



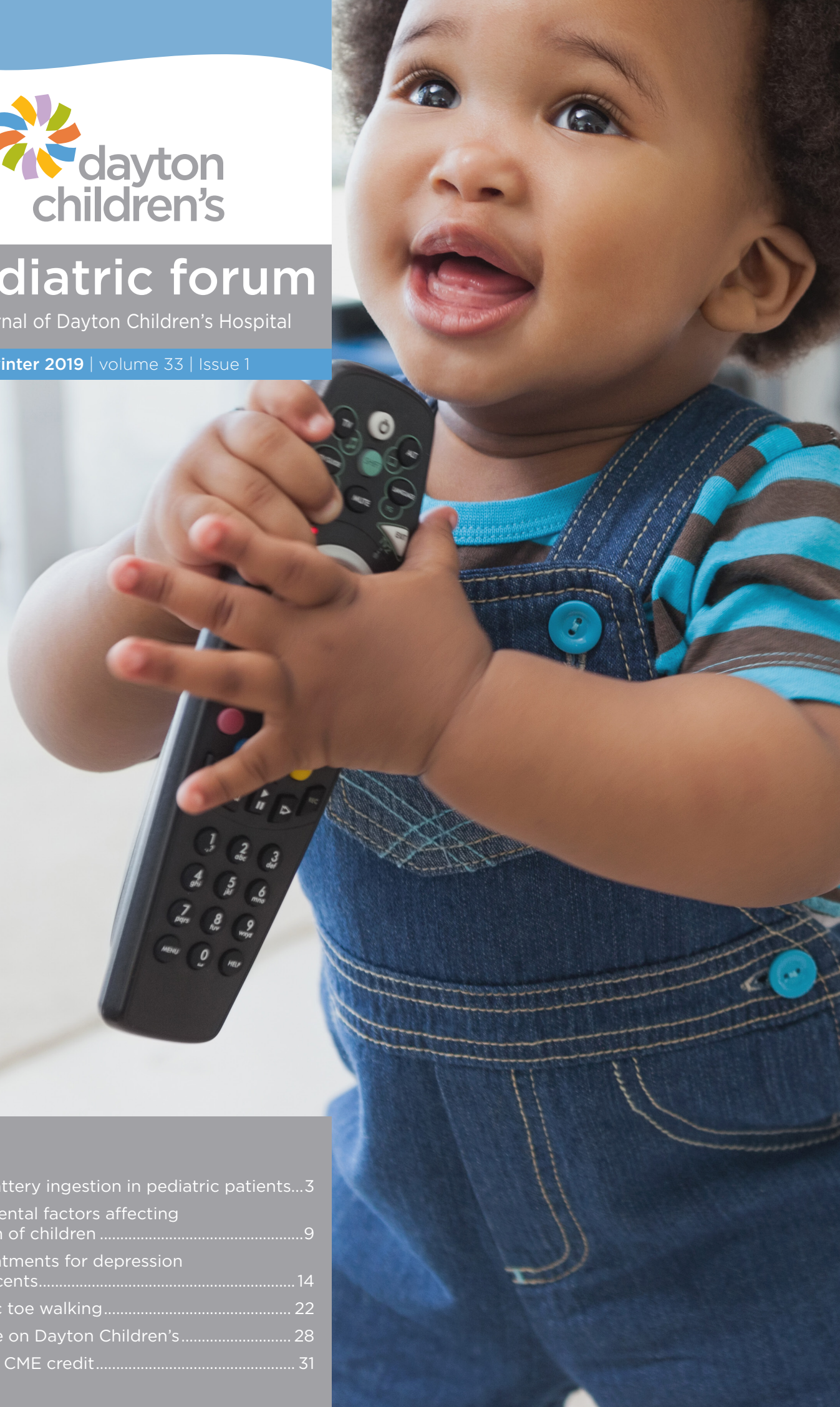
pediatric forum

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pediatric forum

winter 2019

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Pediatric Forum

is produced for the professional staff and referring physicians of Dayton Children's by the marketing communications department.

The purpose of Pediatric Forum is to provide information and news about pediatric health care issues and to provide information about clinical services and management issues of Dayton Children's.

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target audience

This education activity is designed for pediatricians, family physicians and related child health care providers.

educational objectives

- Identify the four pediatric issues covered in this journal and develop appropriate intervention.
- Appropriately use the resources of Dayton Children's Hospital to improve patient care.



cover story

button battery ingestion in pediatric patients

by Mellissa Mahabee

learning objectives

Following the completion of this article, the reader should be able to:

1. Discuss the importance of early recognition of button battery ingestions in children.
2. Review the urgent approach to management of such ingestions.
3. List serious complications that may occur following button battery ingestions.

A 4-year-old was referred from an outside emergency department (ED) to the pediatric intensive care unit (PICU) for episodes of hematemesis. An “ingested coin” was noted in mid-esophagus on an abdominal radiograph. Access to imaging performed at the referring ED was not available to PICU staff. The transport team was dispatched to transfer the patient from outside ED to the PICU. A pediatric gastroenterologist, surgeon and the operating room were placed on alert due to the history of hematemesis with ingested foreign body.

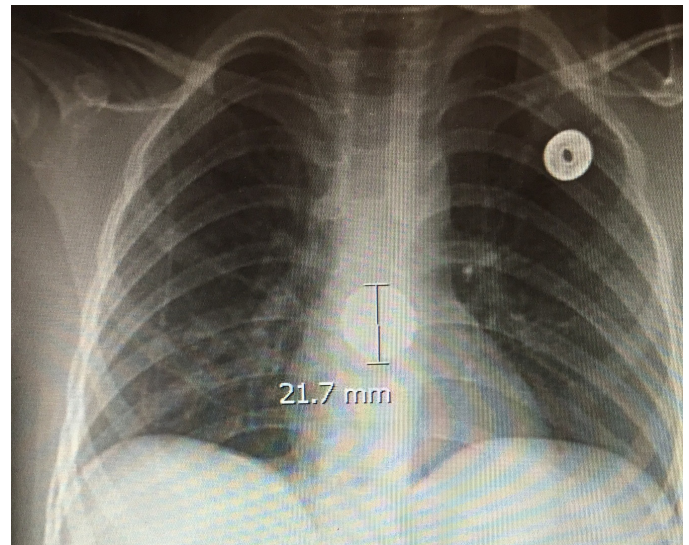


figure 1.

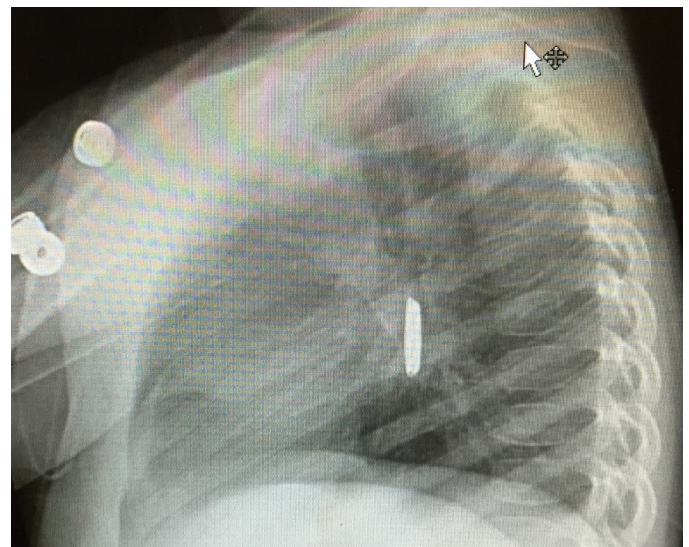


figure 2.

Further history obtained included a single episode of coughing up blood one week prior. The child had associated intermittent coughing, vague abdominal pain and nausea. The patient's mother believed that her daughter likely had a respiratory or gastrointestinal infection and did not seek medical care. The patient seemed to be her normal self. On the day of admission, however, the patient had two more episodes

of coughing up blood at home and passed out for a short period of time. Emergency services were contacted and when the patient presented to her local ED, she was awake, alert and conversational, but very pale. Her initial hemoglobin and hematocrit levels were 7.2 g/dL and 22.4 percent, respectively. An abdominal film noted an “ingested coin” in the mid-esophagus. The patient was emergently given

a blood transfusion, along with initiation of pantoprazole and octreotide drips.

When the transport team arrived, she was noted to be conversational, interactive, had a Glasgow coma scale (GCS) of 15, and was in no acute distress. Her vital signs demonstrated an elevated heart rate to the 130's. Her blood pressure was within normal limits. In route to the hospital, she had another episode of hematemesis, about 30 mL. A second unit of blood was administered. On arrival, with consultants at the bedside, a 2-view chest radiograph was obtained (figures 1 and 2).

At this point the worst fears were realized. The initial assumption was that the child had ingested a coin. However, the chest X-ray demon-

strated that the patient had ingested a button battery. We were able to visualize the step-off and double rim on the lateral and anteroposterior (AP) films. This was not recognized on the abdominal film from the outside ED.

While trying to get the patient to the operating room to have the button battery removed, a severe coughing episode resulted in a large amount of hematemesis and subsequent loss of pulses. Cardiopulmonary resuscitation (CPR) was initiated. Tracheal intubation was performed by anesthesia at the bedside. Maximal resuscitative attempts were continued and the patient received multiple blood products. Surgery attempted to tamponade the bleeding with the use of a Fogarty catheter.

Despite these efforts, the patient further exsanguinated and expired.

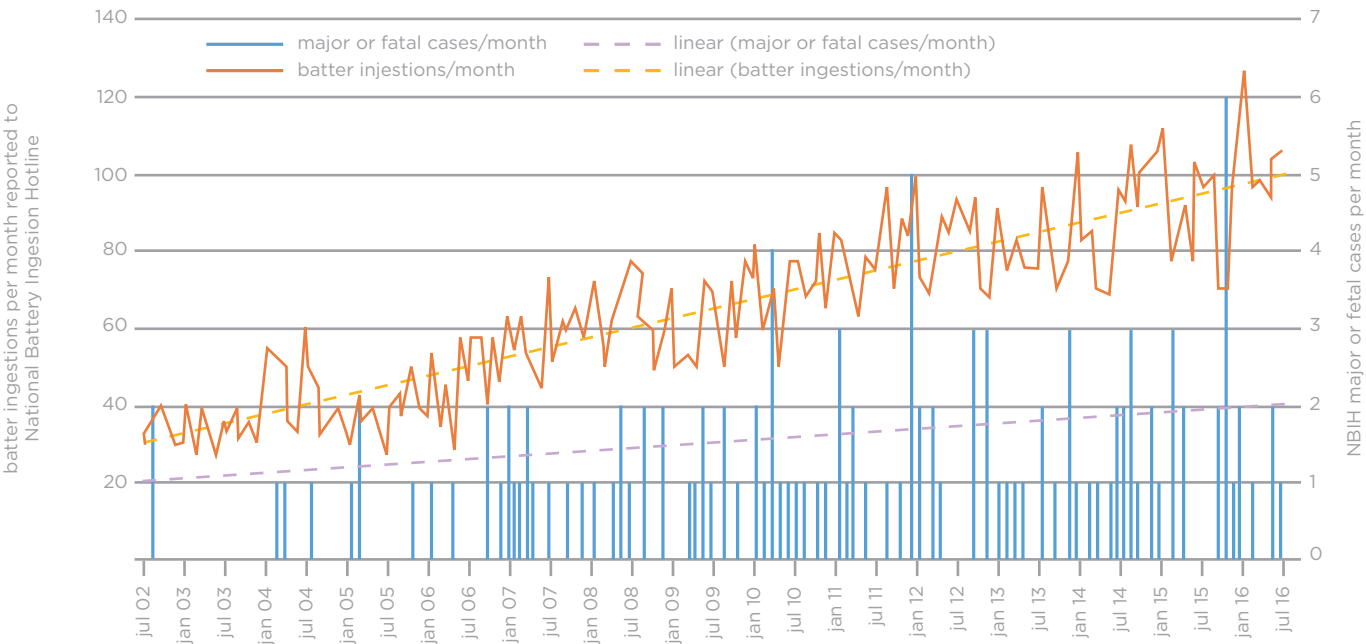
discussion

In this case, an aorto-esophageal fistula developed after an accidental ingestion of a button battery, presumably present for more than one week. Injury from the button battery led to esophageal perforation extending into the aorta. When the patient would cough, the battery would become a little more dislodged until that last coughing episode where it totally became dislodged, resulting in massive exsanguination. Repeat chest films were obtained when the Fogarty catheter was attempted to tamponade the bleed. However, one was unable to see the button battery any longer. The patient either coughed

it up, had it migrate intravascularly or had it shift into another body cavity, perhaps assisted with the active CPR.

epidemiology

Injuries from ingestion, aspiration and impaction associated with button batteries have been well documented in the literature for many years.^{1,2} Of particular concern is the lithium button battery ≥ 20 mm in size.^{3,4} Complications can include aorto-esophageal fistula, massive hemorrhage, esophageal perforation, tracheoesophageal fistula, esophageal stricture and recurrent laryngeal nerve injury. Data from the American Poison Control Center describe over 3,300 exposures annually from button batteries that result in clinically morbid or fatal



graph 1⁵. Reported battery ingestions per month to the National Battery Ingestion Hotline.



figure 3¹²

sequelae. In 2016, the incidence of button battery ingestions was estimated at 10.4 per million people with a major fatal rate of 0.94 percent.⁵

Note the rising number of button battery ingestions since 2002 in graph 1. This can be attributed to the increase in small electronics that now permeate many homes. Epidemiologic data show that in recent years, 60-65 percent of ingestions annually occur in children under 6 years of age, owing to the physiologic characteristics of preschoolers. This includes their innate curiosity, inability to tell the difference between edible and inedible objects, and their poor coordination with chewing and swallowing. This younger age

predisposes these patients to an increased risk of foreign body impaction with the larger lithium battery cells in the smaller diameter of the esophagus.⁶

pathophysiology

Injury from button batteries is multifactorial. These etiologies include mechanically induced pressure necrosis, electric currents from the battery causing hydrolysis with formation of corrosive hydroxyl ions, and leakage of the battery's alkaline contents causing corrosion.⁷⁻⁹ Animal studies tend to refute pressure necrosis and leaking of battery contents as primary causes and lean towards electrolysis causing most of the damage.¹⁰ The general consensus is that they all do contribute, however.

presentation/ clinical symptoms

Most (80-93 percent) patients with ingested button batteries are asymptomatic or may have a few nonspecific symptoms until the onset of severe symptoms.⁹ Gastrointestinal complaints such as nausea, vomiting, hematemesis, dark stools and abdominal pain are the most frequent manifestations of symptomatic cases.⁸ Other symptoms can include chest pain, coughing, fever, barking cough, stridor and decreased range of motion of the neck, and hoarseness. More than half of serious outcomes following button battery ingestion occur after unwitnessed ingestions, in which case there is likely a delay in recognition and diagnosis.⁶ Hematemesis or hemoptysis is usually a late sign.

diagnosis

Button battery ingestions can be misdiagnosed as coin ingestions. Physicians including primary care, emergency room physicians, and other first line caregivers should have a high suspicion for button battery ingestions. If there is any suspicion, a 2-view chest radiograph should be obtained. Button batteries can be seen on the AP chest X-ray as a double rim or halo-effect and on the lateral view, looking for the step off.¹¹ The 'double-ring' or 'halo' signs can be seen due to the telescoping nature of the two ends of the battery housing resulting in the appearance of two concentric circles. You can see this on the case patient photos (figures 1, 2 and 3).

management

Once a diagnosis is made, endoscopy should be performed as soon as possible. The patient should be managed in a center where pediatric surgery, otolaryngology and gastroenterology are available. One retrospective study demonstrated that activation of a level 1 trauma protocol led to expedient evaluation, shortened removal time of esophageal batteries and reduced major sequelae.¹³ Post removal care of button battery includes formal airway evaluation at the time of removal, consideration of nasogastric tube, and esophagram prior to feeding. The presence of an esophageal burn after removal of the foreign body portends an increased risk of fistula development and stenosis at the site. Many experts recommend a second-look esophagoscopy two to four days after the battery is removed. When the button battery is located beyond the stomach, serial radiographic examinations should be used to monitor its progress and to ensure it continues to advance through the intestinal tract.

complications

Aorto-esophageal fistula remains one of the most significant and potentially fatal sequelae of ingestion. As in our case patient, aorto-esophageal fistulas can present in a delayed fashion. Reports of death up to 19 days after injury have been documented.⁴ It is typically heralded by a sentinel bleed or hematemesis. Rapid recognition is the key to survival. Given the increased fatality rate seen in battery ingestion over the years, current recommendations include a computed tomography angiogram to evaluate the proximity of the esophageal injury to the aorta and exclude aortic injury. Serial imaging can be obtained to ensure resolution of the inflammation surrounding the aorta. Referral to a cardiovascular surgeon is recommended in the case of hematemesis or upper gastrointestinal bleeding seen on endoscopy after battery ingestion.

Other complications following button battery ingestion include esophageal perforation and formation of a tracheoesophageal fistula (TEF). Although these injuries typically prompt urgent surgical intervention and repair in older patients, a

conservative approach to these injuries has been described with battery ingestion.¹⁴ Prompt surgical consultation is required. Initiation of broad-spectrum antibiotics and a period of esophageal rest are imperative. Drain placement may be considered; however, many centers have noted that the focal perforation seen in button battery ingestion may not require drainage. A period of observation should be considered as spontaneous closure of the perforation and TEF have been reported.¹⁴ Surgical repair through thoracotomy can be attempted with failure of conservative management or clinical deterioration. Close follow-up and repeat endoscopy is required for early diagnosis and prompt initiation of dilation in the setting of stricture formation, as this has been shown to have the best long-term outcomes.¹⁵

summary

It is of capital importance that primary care physicians and initial caregivers are able to recognize and evaluate the non-specific symptoms of foreign body ingestion. Always maintain a high index of suspicion and realize

that any hematemesis is an ominous sign potentially representative of a button battery ingestion. If suspicious, physicians should obtain a 2-view chest X-ray and be able to recognize a button battery versus a coin on these films. It is imperative that physicians educate families on signs of foreign body ingestion for early recognition and intervention. Not all ingestions have the same complications, but button batteries can be deadly in young children.

Finally, preventive efforts should be directed at families and caretakers. These batteries are easily accessible to children via common household products, such as small remote controls, garage door openers, bathroom scales, cell phones, flameless candles, watches, cameras and digital thermometers. Parents and caregivers are urged to keep these devices out of reach. For patient/family information on button battery ingestions, see the American Academy of Pediatrics healthy-children.org website at <https://www.healthy-children.org/English/safety-prevention/at-home/Pages/Button-Battery-Injuries-in-Children-A-Growing-Risk.aspx>.



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CME questions

1. Three-year-old female presents with intermittent cough for the past week and has had possible coughing up blood. Her older brother received electronics for his birthday two weeks prior and it is missing the battery. Next step should be?

- a. Send home and reassurance
- b. Send to the emergency department for immediate 2-view chest x-ray
- c. Send to outpatient radiology department for abdominal x-ray

2. Complications following ingestion of button batteries have a different pathophysiology than those associated with coin ingestion and can lead to possible worse outcomes.

- a. True
- b. False

3. Three possible mechanisms by which an ingested button battery causes harm include: pressure necrosis, electric currents from the battery causing hydrolysis with formation of corrosive hydroxyl ions, and leakage of the battery's alkaline contents causing corrosion.

- a. True
- b. False



environmental factors affecting the health of children

by Jessica Saunders,
director of community engagement

learning objectives

Following the completion of this article, the reader should be able to:

1. Identify common social drivers of health impacting asthma.
2. Define the role of a community health worker.
3. Identify how a community health worker could enhance asthma outcomes, specifically through home visits.

The environment in which a child lives and the behaviors of his caregivers are significant drivers of his health. Therefore, there is a great need to address the social drivers of health and increase health equity, especially for children with asthma whose living conditions and social needs greatly decrease their ability to effectively manage this chronic disease. The use of community health workers can be one strategy to address the social drivers of health in a clinical setting in order to improve patient outcomes.

social drivers of health and asthma prevalence

Approximately 7.8 percent of people living in the United States have asthma. Asthma is more common in children than in adults, with 8.4 percent of children younger than 18 having the disease, compared to 7.6 percent of adults 18 or older. Factors such as gender, race and ethnicity, and socio-economic status are associated with asthma, with the disease being more common in males than females (for children). Non-Hispanic blacks and Puerto Ricans are also more likely to have the disease than non-Hispanic whites. Persons living below 100 percent of the poverty level are more likely to have asthma than those living at any percentage above the poverty level.

The Asthma and Allergy Foundation of America's (AAFA) 2018 Asthma Capitals™ report looks at factors in cities across the continental U.S. that contribute to asthma rates and management. The organization ranked Dayton, Ohio, as third in the country for asthma prevalence, emergency department visits due to asthma, and asthma-related fatalities. The report also looks at risk factors that contribute to

these outcomes including poverty, air quality, access to specialists, pollen counts, medicine use, tobacco policies and the rate of uninsured residents — all areas where the Dayton region has room for improvement. Dayton is a part of the Ohio-Lake Erie Asthma Belt, which includes Akron, Cincinnati, Cleveland, Dayton, Toledo and Youngstown — all cities in the top 20 of the rankings. Poverty, pollen, air quality and high numbers of medication use are the key risk factors that have placed these Ohio cities at the top of this list.

According to the AAFA, poverty rates among children in these Ohio cities are even higher, especially among minority populations. Dayton's poverty rate is 18.2 percent. Asthma rates among minorities coincide with these poverty rates. In addition, asthma disproportionately affects minorities. In Ohio overall, 16 percent of non-Hispanic black children and 11.9 percent of Hispanic children have asthma, compared to 4.9 percent of non-Hispanic white children.

Asthma can be particularly challenging for families living in poverty. Appropriate asthma management may be difficult for

families worried about meeting basic needs such as food, housing and clothing. Many families living in poverty rent their homes or apartments, which are often substandard. Issues such as mold, pests and dust are prevalent. The cost of care or medications may impact a family's decision to go to the doctor and pharmacy. The lack of reliable transportation often determines whether health care appointments are met. These modifiable social factors, often called social drivers of health, greatly impact a child's health outcomes. Despite their immense impact on outcomes, however, social drivers of health are often difficult to address within the context of a clinic visit.

community health workers

Community health workers (CHW) are members of the care team who "build individual and community capacity by increasing health knowledge and self-sufficiency through a range of activities such as outreach, community education, informal counseling, social support and advocacy."³ CHW selection, training, roles and titles vary across institutions and are often determined by their

respective communities and employers.

At Dayton Children's, we have begun to use CHWs to support families of asthmatics as a way to address the social drivers that might be impacting a child's asthma. Our CHWs have been successful in helping families adhere to recommended clinical care by offering information and support while meeting the unique needs of each patient family. The CHWs support the care team by providing services such as follow-up calls, home visits and linking families with community resources. Our CHWs have special training in tobacco cessation through the American Lung Association's "Freedom from Smoking" program due to the high amount of tobacco exposure to children with asthma. The CHWs can also assess a home using Environmental Protection Agency (EPA) guidelines to identify asthma triggers such as mold. Using a CHW allows other members of the care team to work at the top of their license while providing one-on-one support to families with the highest risks for non-compliance based on their social needs.

referrals to a community health worker

Currently Dayton Children's uses a specific criteria for a CHW consult within our pulmonary clinic. The criteria includes:

1. History of a return visit to ED or readmission within 30 days
2. History of >2 ED visits or admissions in 12 months
3. Absence of a PCP
4. Patient or family identified environmental concerns (i.e. mold)
5. Reported rescue inhaler use of >5 times per week
6. Asthma Control Test score less than 19
7. Child Asthma Risk Assessment Tool® (CARAT) assessment identifying child as high risk.

The CARAT is a risk assessment tool that can rapidly provide a personal risk profile for a child with asthma. A detailed questionnaire looks at a variety of potential risks for a child and then reports on those factors affecting that child. It is designed to help clinicians, asthma counselors and parents determine potential risks for children with asthma in order to identify possible intervention. Risk factors include medical care,

environmental, adherence, responsibility, child well-being, adult well-being and asthma attitudes. Our referral criteria has evolved as we have learned that not all children need a home visit based on our CARAT assessment and priority of home visits typically come from risk factors around environmental concerns.

home visits

If it is determined that a child and family could benefit from home visitation, there are a series of three home visits provided to help the family better manage asthma. During the initial home visit, the CHW assesses the home environment for asthma triggers, which might include mold (figure 1), excessive dust, pests, pets or smoking/secondhand smoke. The CHW also performs a Quality of Life Survey and Asthma Control Test if not previously done in clinic. The family also answers some asthma IQ questions. The CHW ensures the child with asthma has an asthma action plan and, when applicable, verifies the appropriate medications are in use. In addition, a social need screening is conducted to identify if the family is struggling to meet basic needs such as



figure 1. Mold on the ceiling



figure 2. This bed does not have sheets and shows food and debris.

access to food; commodity needs such as bedding, clothing or diapers; educational needs such as after school programming or day care; or help with utilities. The CHW provides referrals and resources to address these needs whenever possible, including referrals to smoking cessation programs.

On the follow-up home visit, the CHW identifies if there were any asthma trigger reductions. The asthma IQ

questions are asked again, and additional education is provided as necessary. Often the CHW uses this visit to work through issues such as challenges with a landlord fixing housing conditions or the family obtaining food. Finally, the hospital has provided cleaning supplies such as a “green cleaning” kit, HEPA vacuum, and other home products such as mattresses and pillow covers (figure 2 and 3) to reduce asthma triggers.



figure 3. Humidifier used to help clean the air is extremely dirty.

At the final home visit, a repeat Quality of Life Survey, Asthma Control Test and CARAT are given to the patient family. There is an assessment of remediation of triggers and outcomes regarding the referral of community resources. Ideally the series of home visits is completed within about six to eight weeks, recognizing there needs to be flexibility depending on the availability of the family and complexity of the case.

challenges

Home visiting does not come without challenges. Often it is a challenge to have parents agree to the home

visit and, therefore, the CHW’s ability to identify and build trust with the family is critical to the program’s success. In addition, there are safety considerations. Going into a home in some of the community’s neighborhoods often experiencing poverty and blight may be unsafe. The CHW has a series of questions that are required to be answered by the family to assess the safety of the situation and reduce risks prior to the home visit being conducted. Finally, the CHW is going into the home often where secondhand smoke and other environmental risks are present.



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Jessica Saunders is the director of community engagement at Dayton Children's. She has worked at Dayton Children's since 2007 and is responsible for the hospital's community outreach and population health programming including the Dayton Asthma Alliance and the Family Resource Connection, a program that screens for social needs of patients.

conclusion

Diseases such as asthma require management not only through appropriate adherence to medications and regular doctors' appointments, but also in the environment where children live, learn and play. The use of community health workers to identify potential non-medical barriers to optimal health, including the presence of asthma triggers in the home or other social drivers, is one way to improve health outcomes.

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CME questions

- 4. Community health workers can do all of the following except:**
- a. Prescribe medications
 - b. Conduct home visits
 - c. Complete follow-up calls
 - d. Connect patient families to community resources
- 5. Which of the following factors are associated with asthma?**
- a. Gender
 - b. Race/ethnicity
 - c. Socio-economic status
 - d. All of the above
- 6. Possible criteria that might indicate whether a home visit might be beneficial include:**
- a. History of a return visit to ED or readmission within 30 days
 - b. A high CARAT score for environmental factors
 - c. Patient or family identified environmental concerns (i.e. mold)
 - d. All of the above



novel treatments for depression in adolescents

by Bethany Harper, MD;
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Adolescent depression is common in the United States, with one in eight adolescents experiencing a depressive episode within the last year.¹ Guidelines have been developed for primary care providers to aid in the management of adolescent depression including screening, diagnostic and management recommendations.^{2,3} These guidelines give an excellent framework for treating adolescent depression, and providers are strongly encouraged to review them. In this article, we present novel treatments for depression to give the practitioner an idea of new and cutting-edge therapies.

learning objectives

Following the completion of this article, the reader should be able to:

1. Describe new and upcoming innovations for the treatment of depression.
2. Have a basic knowledge of more advanced treatments of refractory depression.
3. Identify complementary therapies with potential benefits when used with conventional treatments for adolescent depression.

transcranial magnetic stimulation

Repetitive transcranial magnetic stimulation (rTMS) is a noninvasive neuromodulating therapy approved by the FDA for treatment of major depressive disorder (MDD) in adults. Studies over the last decade show that it is also safe and effective for adolescents with treatment resistant depression. This is important since an estimated 30-40 percent of adolescents with a diagnosis of MDD do not respond or only partially respond to standard treatments of psychotherapy and antidepressant medication, and effective alternatives are needed.

A course of rTMS treatment consists of 30 sessions of high frequency (10-Hz) rTMS at 120 percent motor threshold with 3,000 pulses per session applied to the left dorsolateral prefrontal cortex (L-DLPFC). These parameters from

adult studies have been successfully applied to adolescent patients. Sessions are performed once daily and require about 30 minutes to complete. Pulses are delivered by a coil placed on the scalp. Coil placement for optimal rTMS dosing is one of the challenges faced in extrapolating adult data to the adolescent population. An MRI-guided approach was compared to the 5-cm rule and Beam F3, two methods used to approximate coil placement in adults.⁴ The 5-cm rule involves monitoring the contralateral abductor pollicis brevis (APB) muscle contraction during motor cortical stimulation, then measuring 5-cm anteriorly in a parasagittal plane to locate the coil placement site. This technique, though pragmatic, may fail to locate the optimal site for stimulation of the L-DLPFC in adults when compared with MRI-guided localiza-

tion. The Beam F3 technique, which involves use of EEG to determine placement, is more reliable than the 5-cm rule when used in adults. However, comparison of the 5-cm rule and the Beam F3 with MRI-guided placement in adolescents suggested more variability in this population, so that MRI was the preferred placement method in this open-label study. The authors highlighted the importance of further work to identify clinically practical and reliable biomarkers, since the need for MRI guidance would create barriers in access to treatment for many families, but inaccurate placement can produce suboptimal results.

Early open label studies showed rTMS to be potentially effective adjunctive therapy for adolescents with treatment-resistant MDD⁵, without any adverse effects on attention, learning or memory.⁶ In fact, modest neurocognitive improvements were observed, consistent with a measurable and substantial decrease in depression severity. Suicidal ideation was also shown to decrease with rTMS treatment in an exploratory study of 19 adolescents with severe treatment-resistant depression.⁷ The first randomized, double-blinded, sham-con-

trolled investigations are currently underway for more scientifically rigorous validation of rTMS therapy for adolescent MDD.⁷ These studies also include use of magnetic resonance spectroscopy to elucidate neurochemical changes associated with response, remission and/or maintenance of improvement in depression following a course of rTMS. In these studies, non-responders to initial rTMS treatment enter an open-label maintenance phase to evaluate bi-weekly rTMS treatment over 12 months following acute treatment. This is the first study looking at maintenance treatment in adolescents. Data published so far show that glutamine/glutamate ratios increased in the anterior cingulate cortex (ACC) and in the L-DLPFC in conjunction with depressive symptom improvement.⁸ Studies are underway measuring glutamatergic cortical excitability and GABAergic cortical inhibition (brain activity measures) to understand the neurophysiology of MDD in children and adolescents and how treatment with rTMS and with SSRI antidepressant medications impact these measurements.^{9,10}

The most common side effect of rTMS is transient scalp discomfort at the site of coil placement. Although

rTMS can induce a seizure, this is rare. The technique shows great promise as a safe and effective approach to treatment-resistant depression in adolescent patients.

electroconvulsive therapy

Electroconvulsive therapy (ECT) is an effective treatment for severe persistent major depressive disorder, mania, schizoaffective disorder, catatonia, neuroleptic malignant syndrome and schizophrenia in adolescents when more conservative treatments have failed. ECT could be considered after two or more failed trials of pharmacological treatment when patient symptoms are severe, persistent, disabling, or when symptom severity does not allow time for pharmacological options to be effective. A comprehensive physical examination must be completed prior to ECT. Consideration of laboratories is dictated by the results of the physical examination with the exception of a serum or urine pregnancy test for all females. Informed written consent must be obtained from a legal guardian. Some states require a 72-hour waiting period between signing the consent and the start of treatment. Every patient that is considered for ECT will need a second

opinion performed by a psychiatrist who is knowledgeable about ECT and not responsible for the care of the patient. Anesthesia should be given by an individual with experience in treating adolescents. A common anesthetic agent is methohexital, and a common muscle-relaxing agent is succinylcholine. Ventilation with 100 percent oxygen is provided prior to the electrical stimulation. Treatment is performed two to three times per week. Unilateral electrode placement on the non-dominant hemisphere is preferred, but electrode placement may be performed bilaterally if needed. A brief pulse of an adequate dose of electricity is used to induce a seizure. Adverse effects secondary to ECT include memory impairment, tardive and prolonged seizures, headache, nausea, vomiting, muscle aches, confusion and agitation. Recommendation for a typical course of ECT is 10-12 sessions with an evaluation at session five to six and then making a decision regarding continuation of treatment depending upon an initial response.¹¹

ECT is as effective in adolescents as adults but is used much less commonly. Of the total individuals given ECT, adolescents accounted for 0.43 percent

in India, 0.93 percent in Australia, and 1.5 percent in the United States. In a cohort study of adolescents and adults treated with ECT, remission rates were the same (approximately 58 percent for both). Differences between the two groups included adolescents being more likely to be diagnosed with a psychotic disorder and adults being more likely to be diagnosed with an affective disorder.¹² Other studies have indicated a 60 percent treatment response among hundreds of adolescents treated with ECT with no significant adverse effects. Studies have reported different numbers of ECT treatment sessions that are effective. Many studies report mean numbers between 10 and 12 sessions. One study reported a mean number of ECT sessions of 24 in 36 adolescent patients. In this study, only five patients exhibited significant improvement after six sessions, whereas 21 patients reported improvement after 12 sessions.¹³

ECT is an effective treatment for severe mood disorders, schizophrenia and catatonia in adolescents. However, it is not often used in this population.

ketamine

Ketamine, an anesthetic drug on the market

since 1970, is an NMDA receptor antagonist. In 1990, ketamine mixed with saline was injected into seven depressed adult patients and showed antidepressant properties.¹⁴ Since then, multiple studies have shown the rapid effects of ketamine in adult depression.¹⁵ Excitement about a quick-acting treatment for depression has caused unregulated use around the country. Supervisory bodies are raising concerns due to the lack of clinical data to support ketamine's use. Following is a review of some of the evidence for ketamine use and ongoing regulatory concerns.

Most of the intrigue surrounding ketamine lies in its promise of being a rapid induction antidepressant. Most antidepressants take four to six weeks to see effect, while ketamine has multiple small studies showing rapid (within hours to one day) decrease in depressive symptoms.^{15,16} Research is finding that repeat dosing is required to prolong the antidepressant effects beyond a few days to a week. A few case studies indicated that repeat infusions can sustain antidepressant effects for months.¹⁷

Another exciting avenue for ketamine's use is in its rapid reduction of suicidal thoughts in patients. This decrease

in suicidal thoughts has been found to be independent of what the mood effects are. Studies are limited due to small sample sizes and short periods of study (seven days).^{18,19} This indication holds promise to potentially shorten inpatient hospitalization stays.

In adolescents, studies are even more limited. Currently three studies are in progress through the NIH looking at the role of ketamine in depression and anxiety, and suicidal adolescents.

Many questions remain about ketamine. For instance, we know that it is an NMDA receptor antagonist. However, other medications that hold the same properties do not produce ketamine's antidepressant effects. It is believed that ketamine produces a specific metabolite that is behind the antidepressant effects. However, data to support these models has been mostly collected from rodents.¹⁷ There is also a large concern about the long-term side effects of repeated ketamine infusions. From individual infusions, we know that there are cardiovascular, cognitive and perceptual side effects. From ketamine abusers, we know that side effects of chronic cystitis, hepatotoxicity, gallbladder pathology, impaired cognition and

dissociative effects are all possible.¹⁷

The dosing of ketamine, along with the best mode of administration, has not been fully evaluated. Most studies to date use IV infusions. However, an intranasal preparation of the ketamine enantiomer, esketamine, is currently in development. There is also the question of whether ketamine may help with more than just depression, but studies are lacking at this time.

Improved treatments of depression are desperately needed. While ketamine may be the gold standard in the future, at this time results of long-term use are lacking and need to be further evaluated prior to recommending it for treatment of depression.

integrative medicine

Integrative therapies aimed toward treating depression in adolescents focus on the wellness of the patient by using conventional treatment (antidepressants and cognitive behavioral therapy) along with evidence-based complementary treatments. As depression rates among adolescents continue to rise, incorporation of evidence-based complementary treatments is becoming essential to help reduce depression symptoms. Complementary treatments

allow the adolescents and their families the ability to take more active roles in creating individualized treatment plans to treat depression symptoms.

Evidence-based complementary treatments can include biological supplements (vitamin D, magnesium, fish oil) and mind-body medicine (meditation and mindfulness).

biological supplements

Vitamin D plays a vital role in the differentiation and maturation of dopaminergic neurons.²² However, it has been shown that many adolescents are deficient in vitamin D, which could ultimately lead to adverse neuropsychiatric outcomes such as depression. A control case study conducted on Swedish adolescents found a positive correlation between vitamin D supplementation and improvement of depression symptoms when 4000 IU of vitamin D was given daily for one month, then 2000 IU of vitamin D was given for two months.²²

Magnesium plays a significant role in the central nervous system on GABA receptors, glutamate, serotonin and the synthesis of dopamine.²¹ A reduced amount of magnesium could potentially affect depression along with

other psychiatric problems such as decreased concentration, apathy, fatigue, emotional lability, irritability, anxiety and insomnia.²¹ There have not been any studies done on the effects of magnesium on adolescent depression; however, a study conducted on young adults suggest people with reduced amount of magnesium intake were 81 percent more likely to be depressed compared to young adults with sufficient magnesium intake.²¹

Omega 3 and omega 6 fatty acids are involved in the functioning of the central nervous system and can have an effect on serotonergic neurotransmission and dopaminergic functions.²⁰ A study on adolescents who have not achieved remission of depression symptoms with an SSRI were supplemented with either an omega 3 low dose or omega 3 high dose along with his/her current SSRI. It was found that 60 percent of adolescents in the omega 3 low dose achieved remission and 100 percent of adolescents in the omega 3 high dose achieved remission of depression symptoms.²²

mind-body medicine

Meditation and mindfulness incorporate various techniques that allow adolescents to slow down thought processes and ultimate-

ly focus on emotions and how to better cope with them. Meditation and mindfulness have been shown to affect neuronal pathways, increase serotonin and decrease noradrenergic activity.²² Long-term dedication and use of these practices have shown benefits in the reduction of depression symptoms in adolescents. According to a randomized control trial, 102 adolescents reported a significant decrease in depression symptoms on a self-reported symptom checklist after an eight-week mindfulness class.²²

Additional mind-body medicine techniques include daily exercise, acupuncture, yoga, art therapy and music therapy.

pharmacogenetic testing

Guidelines for Adolescent Depression in Primary Care (GLAD-PC) treatment recommendations include initiation of an evidence-based antidepressant for treatment of depression.³ A common question among both clinicians and parents involves the reasoning behind choosing a specific antidepressant. While this decision involves many factors, the recent availability of pharmacogenetic testing may give additional data to choose an appropriate medication.



Commercially available pharmacogenetic tests for antidepressants generally focus on genetic polymorphisms that may affect both the pharmacodynamics and pharmacokinetics of a medication. Pharmacodynamically, because SSRI medications are primarily metabolized through the cytochrome P450 system, polymorphisms affecting this system could lead to different medication levels. Pharmacokinetically, allelic variations in the serotonin transporter (SLC6A4) and the serotonin receptor (HTR2A) genes may affect an individual's response to antidepressant therapy.

In practice, obtaining pharmacogenetic testing is usually simple. Sample collection is a buccal swab that can be done quickly in the office, which is then

sent to a lab for analysis. Results usually include a list of allelic variations of the tested genes as well as a list of medications that are affected by these variations. This would then enable the clinician to choose an appropriate medication based on an individual's genetics.

In theory, identifying a specific antidepressant based on the above factors would lead to faster response (by avoiding a medication with low likelihood of response) as well as fewer side effects (by adjusting the dose based on pharmacodynamic factors). Currently no studies have examined these outcomes in pediatric patients.²³ A review in 2017 found a small number of published studies (of adults) showing improvement in depression outcomes when pharmacogenetic testing was used to guide treatment.

In addition, the use of testing resulted in lower cost of treatment. However, the authors note that the studies were low-quality and had the potential for significant bias and that higher-quality, blinded and randomized trials are needed.²⁴

Pharmacogenetic testing has the potential to improve depression by reducing the number of failed medication trials and minimizing side effects. Currently effectiveness data is limited in adults and almost nonexistent in pediatrics, and more studies are needed to assess the current impact of pharmacogenetic testing. As more allelic variations affecting depression are discovered, we may someday be able to confidently choose the right medicine at the right dose without the long process of trial and error.

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CME questions

7. According to early open label studies, rTMS was found to be potentially effective in which of the following populations:

- a. First episode psychosis in adolescents with schizophrenia
- b. Adjunctive therapy in treatment resistant depression in adolescents
- c. Suicidal ideation in adolescents with bipolar disorder
- d. Adjunctive therapy in treatment resistant OCD in children
- e. Treatment resistant OCD in children with comorbid tic disorders

8. Which of the following supplements has been shown to play a vital role in the maturation of dopamine neurons in the central nervous system?

- a. Kava
- b. Magnesium
- c. Potassium
- d. St. John's Wort
- e. Vitamin D

9. Ketamine has been found to rapidly induce remission of depressive symptoms in adults. Which of the following is true?

- a. Ketamine has been shown to decrease depressive symptoms over the course of two days
- b. Ketamine is an NMDA receptor agonist
- c. Ketamine infusions have been shown to sustain antidepressant effects for years
- d. Ketamine is thought to rapidly reduce suicidal ideation and could decrease inpatient hospital stays
- e. There are no concerns about long-lasting side effects after ketamine infusions

10. ECT has been found to be an effective treatment in adolescents and adults. Which of the following is false?

- a. A typical course of ECT is 10-12 sessions
- b. Unilateral electrode placement is preferred
- c. ECT is performed four to five times per week
- d. Remission rates for adolescents and adults were the same
- e. Adverse effects include memory impairment and prolonged seizures



idiopathic toe walking

by Michelle A. Potts, MD, FAAPMR

Toe walking is a toe-to-toe or forefoot-to-forefoot gait that lacks initial heel strike (figures 1 and 2.) In typical early child development, nearly all children toe walk to some degree. If a child persistently toe walks between ages 2 to 3 years, then further evaluation is needed. There are several reasons for toe walking, including diseases such as cerebral palsy, muscular dystrophy, myopathy and neuropathy, which may cause muscle imbalances due to spasticity or weakness. It has also been reported that 68 percent of children with autism spectrum disorder exhibit toe walking or other types of gait abnormality.⁷ If a specific disease process is not identified after a thorough neurologic and musculoskeletal exam, then the toe walking is considered idiopathic. There are

several theories for idiopathic toe walking (ITW) including increasing sensory stimulation, increasing proprioception and balance for the lower limbs, shortened Achilles tendons, increased Type I muscle fibers, and possibly genetic contributions as it seems to be hereditary.

learning objectives

Following the completion of this article, the reader should be able to:

1. Understand that idiopathic toe walking is a diagnosis of exclusion and a thorough neurologic and musculoskeletal examination is necessary before diagnosing toe walking as idiopathic.
2. Understand how to examine a child that presents with toe walking.
3. Identify several treatment options for idiopathic toe walking.



figure 1. Typical heel-to-toe gait pattern



figure 2. Foot position with toe walking

history

A detailed history of the child who toe walks should be taken. This includes birth history, child development and gait. A child with ITW has normal development and begins walking between 12-18 months. If parents report a history of prematurity of birth, developmental delays, muscle tightness or weakness, then further evaluation is necessary as these are clues that the toe walking may not be idiopathic. Additional indicators of an etiology other than idiopathic

include sensory changes and bowel or bladder dysfunction. Parents typically report that the child spends most of their time in a toe-to-toe gait but does occasionally walk in a heel-to-toe gait pattern. There is commonly a family history of toe walking but no neuropathic or myopathic family history. Of note, children with autism spectrum disorder often toe walk and treatment is similar to ITW; however, sensory processing problems may create difficulties with treatment.

exam

Physical examination of the child who toe walks must include a thorough neurologic and musculoskeletal exam. While the exam should focus on the lower limbs, examination findings in the upper limbs may indicate a different etiology if there is any upper limb asymmetry, weakness or changes in tone. Inspection of the spine and lower limb lengths, muscle bulk and tone should be normal. Lower limb muscle strength and reflexes should be normal as well. Normal

range of motion (ROM) for ankle dorsiflexion is typically 10-20 degrees past neutral (figure 3). Depending on the age of the child and how long they have been toe walking, ankle ROM can be normal to lacking. Ankle plantar flexion contractures (defined as the inability to stretch the ankle past neutral) are commonly seen in a child who toe walks due to constant shortening of the Achilles tendon (figure 4). Last, but certainly but not least, the child's gait

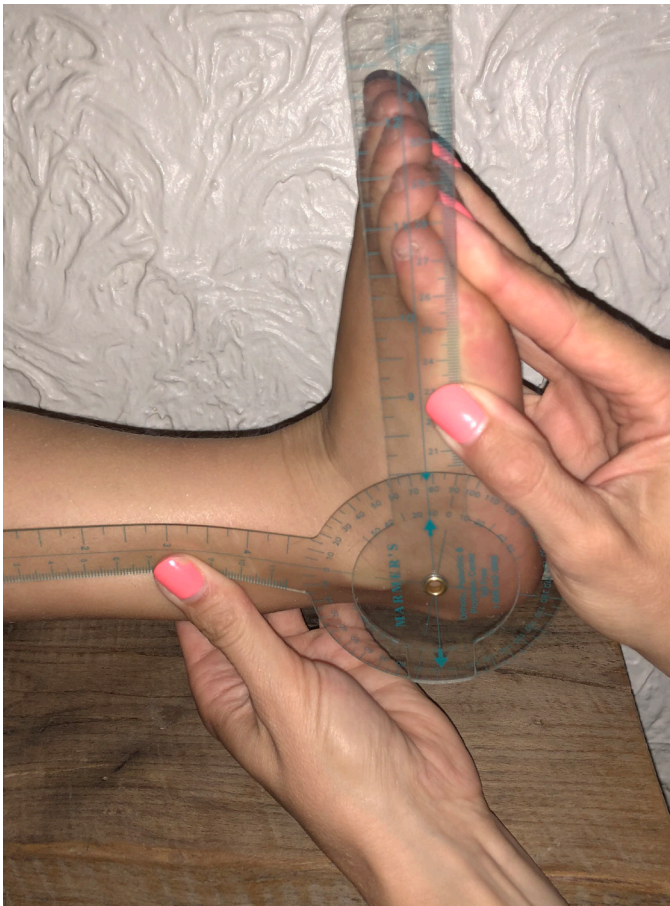


figure 3. Normal ankle dorsiflexion of ~ 10 degrees



figure 4. Ankle plantar flexion contracture with the inability to dorsiflex the ankle to neutral position (90 degrees between foot and lower leg)

should be observed with shoes and socks off and while wearing shorts or having the pants rolled up past the knee. Commonly a child with ITW is able to demonstrate a heel-to-toe gait when asked to do so. If a child does have an ankle plantar flexion contracture, he or she may not be able to walk with heel initial contact, or may compensate with knee hyperextension and external rotation of the lower limb.

diagnostic testing

If the child's exam is normal except for the toe walking with no neurologic or musculoskeletal abnormalities, then further testing may not be necessary. If there is concern for a neurologic or musculoskeletal problem, then a brain and/or spine MRI, creatine kinase, muscle biopsy, electromyography/nerve conduction study, and/or gait analysis will be helpful in the evaluation. If these tests are all normal, the diagnosis leans toward ITW.

treatment

ITW can be treated with just observation, but if ankle dorsiflexion is limited and the toe walking is persisting beyond two to three years, then other treatment options should be pursued. Typically ITW is treated with physical therapy to teach a typical heel-to-toe gait pattern, heel cord stretching, balance and coordination exercises. A sturdy high top shoe can be helpful to deter toe walking. Sometimes ankle foot orthoses (AFOs) are used to prevent toe walking (figure 5a). They consist of sturdy plastic and go below the knee and un-

der the plantar surface of the foot. They limit plantar flexion. A night-time stretching AFO (figure 5b) can also be used to provide a prolonged stretch to the gastroc-soleus-Achilles complex (figure 6) and improve ankle ROM.

For patients with significant ankle plantar flexion contractures that don't respond to physical therapy, home stretching and AFOs, other measures should be taken to improve ankle ROM and allow the child to have a heel-to-toe gait pattern. Serial casting (figure 7) has been shown to be effective in improving ankle ROM. Serial casting is



figure 5a. Typical daytime AFO



figure 5b. Nighttime stretching AFO

typically performed by a physical therapist. A series of short leg casts are placed with the ankle in maximum dorsiflexion. Each cast is left on for one week before removing, re-stretching the ankle into maximum dorsiflexion, and replacing the cast. This is typically repeated for four to six weeks depending on the improvement in ankle ROM. A cast shoe can be worn so the child can ambulate with the casts in place. The casts are thought to help in two ways: 1. Eliminate the ability of the child to walk on his or her toes with the hope of breaking the

habit of toe walking, and 2. Provide a continuous stretch to the gastroc-soleus-Achilles complex. Physical therapy and AFOs are typically used following the serial casting to continue to improve ROM, heel-to-toe gait, balance and coordination.

Some physicians have tried adding botulinum toxin injections to the gastrocnemius and soleus muscles prior to the serial casting to help relax these muscles and improve ankle range of motion. In a randomized control trial that compared serial casting alone

to botulinum toxin injections and serial casting, both groups improved ankle dorsiflexion by 5 degrees and range of motion and gait improvements were sustained at one year.¹ This study did not show a benefit nor was harm done by adding botulinum toxin to the serial casting. Surgical lengthening of the gastroc-soleus-Achilles complex is another option for patients with limited dorsiflexion when more conservative treatments such as physical therapy, stretching, AFOs and

serial casting have not been helpful. Typically the child is placed in a cast in dorsiflexion for four to six weeks post-op. Complications such as infections, nerve damage and scars can occur. Although surgical lengthening is more invasive with more risks, it is successful. One study showed that at follow-up three years post-operatively, surgical patients had normal dorsiflexion and only a small proportion toe walked intermittently.¹

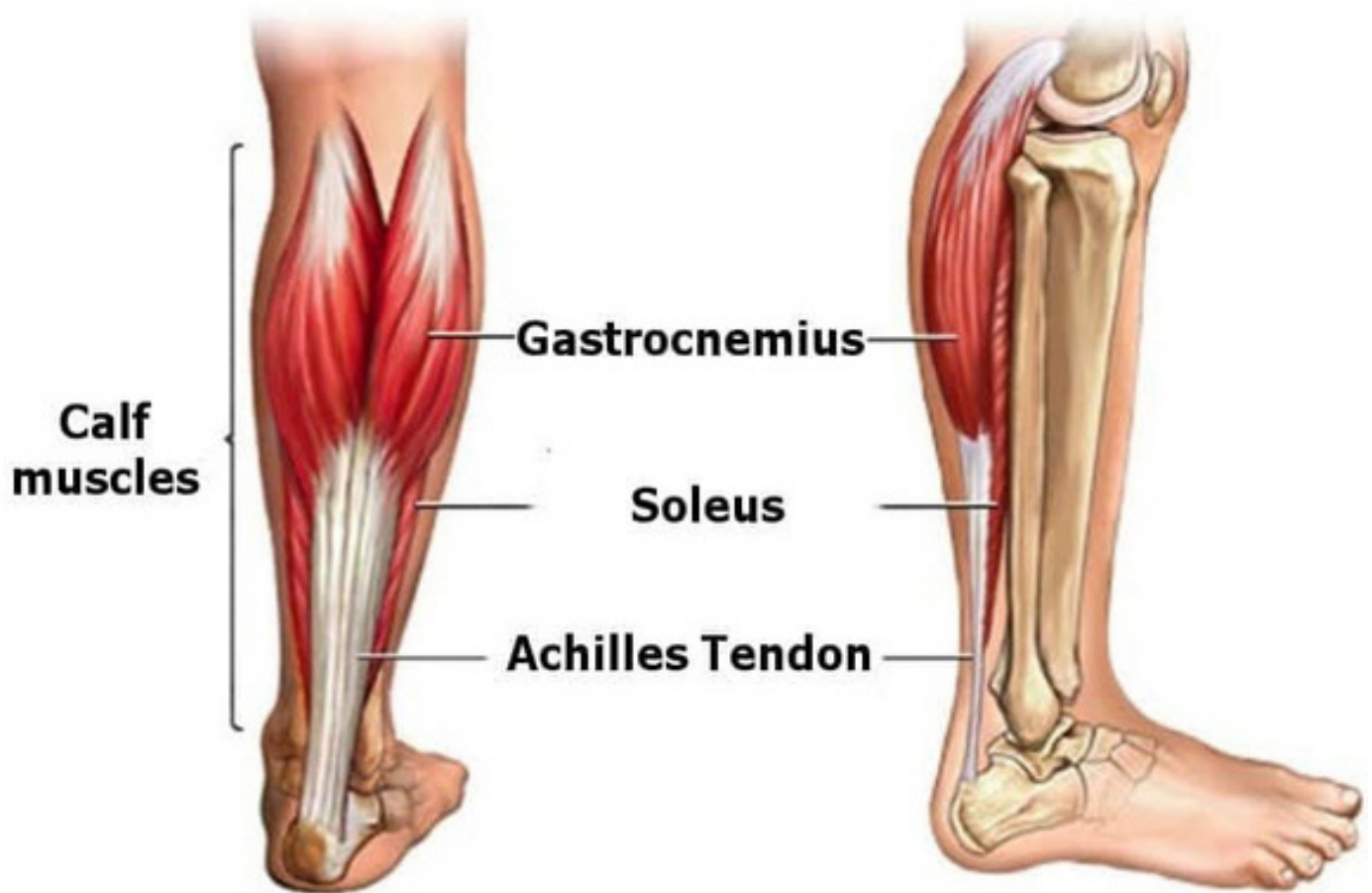


figure 6. Gastroc-soleus-Achilles complex

conclusion

Toe walking in a child is part of typical gross motor development, but if it persists beyond 2 to 3 years of age, it should be evaluated. There are many reasons for toe walking including serious neurologic and musculoskeletal problems. However, if these are ruled out, then the diagnosis is ITW. There are several

treatment options for ITW, including observation, physical therapy, AFOs, as well as serial casting and surgical lengthening for those who have limited ankle dorsiflexion. There is no single treatment option reported that is superior to the others and eliminates ITW long term.



figure 7. Serial casts

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CME questions

11. Persistent toe walking should be concerning after what age?
 - a. One year
 - b. 18 months
 - c. Two to three years
 - d. None of the above
 - e. All of the above
12. What are common treatment options for idiopathic toe walking?
 - a. Physical therapy
 - b. Braces such as an AFO (ankle foot orthosis)
 - c. Serial casting
 - d. All of the above
 - e. None of the above
13. Which of the following statements is false?
 - a. Idiopathic toe walking is a diagnosis of exclusion.
 - b. Ankle plantar flexion contractures can develop with prolonged toe walking.
 - c. In-depth diagnostic testing is necessary to make the diagnosis of idiopathic toe walking.
 - d. The etiology of idiopathic toe walking is uncertain.
 - e. None of the above.



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Dayton Children's updates

Dayton Children's joins with Children's Brain Tumor Tissue Consortium to launch first-of-its-kind Pediatric Brain Tumor Atlas



"That is a huge boost because just growing them and banking them does nothing until you get them in the hands of the researchers who need them. This is how you are going to get a cure for brain cancer."

The fight to cure cancer took a giant leap forward with the launch of the Pediatric Brain Tumor Atlas (PBTA) – and Dayton Children's is proud to be a member of this initiative.

The PBTA is one of the world's most comprehensive collections of childhood brain tumor data now available to all researchers worldwide for free. Created by a group of 16 primary member institutions across the globe called the Children's Brain Tumor Tissue Consortium (CBTTC), this initiative will provide samples and previously unimaginable amounts of data about childhood brain tumors in one place. This will allow researchers to spend less time tracking down the data they need, and spend more time focused on discovery of treatments and trials.

Brain tumors are the leading cause of disease-related death in children. Even so, little progress has been made in finding a cure. Doctors still can't say what causes many of

these tumors. Therapies to treat them haven't changed much in decades. Many tumors don't respond to chemotherapy and the other available treatments can have side effects that cause life-long damage.

"We decided to do something different at Dayton Children's," says Robert Lober, MD, PhD, neurosurgeon and brain tumor researcher at Dayton Children's Hospital. "We decided to make a living biobank. The tumors that we remove from children are grown in a dish so that one tumor can be propagated into 100 tumors or more. That tumor can be shared with researchers all over the world, again and again. In addition, cloud technology has allowed us to link it with massive amounts of data from the donor, clinical and imaging features, giving researchers more information to work with."



Dayton Children's receives the 2019 Women's Choice Award® as a Best Children's Hospital

"This consortium takes the work being done here and increases the depth and breadth of it by combining it with similar work from more than a dozen satellite member locations," says Adam Mezoff, MD, FAAP, AGAF, chief medical officer at Dayton Children's. "They share the vision of providing these tumors to people who need them, without restricting them in any way, which can sometimes happen. The collaboration is the key."

The dataset available in the Pediatric Brain Tumor Atlas represent data collected from more than 1,000 subjects and 30 unique brain tumor types. That number will continue to grow. "We have about 20 tumors here at Dayton Children's that are part of this data set," says Dr. Lober.

urgent care opens in Huber Heights

Dayton Children's offers the only urgent cares in the region with board-certified pediatricians

hours

Monday through Friday, 2:00 pm - 10:00 pm

Saturday and Sunday, 9:00 am - 9:00 pm

Dayton Children's opened its newest urgent care location in Huber Heights, just in time for winter's sneezes and sniffles. Located at 8501 Old Troy Pike and right off I-70, it's a perfect location for busy families when their child has a minor illness or injury and their doctor's office isn't open. Dayton Children's urgent care centers are the only ones in the Dayton region that are fully staffed by board-certified pediatricians and pediatric nurse practitioners, specially trained on how to treat illnesses and injuries in children.

Dayton Children's Huber Heights urgent care also offers parents

Dayton Children's Hospital has been named as a Best Children's Hospital and Best in Emergency Care by the Women's Choice Award®, America's trusted referral source for the best in health care.

The list of 38 award winners, including Dayton Children's, represents hospitals

that have met the highest standards for childcare.

"At Dayton Children's, moms know we treat their kids like they are our own," says Deborah A. Feldman, president and CEO, Dayton Children's Hospital. "We are honored that the Women's Choice Award proves that trust."

the ability to book an appointment and wait at home, instead of the waiting room. Simply go to the website and click the "save your spot" button. Wait times are updated every minute and estimates are based

on the average time it takes for a patient to be placed in an exam room. Parents can select a time slot beginning two hours after opening and one hour before closing. Walk-in patients are also accepted.

When to visit an urgent care

Sometimes an injury or an illness isn't life threatening but needs medical attention on the same day. A child's primary care doctor should be the first choice, but if the office is closed or booked, parents can choose Dayton Children's urgent care.

Urgent care centers usually allow you to walk in without an appointment, just as you would in an emergency department. They are equipped and staffed to treat minor, non-critical issues. Patients usually will be seen by a doctor or nurse practitioner and also might be able to get X-rays or blood drawn.

Common illnesses or conditions treated:

Cuts, minor injuries, vomiting or diarrhea, ear pain, sore throat, infected bug bites, mild allergic reactions, suspected sprain or broken bone, minor animal bites

Dayton Children's also offers an urgent care at the south campus in Springboro, as well as emergency departments at both main and south campuses.

toddler gets new face, and new life

pediatric surgeon and miracle worker



“It’s nothing short of a miracle,” says Hilcy, in Spanish

Raquel Cabrera was born with a hole in the middle of her face so big she could put her fist inside it. It’s a rare birth defect called a facial bipartition. “If I were to compare her to the usual clefts I see, on a scale of zero to ten, she is the ten,” says Petra Warner, MD, chief of staff at Shriner’s Hospital for Children - Cincinnati.

Her mother, Hilcy, struggled to get her help. Most doctors who saw Raquel on mission trips to her Latin American home country couldn’t tackle the staggering magnitude of the surgery needed to fix her facial differences. Luckily, they all knew someone who could.

“It’s sort of like a band of brothers who do these mission trips,” says Chris Gordon, MD, craniofacial surgeon at Dayton Children’s Hospital and Cincinnati Shriner’s Hospital. “Hilcy got Raquel to a Cincinnati Shriner’s clinic in Guatemala City. A doctor there knew I did this kind of

work so they asked me if I would take her case. Dayton Children’s graciously agreed to partner in this project, so Cincinnati Shriner’s brought her to the states and we went from there.”

Raquel’s surgery was intense, requiring substantial resources. Dr. Gordon brought in Robert Lober, MD, PhD, neurosurgeon at Dayton Children’s to be his partner, along with an entire team of surgical and critical care staff.

It wasn’t just the scope of the surgery, it was also the scale of how many things the surgeons had to fix at once. Raquel had an encephalocele, where the brain protrudes outside the skull - in her case, into her face - along with a fatty tumor inside her skull. She had hypertelorism, which is an abnormally large distance between the eyes, due to the large cleft, or hole in her face. That large hole also meant she didn’t have a nose or the top of a mouth.

“Fixing all this at once isn’t typical, but she may not have another chance,” says Dr. Gordon. “We made sure her brain was in the right place and sealed to protect it. We removed a lot of duplicated structures - for example, she had four nasal septums. That’s the wall that separates your nose into left and right sides. By removing the extras, we made space for her eyes to be where they should be. Then we had to give her a nose and a mouth, all while making sure she could still breathe well.”

“No one I talked to has ever seen anything like this,” says Dr. Gordon. “We made 3D models to guide surgery but even so, it was a unique challenge. This is where experience, expertise and collaboration really made a difference.”

For Hilcy, seeing her daughter for the first time after surgery was the day she’s dreamed of since Raquel was born. “It’s nothing short of a miracle,”

says Hilcy, in Spanish. “I didn’t take her out much before because I was worried about how people would treat her, that they would call her a monster. Now she can live freely.”

“I’m just amazed. She looks beautiful,” says Dr. Lober. “She was cute as can be to begin with - that big smile, and she’ll just jump up in your lap. Everybody fell in love with her immediately. Now to see her heal so fast and be happy is just amazing.”

“She’s just an unbelievable kid with great personality, super friendly and happy. It’s heartbreaking to have such an incredible facial difference that it frightens people,” says Dr. Gordon. “I am honored that Hilcy trusted me with her daughter and thankful that I could live up to that trust. I have great hopes that she has a wonderful life, now that people can focus not on her face but her amazing spirit and personality.”

program evaluation

- The material presented in this publication met the mission to enhance health care delivery in our region through education based on the essentials and policies of the Accreditation Council for Continuing Medical Education.
☐ Strongly agree ☐ Agree ☐ Neutral
☐ Disagree ☐ Strongly disagree
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☐ Yes ☐ No
- Did the material presented in this publication have a commercial bias?
☐ Yes ☐ No
- Please rate the contents of this issue using the following scale:
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- Are there any other topics you would like to have addressed in this publication or future educational programs for health care providers?
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