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Neonatal Gastrostomy

One of the main reasons for prolonged hospitalization in newborn infants is delay in achieving full oral feedings. Infants who are unable to orally feed or have insufficient oral intakes require longer hospitalization after birth. Prematurity impacts negatively in the attainment of feeding milestones and 40% of infants referred to feeding clinics are born preterm. Infants may not be able to achieve full oral feedings due to congenital anomalies, being congenital heart disease one of the main reasons, genetic conditions, neurologic injury, respiratory insufficiency and extreme prematurity. Feeding difficulty in infants in the neonatal period are related to sensory or motor neurologic vulnerabilities, static or progressive neurological disease, behavioral deficits, chronic lung disease, gastrointestinal disorders or a combination of all of these etiologies. When the neonate cannot consume adequate oral feeding, is gavage-tube feeding dependent, suffers from postprandial related cardio-respiratory spells, refuse to feed or has poor sucking ability a gastrostomy tube placement is performed. Gastrostomy placement is most strongly associated with bronchopulmonary dysplasia, intraventricular hemorrhage or periventricular leukomalacia and small for gestational age status. Gavages tubes when dislodge results in a high choking and aspiration risk, are associated with leaks, infection, reflux and feeding aversion. Nevertheless, home nasogastric feeding is a particular good alternative in infants discharge home on room air or nasal cannulas who are taking almost 50% of feeds orally. Gastrostomy tube are either placed open, laparoscopically or using endoscopic technique (PEG) depending on the preference of the surgeon. Gastrostomy tubes are placed when the baby attains at least 3 Kg of weight. Surgeons are moving to laparoscopic gastrostomy as the standard of care. Carbon dioxide insufflation and absorption during short laparoscopic procedures have demonstrated no significant alteration in cerebral or renal oxygenation or oxygen extraction. Premature infants that undergo gastrostomy placement have a significant increased risk of both inpatient readmission and emergency department visits within three months of NICU discharge. One-third of infants with g-tube have at least one emergency department visit and 9% multiple, with inadvertent removal/misplacement of the tube being the most common cause. For NICU infants who cannot feed or take medications by mouth, gastrostomy tube represents a safe way of administering nutrition and medications for long periods of time. After placement of the g-tube, infants may take more than two weeks to gain weight at rates seen prior to the surgery. Weight gain and appropriate growth occur more frequently in the population of children with neurodevelopmental disability when g-tubes placement occurs early, before morbidity and malnutrition become evident. Additional benefits of g-tube placement in newborns include safety of administration of nutrients, fluids, and medications, as well as facilitating discharge

planning, including parental comfort and decreased stress regarding the long-term nutritional status of the baby.

References:
1- Jadcherla SR, Khot T, Moore R, Malkar M, Gulati IK, Slaughter JL: Feeding Methods at Discharge Predict Long-Term Feeding and Neurodevelopmental Outcomes in Preterm Infants Referred for Gastrostomy Evaluation. J Pediatr. 181: 125-130, 2017
2- Duncan TL, Ulugia J, Bucher BT: Association of gastrostomy placement on hospital readmission in premature infants. J Perinatol. 39(11):1485-1491, 2019
3- Munoz A, Tan J, Hopper A, Vannix R, Carter H, Woodfin M, Blood A, Baerg J: Cerebral and Renal Oxygenation in Infants Undergoing Laparoscopic Gastrostomy Tube Placement. J Surg Res. 256:83-89, 2020
4- Puia-Dumitrescu M, Benjamin DK Sr, Smith PB, et al: Impact of Gastrostomy Tube Placement on Short-Term Weight Gain in Hospitalized Premature Infants. JPEN J Parenter Enteral Nutr. 44(2):355-360, 2020
5- Chapman A, George K, Selassie A, Lesher AP, Ryan RM: NICU infants who require a feeding gastrostomy for discharge. J Pediatr Surg. 56(3):449-453, 2021
6- Khalil ST, Uhing MR, Duesing L, et al: Outcomes of Infants With Home Tube Feeding: Comparing Nasogastric vs Gastrostomy Tubes. JPEN J Parenter Enteral Nutr. 41(8):1380-1385, 2017
7- Williams SL, Popowics NM, Tadesse DG, Poindexter BB, Merhar SL: Tube feeding outcomes of infants in a Level IV NICU. J Perinatol. 39(10):1406-1410, 2019

Multiple Endocrine Neoplasia Type 2

The multiple endocrine neoplasia type 2 (MEN-2) is a rare autosomal dominant inherited disorder caused by a germline mutation in the RET protooncogene with a prevalence of one in 30,000 live births. The RET protooncogene encodes the transmembrane tyrosine kinase receptor on chromosome 10q11.2. MEN-2 consists of three different syndromes: the MEN-2A (80-90%) characterized by medullary thyroid carcinoma (MTC), pheochromocytoma and primary hyperparathyroidism, the MEN-2B (5-10%) characterized by MTC, pheochromocytoma in children with distinct physical manifestation such as marfanoid habitus and multiple neuromas, and the familial MTC. Direct DNA analysis allows identification of children with MEN-2A. MTC is usually the first neoplasm to develop in 90-100% of cases, and the most common cause of death in MEN patients. This is the reason why prophylactic total thyroidectomy before the age of 5 years is recommended to those with the RET protooncogene mutation of codon 634 in the extracellular domain of the receptor. MTC in MEN-2 children can be cured by surgically removing all the c-cells at risk of becoming malignant. Calcitonin is utilized as marker of residual or recurrent disease. Pheochromocytomas has an incidence of 50% in MEN-2 syndromes, they are diagnosed at an earlier age, mostly of adrenal origin, rarely becomes metastatic, although they most almost always develop bilaterally. Management is surgical excision of the tumor harboring the pheochromocytoma. Cortical sparing adrenalectomy can be performed as part of bilateral adrenal resection. Hyperparathyroidism caused by hyperplasia of the gland occurs in 35% of patients with MEN-2. A group of children with MEN-2A develop Hirschsprung's disease (HD). Diagnosis is through rectal biopsy and management is pull-through surgery. In MEN-2B, pheochromocytomas develop in 50% of patients and all patients have neural gangliomas, particularly in the mucosa of the digestive tract, conjunctiva, lips and tongue. MEN-2B do not develop hyperparathyroidism. MTC in MEN-2B develop at a very young age (infancy) and appears to be the most aggressive form of hereditary MTC. Prophylactic

total thyroidectomy is recommended before the age of two years in children with MEN-2B. Gastrointestinal ganglioneuromatosis is the predominant etiology of most alimentary tract symptoms in children with MEN-2B, resulting in thickening of myenteric plexus and ganglion cell hypertrophy leading to loss of normal bowel tone, distension, segmental dilatation and megacolon, though the number of ganglion cells is not reduced or absent as with HD. They develop constipation and intermittent diarrhea. Management is conservative, as symptoms are less severe than MEN-2A with HD. Marfanoid habitus is present in 65-75% of children with MEN-2B characterized by elongated face, large hands and feet with relatively long extremities. Skeletal anomalies include lordosis, kyphosis, joint laxity and talipes equine varus. 86% of MEN-2B are unable to shed tears. Familial MTC represent the remaining hereditary MTC cases and is characterized by presence of MTC without pheochromocytoma, hyperparathyroidism or physical characteristics of MEN-2B. MTC has a late onset with a good prognosis in the majority of familial cases. Late genetic testing, surgery beyond recommended age and elevated basal calcitonin levels are factors associated with higher rate of MTC in the specimen. No lymph node metastasis is present with basal calcitonin below 40 pg/ml. Above that level or in the presence of clinical palpable lymph nodes central lymph node dissection is recommended during thyroidectomy.

References:

1- Danko ME, Skinner MA: Surgical intervention in children with multiple endocrine neoplasia type 2. Curr Opin Pediatr. 18(3):312-5, 2006

2- Martucciello G, Lerone M, Bricco L, Tonini GP, Lombardi L, Del Rossi CG, Bernasconi S: Multiple endocrine neoplasias type 2B and RET proto-oncogene. Ital J Pediatr. 38:9, 2012

3- Machens A, Dralle H: Multiple endocrine neoplasia type 2: achievements and current challenges. Clinics (Sao Paulo). 67 Suppl 1(Suppl 1):113-8, 2012

4- Wohllk N, Schweizer H, Erlic Z, et al: Multiple endocrine neoplasia type 2. Best Pract Res Clin Endocrinol Metab. 24(3):371-87, 2010

5- Prete FP, Abdel-Aziz T, Morkane C, et al: Prophylactic thyroidectomy in children with multiple endocrine neoplasia type 2. Br J Surg. 105(10):1319-1327, 2018

6- Bussieres V, Roy S, Deladoey J, et al: Prophylactic thyroidectomies in MEN2 syndrome: Management and outcomes. J Pediatr Surg. 53: 283-285, 2018

7- Ordonez J, Perez-Egido L, Garcia-Casillas, et al: Management and results of thyroidectomies in pediatric patients with MEN 2 syndrome. J Pediatr Surg. https://doi.org/10.1016/j.pedsurg.2021.02.061

Functioning Adrenocortical Tumors

Adrenocortical tumors (ACT) in children are rare, comprising 10-25% of all adrenal neoplasms. It is estimated that 25 new cases are seen each year in the US. The incidence is high in southern Brazil due to a high rate of mutation in the tumor suppression gene p53. Most of these tumors (95%) are functional producing hormones such as androgens, cortisol, aldosterone and estrogens in decreasing order of frequency. In cases who present with virilization, the most prominent symptom is rapid growth, acne, deepening of the voice, advanced bone age, clitoromegaly or penile enlargement. Functional adrenocortical tumors have a good prognosis when managed appropriately. Functioning ACT has a peak presentation during the first decade of life and occur more commonly in females. A family history is common in cases of ACT. Survival rates are better in children with ACT than adults. ACT in children are associated with Beckwith-Weidman, MEN-1, Carney complex,

congenital adrenal hyperplasia or Li-Fraumeni syndromes. The most common clinical presentation is virilization, followed by cushingoid features, hypertension, hyperestrogenism or a combination of these clinical manifestations. Adrenocortical adenomas and carcinomas can occur both in children with ACT. Presence of metastasis is absolute evidence of malignancy. Criteria suggesting malignancy include large tumor size, tumor weight exceeding 400 gm, extension into periadrenal soft tissue, high nuclear grade, high mitotic rate per high power field (> 15 mitotic figures per 20 HPF), atypical mitosis, diffuse architecture, necrosis, capsular invasion and vascular invasion. ACT in young children and infants are more likely associated with the best overall prognosis and may not be as uniformly fatal as they are in older children. A thorough hormonal evaluation is needed for a precise classification of functioning ACT even if there is no clinical sign or symptom of hormone excess. Most ACT are located in the left adrenal gland. Most imaging modalities (US, CT and MRI) can detect the adrenal tumor. Management of ACT is surgical excision of the affected adrenal gland. The laparoscopic approach for removing the adrenal gland is the gold standard in all functioning ACT except the adrenocortical carcinoma, since minimal tumor spillage changes negatively the prognosis dramatically. In the postoperative follow-up, positron emission tomography with computer tomography (PET-CT) can be helpful in the detection of secondary lesions. Cryoablation should be considered in rare, selected cases of tumors that are not amenable to surgical resection.

References:

1- Patil KK, Ransley PG, McCullagh M, Malone M, Spitz L: Functioning adrenocortical neoplasms in children. BJU Int. 89(6):562-5, 2002

2- Ahmed AA: Adrenocortical neoplasms in young children: age as a prognostic factor. Ann Clin Lab Sci. 39(3):277-82, 2009

3- Ghazi AA, Mofid D, Salehian MT, et al: Functioning adrenocortical tumors in children-secretory behavior. J Clin Res Pediatr Endocrinol. 5(1):27-32, 2013

4- Mihai R: Rare adrenal tumors in children. Semin Pediatr Surg. 23(2):71-5, 2014

5- Gupta N, Rivera M, Novotny P, Rodriguez V, Bancos I, Lteif A: Adrenocortical Carcinoma in Children: A Clinicopathological Analysis of 41 Patients at the Mayo Clinic from 1950 to 2017. Horm Res Paediatr. 90(1):8-18, 2018

6- Lopes RI, Suartz CV, Neto RP, et al: Management of functioning pediatric adrenal tumors. J Pediatr Surg. 56: 768-771, 2021

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