arthralgia in 1 to 3 joints, or back pain, or spondylitis, or spondylo-
|sis/spondylolisthesis | | |
| Dislocation in >1 joint, or in 1 joint on >1 occasion | | |
| At least 3 soft-tissue lesions (eg, epicondylitis, tendosynovitis, and bursitis) | | |
| Marfanoid habitus (tall, slim, arm span greater than height, arachnodactyly) | | |
| Skin striae, hyperextensibility, thin skin, or abnormal scarring | | |
| Eye signs: drooping eyelids, or myopia, or antimongoloid slant | | |
| Varicose veins, or hernia, or uterine/rectal prolapse | | |

One point may be gained for the ability to perform maneuvers 1 through 4 on each side, so that the maximum hypermobility score is 9, indicating positivity for all maneuvers. A score of 4/9 indicates widespread hypermobility.
Lesson 249 continued from page 37

for bruising. In addition, vasopressin (1-deamino-8-arginine vasopressin; DDAVP) has been found to normalize bleeding times in patients with chronic bruising and epistaxis. Its exact mechanism of action is presently unknown, although the release of von Willebrand factor has been implicated. The use of DDAVP in this subpopulation may therefore be beneficial to those with mitral valve prolapse and regurgitation require antibiotic prophylaxis against bacterial endocarditis. Because patients with EDS are prone to cardiac conduction abnormalities and aortic dilation and dissection, baseline echocardiography with measurement of the aortic diameter is recommended for those younger than 10 years. Follow-up studies to assess cardiac function can then be performed in those with abnormal findings.

Prophylactic measures are of special importance for patients with the vascular type of EDS. Drugs (including herbal medication) that interfere with platelet function should be avoided. Invasive vascular procedures, such as arteriography and catheterization, should be replaced by ultrasonography or subtraction angiography because of the risk for vascular rupture. Surgical interventions are generally discouraged. If such procedures are unavoidable, careful manipulation of vascular and the development of aortic insufficiency is imperative. Women with type IV EDS should be counseled about the increased risk for ureteric rupture, bleeding, and other complications of pregnancy.

To enable patients to cope with the limitations imposed by all types of EDS, emotional support and psychological therapy may be indicated. Approximately 36% of patients with EDS were found to have a decline in psychological wellbeing, compared with 14% of healthy controls. For this reason, support groups are available via the Internet (eg, www.ehlers-danlos.org) and can be beneficial to all those affected by the illness, including families.

Anesthetic Management

Because of the many clinical manifestations of EDS, patients with the condition must be given special consideration if any anesthesia is required during the perioperative period.

The patient’s EDS subtype should be determined preoperatively because each subtype presents different challenges. For example, patients with type III are prone to joint dislocations, whereas patients with type IV can have severe vascular complications. The blood of all patients should be typed, cross-matched, and evaluated for clotting abnormalities. Although most such abnormalities tend to be relatively mild, a detailed cardiac evaluation should be completed before any surgical procedure is undertaken. Particular attention must be paid to conduction abnormalities—most commonly atrial fibrillation secondary to mitral regurgitation and atrial enlargement—which should be continually assessed intraoperatively with electrocardiography. The administration of prophylactic antibiotics guards against subacute bacterial endocarditis if mitral valve disease is detected. In addition, the cervical spine should be evaluated for atlantoaxial instability as a result of laxity in the ligaments.

Many problems arise perioperatively because of tissue fragility and the propensity to hemorrhage and hematoma formation; therefore, the number of needle punctures should be minimized. According to the National Institute for Clinical Excellence (based in the United Kingdom), all central monitoring devices should be inserted under ultrasound guidance to safeguard against the rupture of an underlying aneurysm or dissection. In addition, such monitors should be used for the minimum amount of time necessary. Any anesthetic technique should avoid hypertension because arterial walls are already weakened.

Tissue fragility may also present problems during intubation. Any instrumentation of the nose, mouth, or oropharynx must be carefully performed with an awareness of the patient’s increased susceptibility to bleeding that may compromise the airway. A simple laryngoscopy can damage the gums, mucosa, and airway. An immediate assessment of the position of the tongue is required to ensure proper placement. The airway and teeth should be evaluated for any defects that may cause intubation difficulties or trauma. If the use of a mask is necessary, the pressure applied to it should be closely monitored to avoid excessive bruising on the face. The application of petroleum jelly may be considered for protection of the skin. Low airway pressures with assisted or controlled ventilation should be maintained because of a higher risk for pneumothorax.

Management of the Case

The risks and benefits of local, regional, and general anesthesia were discussed with the patient. A double-port 7F central line was placed without incident. The patient underwent an inguinal herniorrhaphy; a supraglottic ventilatory device was used, and midazolam, fentanyl, propofol, nitrous oxide, and sevoflurane were administered. Emphasis was placed on positioning, and foam used to support the patient’s entire body. The surgical procedure consisted of dissection and opening of the hernia sac at the neck and reduction of the small bowel. Surgical bleeding was minimal, and the patient received a total of 850 mL of crystalloid solution. She received a total of 9 mg of morphine sulfate in the recovery room. The patient recovered fully; early ambulation was encouraged, and she was discharged on the following day.

Conclusion

EDS is an inherited disorder that results in the formation of dysfunctional collagen bundles. These are most noticeable in tissues rich in collagen fibers—skin, vessels, ligaments, and the gastrointestinal system. Until advancements in gene therapy are forthcoming to correct the underlying genetic mutations, the mainstay of treatment is the prevention of traumatic injury. Successful anesthetic management requires an understanding of the role of collagen in various bodily tissues. Fragility of collagen-rich tissue, skin hyperextensibility, joint hypermobility, hematoma formation, and cardiovascular complications of pregnancy are just some of the clinical features that should be considered before any anesthetic procedures are undertaken in patients with EDS. Anesthesiologists should be keenly aware that any physical manipulation of such patients incurs risks for trauma.
January 2006 Anesthesiology News 39

Lesson 249: PreAnesthetic Assessment Of the Patient With Ehlers-Danlos Syndrome

Post-test

1. The pattern of inheritance for Ehlers-Danlos syndrome (EDS) is:
   a. autosomal-dominant
   b. autosomal-recessive
   c. X-linked
   d. all of the above

2. Genetic mutations that cause EDS do not involve the synthesis of:
   a. tenascin-X
   b. peptidoglycan
   c. collagen-modifying enzymes
   d. collagen

3. All of the following statements are true except:
   a. Currently, there is no cure for EDS.
   b. The treatment of EDS involves maximal attempts to prevent trauma.
   c. The treatment of EDS involves correcting the underlying disease process.
   d. Gene therapy may play a role in the advancement of treatment for patients with EDS.

4. The most recently accepted classification of EDS is:
   a. Villefranche nosology
   b. Stanford classification
   c. Brighton tables
   d. Brighton classification

5. The most common subtypes of EDS are:
   a. determined by ethnic background
   b. EDS I, II, and III
   c. age-dependent
   d. EDS IV, V, and VI

6. The EDS subtype that carries the greatest risk for mortality is:
   a. EDS II, because it is associated with marked weakness of blood vessels and a positive family history.
   b. EDS II, because it is associated with increased complications of cardiovascular valve disease.
   c. EDS IV, because it is associated with marked weakness of blood vessels and increased incidence of spontaneous rupture.
   d. EDS I, because it is associated with increased complications of joint dislocation.

7. Which of the following clinical manifestations is not seen in all subtypes of EDS?
   a. Soft, velvety skin
   b. Skin hyperextensibility
   c. Joint hypermobility
   d. Easy bruising

8. Which of the following preanesthetic assessments should be performed for patients with EDS?
   a. The EDS subtype should be determined so the patient can be evaluated for specific risk factors.
   b. The patient’s airway and teeth should be evaluated for any defects that might cause intubation difficulties or trauma.
   c. Evaluation for cardiovascular and arterial disease is necessary because many EDS patients have valvular anomalies that may require prophylactic antibiotics.
   d. All of the above are true.

9. Anesthetic considerations for patients with EDS include the following:
   a. an increased risk for hematomas formation and bleeding following intramuscular injections
   b. an increased risk for joint trauma during positioning of the patient
   c. an increased risk for esophageal and pharyngeal perforation during intubation
   d. all of the above

10. Which of the following statements regarding intubation of the patient with EDS is false?
    a. Fiber-optic visualization is the gold standard for intubation.
    b. Oral intubation is preferred to nasal intubation.
    c. Visualization of correct passage of the endotracheal tube, with or without the aid of fiber optics, is mandatory to protect the patient from pharyngeal perforation.
    d. Assessment of endotracheal tube placement should be performed immediately.

References