

Five Things Physicians and Patients Should Question

1 Don't order a CT to initially investigate macrocephaly (order an ultrasound or MRI).

A common pediatric neurosurgery referral is a young child with a rapidly increasing head circumference crossing percentiles. The differential diagnosis is broad and includes benign expansion of the subarachnoid spaces (BESS), subdural collections, hydrocephalus, and neoplasm. When the fontanelle is open, the etiology can usually be diagnosed on head ultrasound, and this should therefore be the initial screening test of choice. In the absence of an open fontanelle, or if there are other signs and symptoms of acute raised intracranial pressure (vomiting, headache, irritability, drowsiness, full fontanelle, sun setting eyes), the etiology should be diagnosed with MRI, if available, in order to limit radiation exposure. There is growing evidence that exposure to radiation through CT imaging increases a child's life long risk of cancer, and so all care should be taken to minimize this exposure as much as possible. Ultrasound (when fontanelle open), and/or MRI (when fontanelle closed), are therefore the screening tests of choice to investigate macrocephaly.

2 Don't image a midline dimple related to the coccyx in an asymptomatic infant or child.

Sacroccocygeal dimples (also called simple sacral dimples or sacroccocygeal pits) are common findings in newborns, with a prevalence of approximately 2 to 5%. They are not associated with any increased risk of occult spinal dysraphism (e.g., low lying conus, fatty filum, lipomyelomeningocele, split cord malformation, dermal sinus tract, etc.) compared with the general population of infants without sacroccocygeal dimples. There is therefore no need to investigate infants with this finding, with either ultrasound or MRI. Red flags for which investigating would be indicated include the presence of midline tuft of hair, sacral dimple or sinus tract above the gluteal cleft, hemangioma, dermal appendage, and/or a subcutaneous lump. The ideal choice for initial investigation (ultrasound or MRI) would depend on the specific cutaneous findings and clinical symptoms present.

3 Don't use CT scans for routine imaging of children with hydrocephalus. Fast sequence non-sedated MRIs or ultrasounds provide adequate information to assess patients without exposing them to radiation or an anesthetic.

Children with hydrocephalus, on average, obtain two head imaging assessments annually until the age of 20. Their lifetime increase risk of fatal cancer is estimated to be 1 excess case of fatal cancer per 97 patients if standard head CT is used, or 1 excess case of fatal cancer per 230 patients if low-dose head CT is used. Head ultrasound (in infants with open fontanelles), and rapid sequence MRI (in all other children) do not require ionizing radiation and adequately assess for radiographic change in ventricle size. A rapid sequence MRI can be obtained without sedation and in under 3 minutes. It is therefore recommended that ultrasound (in infants with open fontanelles), or rapid sequence MRI (in all other children) be used for surveillance imaging in hydrocephalus at minimum, and ideally in emergency assessments as well when available. In the emergent setting, or when MRI is not available, low-dose non-contrast CT is appropriate.

4 Don't recommend helmets for mild to severe positional flattening.

Positional flattening is very common, affecting up to 40% of infants since the Back to Sleep campaign began in 1992. There is now prospective, randomized control trial evidence that helmeting is no better at improving head shape in mild to severe positional flattening compared with physical therapy and providing general positioning recommendations such as maximizing tummy time while awake, and limiting time in swings and car seats. New guidelines from the Congress of Neurological Surgeons, following a systematic literature review including a review of the randomized trial mentioned above, consider helmeting as an option for severe cases of positional flattening. The prevalence of positional flattening in teens from the era following the Back to Sleep campaign but before helmets were widely used was less than 2%, suggesting that regardless of both the intervention used and the severity of the flattening, the vast majority of cases of positional flattening will cosmetically normalise. The cost of helmeting is also significant; a helmet costs thousands of dollars, and requires frequent adjustments over several months to adjust to an infant's growing head. There are also risks associated with helmeting, including pressure sores and interference with parental attachment. With its associated high cost and only very weak evidence of benefit in treating positional flattening, there is no clear additional value in recommending helmets for infants with mild to severe positional flattening in addition to traditional positioning recommendations and physiotherapy.

5 Don't do routine surveillance imaging for incidentally discovered Chiari I malformation.

Chiari I malformation, defined as cerebellar tonsillar herniation greater than or equal to 5mm below the foramen magnum on MRI brain, is a frequent incidental finding in children, with an estimated prevalence of 1 to 3%. The vast majority of children with incidentally discovered, asymptomatic Chiari I malformations have no clinically significant progression of tonsillar descent on routine follow-up, and symptom development is often unassociated with radiographic change. Radiographic follow-up in the absence of new symptomatology is therefore unnecessary.

How the list was created

The Canadian Pediatric Neurosurgery Study Group (CPNSG)'s membership is composed of pediatric neurosurgeons practicing in Canada. Contact information for the group's members was used to invite pediatric neurosurgeons practicing in Canada to complete two anonymized emailed questionnaires, first to brainstorm recommendations, and then to rate them. Recommendations that had overall support were presented for discussion at the CPNSG annual meeting in 2016. From this list, suggested recommendations were eliminated if they were felt by the study group to not be adequately evidence-based, or if they were felt to not be significantly impactful on a pediatric neurosurgical patient population. A final questionnaire was then sent out to Canadian pediatric neurosurgeons, asking each participant to rank each of the final suggested recommendations. The top five suggested recommendations with the strongest support were then selected as the Choosing Wisely Canada recommendations for pediatric neurosurgery and presented to Choosing Wisely Canada for final approval and endorsement.

Sources

- 1 Chen JX, Kachniarz B, Gilani S, et al. Risk of malignancy associated with head and neck CT in children: a systematic review. *Otolaryngol Head Neck Surg*. 2014 Oct;151(4):554-66. PMID: 25052516.

Mathews JD, Forsythe AV, Brady Z, et al. Cancer risk in 680,000 people exposed to computed tomography scans in childhood or adolescence: data linkage study of 11 million Australians. *BMJ*. 2013 May 21;346:f2360. PMID: 23694687.

Miglioretti DL, Johnson E, Williams A, et al. The use of computed tomography in pediatrics and the associated radiation exposure and estimated cancer risk. *JAMA Pediatr*. 2013 Aug 1;167(8):700-7. PMID: 23754213.

Pearce MS, Salotti JA, Little MP, et al. Radiation exposure from CT scans in childhood and subsequent risk of leukaemia and brain tumours: a retrospective cohort study. *Lancet*. 2012 Aug 4;380(9840):499-505. PMID: 22681860.

Tucker J, Choudhary AK, Piatt J. Macrocephaly in infancy: benign enlargement of the subarachnoid spaces and subdural collections. *J Neurosurg Pediatr*. 2016 Jul;18(1):16-20. PMID: 26942270.
- 2 Albert GW. Spine ultrasounds should not be routinely performed for patients with simple sacral dimples. *Acta Paediatr*. 2016 Aug;105(8):890-4. PMID: 27059606.

Kucera JN, Coley I, O'Hara S, et al. The simple sacral dimple: diagnostic yield of ultrasound in neonates. *Pediatr Radiol*. 2015 Feb;45(2):211-6. PMID: 24996813.

Zywicke HA, Rozzelle CJ. Sacral dimples. *Pediatr Rev*. 2011 Mar;32(3):109-13; quiz 114, 151. PMID: 21364014.
- 3 DeFlorio RM, Shah CC. Techniques that decrease or eliminate ionizing radiation for evaluation of ventricular shunts in children with hydrocephalus. *Semin Ultrasound CT MR*. 2014 Aug;35(4):365-73. PMID: 25129213.

Koral K, Blackburn T, Bailey AA, et al. Strengthening the argument for rapid brain MR imaging: estimation of reduction in lifetime attributable risk of developing fatal cancer in children with shunted hydrocephalus by instituting a rapid brain MR imaging protocol in lieu of Head CT. *AJNR Am J Neuroradiol*. 2012 Nov;33(10):1851-4. PMID: 22555583.

O'Neill BR, Pruthi S, Bains H, et al. Rapid sequence magnetic resonance imaging in the assessment of children with hydrocephalus. *World Neurosurg*. 2013 Dec;80(6):e307-12. PMID: 23111234.

Patel DM, Tubbs RS, Pate G, et al. Fast-sequence MRI studies for surveillance imaging in pediatric hydrocephalus. *J Neurosurg Pediatr*. 2014 Apr;13(4):440-7. PMID: 24559278.

Tekes A, Jackson EM, Ogborn J, et al. How to Reduce Head CT Orders in Children with Hydrocephalus Using the Lean Six Sigma Methodology: Experience at a Major Quaternary Care Academic Children's Center. *AJNR Am J Neuroradiol*. 2016 Jun;37(6):990-6. PMID: 26797143.
- 4 Kmietowicz Z. Expensive helmets do not correct skull flattening in babies. *BMJ*. 2014 May 1;348:g3066. PMID: 24791750.

Roby BB, Finkelstein M, Tibesar RJ, et al. Prevalence of positional plagiocephaly in teens born after the "Back to Sleep" campaign. *Otolaryngol Head Neck Surg*. 2012 May;146(5):823-8. PMID: 22241785.

Tamber MS, Nikas D, Beier A, et al. Congress of Neurological Surgeons Systematic Review and Evidence-Based Guideline on the Role of Cranial Molding Orthosis (Helmet) Therapy for Patients With Positional Plagiocephaly. *Neurosurgery*. 2016 Nov;79(5):E632-E633. PMID: 27776089.

van Wijk RM, van Vlimmeren LA, Groothuis-Oudshoorn CG, et al. Helmet therapy in infants with positional skull deformation: randomised controlled trial. *BMJ*. 2014 May 1;348:g2741. PMID: 24784879.
- 5 Gupta SN, Gupta VS, White AC. Spectrum of intracranial incidental findings on pediatric brain magnetic resonance imaging: What clinician should know? *World J Clin Pediatr*. 2016 Aug 8;5(3):262-72. PMID: 27610341.

Morris Z, Whiteley WN, Longstreth WT Jr, et al. Incidental findings on brain magnetic resonance imaging: systematic review and meta-analysis. *BMJ*. 2009 Aug 17;339:b3016. PMID: 19687093.

Poretti A, Ashmawy R, Garzon-Muvdi T, et al. Chiari Type 1 Deformity in Children: Pathogenetic, Clinical, Neuroimaging, and Management Aspects. *Neuropediatrics*. 2016 Oct;47(5):293-307. PMID: 27337547.

Pomeranic J, Ksendzovsky A, Awad AJ, et al. Natural and surgical history of Chiari malformation Type I in the pediatric population. *J Neurosurg Pediatr*. 2016 Mar;17(3):343-52. PMID: 26588459.

Whitson WJ, Lane JR, Bauer DF, et al. A prospective natural history study of nonoperatively managed Chiari I malformation: does follow-up MRI surveillance alter surgical decision making? *J Neurosurg Pediatr*. 2015 Aug;16(2):159-66. PMID: 25932776.

About Choosing Wisely Canada

Choosing Wisely Canada is a campaign to help clinicians and patients engage in conversations about unnecessary tests, treatments and procedures, and make smart and effective choices to ensure high-quality care.

For more information on Choosing Wisely Canada or to see other lists of Five Things Physicians and Patients Should Question, visit www.choosingwiselycanada.org. Join the conversation on Twitter @ChooseWiselyCA.

About The Canadian Pediatric Neurosurgery Study Group

The Canadian Pediatric Neurosurgery Study Group (CPNSG) is a proud partner of the Choosing Wisely Canada campaign. The CPNSG is a national collaborative representing all provincial pediatric neurosurgery centres across Canada and is dedicated to optimizing Canadian pediatric neurosurgical patient care through collaborative data collection, clinical research and innovation.