Anaesthetic Management of Diabetic Child

Essay

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in Anaesthesia

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وأنزل الله عليك
الكتاب والحكمة
وعلَّمَكَ مَا لَمْ تَكُن
تَعْلَمُ وكَانَ فَضْلُ
اللَّهِ عَلَيْكَ عَظِيماً
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Candidate

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List of Abbreviations

Abbr.	Full-term
ACR	: Albumin/creatinine ratio
ADA	: American Diabetes Association
BG	: Blood glucose
BOHB	: Blood glucose and measure blood ß-hydroxybutyrate
cIMT	: Carotid intima-media thickness
CKD	: Chronic kidney disease
CSII	: Continuous subcutaneous insulin infusion
CVD	: Cardiovascular disease
DHC	: Diabetes healthcare
DKA	: Diabetic ketoacidosis
DN	: Diabetic neuropathy
ECG	: Electrocardiogram
eGFR	: Estimated GFR
GA	: General anesthetic
GAD	: Glutamic acid decarboxylase
I-A2	: Insulinoma-associated antigen 2
IAA	: Insulin auto antibodies
ICA	: Islet cell antibodies
ICU	: Intensive care unit
IV	: Intravenous

List of Abbreviations (Cont.)

Abbr.	Full-term
IFG	: Impaired fasting glycaemia
IGT	: Impaired glucose tolerance
IMCL	: Intramyocellular lipid content
IV	: Intravenous
LDL-C	: Low-density lipoprotein cholesterol
MODY	: Maturity onset diabetes of the young
NPH	: Neutral protamine Hagedorn
NPO	: Nil per os
OGTT	: Oral glucose tolerance test
OHAs	: Oral hypoglycaemic agents
PG	: Plasma glucose; SC, subcutaneous.
PPI	: Preproinsulin
T1D	: Type 1 diabetes
TCRs	: T cell antigen receptors
TDD	: Total daily dose
TPN	: Total parenteral nutrition
Treg	: T regulatory
VDD	: Vitamin D deficiency
ZnT8	: Zinc transporter

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Introduction

Diabetes mellitus is a group of metabolic diseases characterised by chronic hyperglycemia resulting from defects in insulin secretion, insulin action, or both. If ketones are present in blood or urine, treatment is urgent, because ketoacidosis can evolve rapidly ***(Craig et al., 2009).***

Type 1 diabetes results from the autoimmune destruction of insulin-producing β cells in the pancreas. Genetic and, as yet undefined, environmental factors act together to precipitate the disease. The excess mortality associated with the complications of type 1 diabetes and the increasing incidence of childhood type 1 diabetes emphasize the importance of therapeutic strategies to prevent this chronic disorder ***(Kathleen, 2006).*** Type 2 diabetes in youth was almost unheard of only two decades ago. However, tracking the recent dramatic rise in childhood obesity, type 2 diabetes has become increasingly prevalent ***(Gemmill et al., 2011).***

The incidence of both type 1 and type 2 diabetes mellitus in children is increasing worldwide. The use of insulin pumps and various multicomponent insulin regimens has increased the complexity of perioperative management of children with diabetes. Anesthesiologists must carefully consider the pathophysiology of the disease, as well as each child's specific diabetes treatment regimen, glycemic control, intended surgery, and anticipated postoperative course, when devising an

appropriate perioperative management plan. Standardized algorithms for perioperative diabetes management improve care without significantly increasing costs ***(Krane et al., 2013).***

When children with diabetes require surgery or other procedures requiring sedation or anaesthesia, optimal management should maintain adequate hydration and near to normal glycemia, while minimising the risk of hypoglycemia. The stress of surgery may cause acute hyperglycemia, which increases the risk of postoperative infection ***(Betts et al., 2009).*** The management of the pediatric patient before, during and after surgery or diagnosis is aimed at maintaining a normal glucose level; i.e. plasma sugar between 100 y 200 mg/dL. The goal is to keep the patient within this range to reduce the risk of osmotic diuresis, dehydration, hydroelectrolytic imbalance, metabolic acidosis, infection and hypoglycemia.The diabetic child scheduled for minor surgical interventions can be admitted on the same day of surgery, while those scheduled for major surgical procedures should be admitted one day before surgery ***(Ana et al., 2011).***

Once the child is able to resume oral nutrition, resume the child's usual diabetes treatment regimen. Give short- or rapid-acting insulin (based on the child's usual insulin: carbohydrate ratio and correction factor), if needed, to reduce hyperglycemia or to match food intake ***(Erinn et al., 2014).***

Aim of the Study

The aim of this study is to provide clear and standardised guidelines for all staff caring for paediatric patients with type 1 and 2 diabetes requiring a general anaesthetic or sedation for surgery.

Chapter (1):
Pathophysiology of Diabetes Mellitus

Definition:

Diabetes mellitus is a general term for heterogeneous disturbances of metabolism for which the main finding is chronic hyperglycaemia. The cause is either impaired insulin secretion or impaired insulin action or both. The definition includes the following criteria:

- HbA1c ≥6.5% (≥48mmol/mol)
- Random plasma glucose ≥200mg/dl (≥11.1mmol/l)
- Fasting plasma glucose ≥126mg/dl (≥7.0mmol/dl)
- OGTT 2-hour glucose in venous plasma ≥200mg/dl (≥11.1mmol/l)

These guidelines have been recommending the use of HbA1c for diagnosing diabetes since 2010 ***(Kerner et al., 2014).***

Classification

Table (1): Etiologic classification of diabetes mellitus ***(Drouin et al., 2013)***

- Type 1 diabetes (β-cell destruction, usually leading to absolute insulin deficiency)
  - A. Immune mediated
  - B. Idiopathic
- Type 2 diabetes (may range from predominantly insulin resistance with relative insulin deficiency to a predominantly secretory defect with insulin resistance)

- Other specific types
  - A. A. Genetic defects of β-cell function
    1. Chromosome 12, HNF-1α (MODY3)
    2. Chromosome 7, glucokinase (MODY2)
    3. Chromosome 20, HNF-4α (MODY1)
    4. Chromosome 13, insulin promoter factor-1 (IPF-1; MODY4)
    5. Chromosome 17, HNF-1β (MODY5)
    6. Chromosome 2, *NeuroD1* (MODY6)
    7. Mitochondrial DNA
    8. Others
  - B. Genetic defects in insulin action
    1. Type A insulin resistance
    2. Leprechaunism
    3. Rabson-Mendenhall syndrome
    4. Lipoatrophic diabetes
    5. Others
  - C. Diseases of the exocrine pancreas
    1. Pancreatitis
    2. Trauma/pancreatectomy
    3. Neoplasia
    4. Cystic fibrosis
    5. Hemochromatosis
    6. Fibrocalculous pancreatopathy
    7. Others
  - D. Endocrinopathies
    1. Acromegaly
    2. Cushing's syndrome
    3. Glucagonoma

4. Pheochromocytoma
5. Hyperthyroidism
6. Somatostatinoma
7. Aldosteronoma
8. Others

E. Drug or chemical induced
1. Vacor
2. Pentamidine
3. Nicotinic acid
4. Glucocorticoids
5. Thyroid hormone
6. Diazoxide
7. β-adrenergic agonists
8. Thiazides
9. Dilantin
10. γ-Interferon
11. Others

F. Infections
1. Congenital rubella
2. Cytomegalovirus
3. Others

G. Uncommon forms of immune-mediated diabetes
1. "Stiff-man" syndrome
2. Anti-insulin receptor antibodies
3. Others

H. Other genetic syndromes sometimes associated with diabetes
1. Down syndrome
2. Klinefelter syndrome
3. Turner syndrome
4. Wolfram syndrome
5. Friedreich ataxia
6. Huntington chorea
7. Laurence-Moon-Biedl syndrome
8. Myotonic dystrophy
9. Porphyria
10. Prader-Willi syndrome
11. Others

- Gestational diabetes mellitus