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Friedreich's ataxia

Glycogen storage disease type I

orphanaesthesia

a project of the German Society
of Anaesthesiology and Intensive Care Medicine

SUPPLEMENT NR. 4 | 2017

OrphanAnesthesia –
ein krankheitsübergreifendes Projekt des Wissenschaftlichen Arbeitskreises Kinderanästhesie der Deutschen Gesellschaft für Anästhesiologie und Intensivmedizin e.V.

Ziel des Projektes ist die Veröffentlichung von Handlungsempfehlungen zur anästhesiologischen Betreuung von Patienten mit seltenen Erkrankungen. Damit will Orphan Anesthesia einen wichtigen Beitrag zur Erhöhung der Patientensicherheit leisten.

Patienten mit seltenen Erkrankungen benötigen für verschiedene diagnostische oder therapeutische Prozeduren eine anästhesiologische Betreuung, die mit einem erhöhten Risiko für anästhesieassoziierte Komplikationen einhergehen. Weil diese Erkrankungen selten auftreten, können Anästhesisten damit keine Erfahrungen gesammelt haben, so dass für die Planung der Narkose die Einholung weiterer Information unerlässlich ist. Durch vorhandene spezifische Informationen kann die Inzidenz von mit der Narkose assoziierten Komplikationen gesenkt werden. Zur Verfügung stehendes Wissen schafft Sicherheit im Prozess der Patientenversorgung.

Die Handlungsempfehlungen von OrphanAnesthesia sind standardisiert und durchlaufen nach ihrer Erstellung einen Peer-Review-Prozess, an dem ein Anästhesist sowie ein weiterer Krankheitsexperte (z.B. Pädiater oder Neurologe) beteiligt sind. Das Projekt ist international ausgerichtet, so dass die Handlungsempfehlungen grundsätzlich in englischer Sprache veröffentlicht werden.

Ab Heft 5/2014 werden im monatlichen Rhythmus je zwei Handlungsempfehlungen als Supplement der A&I unter www.ai-online.info veröffentlicht. Als Bestandteil der A&I sind die Handlungsempfehlungen damit auch zitierfähig. Sonderdrucke können gegen Entgelt bestellt werden.

Bisher in A&I publizierte Handlungsempfehlungen finden Sie unter:

www.ai-online.info/Orphsuppl
www.orphananesthesia.eu

OrphanAnesthesia –
a common project of the Scientific Working Group of Paediatric Anaesthesia of the German Society of Anaesthesiology and Intensive Care Medicine

The target of OrphanAnesthesia is the publication of anaesthesia recommendations for patients suffering from rare diseases in order to improve patients' safety. When it comes to the management of patients with rare diseases, there are only sparse evidence-based facts and even far less knowledge in the anaesthetic outcome. OrphanAnesthesia would like to merge this knowledge based on scientific publications and proven experience of specialists making it available for physicians worldwide free of charge.

All OrphanAnesthesia recommendations are standardized and need to pass a peer review process. They are being reviewed by at least one anaesthesiologist and another disease expert (e.g. paediatrician or neurologist) involved in the treatment of this group of patients.

The project OrphanAnesthesia is internationally oriented. Thus all recommendations will be published in English.

Starting with issue 5/2014, we'll publish the OrphanAnesthesia recommenations as a monthly supplement of A&I (Anästhesiologie & Intensivmedizin). Thus they can be accessed and downloaded via www.ai-online.info. As being part of the journal, the recommendations will be quotable. Reprints can be ordered for payment.

A survey of until now in A&I published guidelines can be found on:

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orphananesthesia

Anaesthesia recommendations for patients suffering from

Glycogen storage disease type I

Disease name: Glycogen storage disease type I

ICD 10: E74.0

Synonyms: von Gierke disease, glycogenosis type I, glucose-6-phosphatase deficiency, GSD-I

Disease summary: Glycogen storage disease type I is a rare autosomal recessive inherited disorder with an annual incidence of approximately 1:100,000 [1]. Due to a deficiency of glucose-6-phosphatase [2], glycogen stored in the liver cannot be metabolized. This leads to poor tolerance to fasting and increased risk of hypoglycemia and lactate acidosis. The accumulation of glycogen [3] in liver tissue leads to hepatomegaly, and later in life to an increased risk of hepatocellular adenoma and/or carcinoma. The clinical presentation is accompanied by growth retardation. Renal affection, hyperlipidemia [4], and platelet dysfunctions [5] are common. Perioperative management has to focus on metabolic homeostasis by adequate glucose supply and prevention of lactate acidosis exacerbation. Platelet dysfunction poses a challenge to regional anaesthesia techniques, and haemostasis throughout an operation. Subtype Ib is caused by deficiency of glucose-6-phosphatase-translocase and is accompanied by neutrophil dysfunction, recurrent infections, autoimmune thyreoid disease, and inflammatory bowel disease.

Medicine in progress

Perhaps new knowledge

Every patient is unique

Perhaps the diagnostic is wrong

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Typical surgery

Oral/facial surgery in type Ib: Relapsing aphthous gingivostomatitis and its complications.

Abdominal surgery: adenoma and carcinoma resection [6,7], liver transplantation, liver biopsy, pancreatitis.

Type of anaesthesia

General anaesthesia as well as all regional anaesthesia techniques have been performed in patients with GSD-I. Both demonstrate specific issues in GSD-I that the anaesthesiologist has to be aware of.

General anaesthesia: Prolonged fasting in the perioperative period leads to hypoglycemia and lactate acidosis. Adequate glucose supply throughout the fasting period is essential for homeostasis of the metabolic situation [8,9]. Hepatomegaly and enzyme induction can potentially lead to altered pharmacology of anaesthetic drugs, both in reduced or accelerated clearance, although this has not been studied specifically.

Regional anaesthesia: GSD-I is associated with platelet dysfunction [5,10], which is in part correlated to the extent of the dyslipidemia [4]. Clinically, the platelet dysfunction can lead to recurrent epistaxis and ecchymosis, which should be noted as important sign for later haemorrhagic adverse events throughout an operation. Platelet count and functional testing can quantify the extent of the platelet dysfunction prior to planned surgery. Neuraxial anaesthesia, specifically epidural catheters have been placed without complications [6]. In several cases, specifically for caesarean sections, spinal anaesthesia has been performed safely [11].

Necessary additional diagnostic procedures (preoperative)

Prior to planned surgery, the following blood tests should be performed: complete blood count (neutrophil count in subtype GSD-Ib), creatinine, triglyceride, cholesterol [4], electrolyte status, uric acid [12], urine status [13], thyroid hormone status [14], and if possible platelet function.

Lactate and blood glucose levels have to be monitored closely during the fasting period until the regular enteral glucose supply is re-established.

Echocardiography and ECG can be helpful when signs of pulmonary hypertension, a rare but severe complication described in GSD-I, are present [15,16].

Patients should wear a medical alert identification. Admission to the hospital should be 24 hours prior to planned surgery to allow for adequate infusion therapy, and metabolic control [17].

Particular preparation for airway management

In GSD-Ib, oral aphthous gingivostomatitis is common. Its complications could potentially lead to problems in airway management, but airway problems have not been reported specifically so far.

Particular preparation for transfusion or administration of blood products

Platelet dysfunction can be treated by transfusion of homologue platelet concentrates. Nonsteroidal anti-inflammatory drugs and medications that affect platelet function should be avoided. In case of severe neutrophil dysfunction in GSD-Ib, haematopoietic stem cell transplantation can be an option, and transfusion management should in this case be directed in order to avoid later incompatibilities. Otherwise, GSD-I does not pose specific problems for transfusions of RBCs or plasma. There is no data on the – theoretically evident – benefit of desmopressin.

Particular preparation for anticoagulation

Not reported. Although arterial dysfunction, characterized by increased media thickness, is described, the overall risk of atherosclerosis and cardiovascular complications does not seem to be increased in early adulthood [18,19].

Particular precautions for positioning, transport or mobilisation

GSD-I can lead to osteopenia and osteoporosis, although they are usually not associated with fractures. Given the case, careful positioning is advised.

Due to hepatomegaly, abdominal compression in prone position should be avoided or minimized in order to avoid hepatic injuries due to compression.

Probable interaction between anaesthetic agents and patient's long term medication

Common drugs used in long-term therapy are ACE-inhibitors and allopurinole. Hepatomegaly can be associated with enzyme induction and can potentially lead to accelerated or reduced hepatic clearance.

Anaesthesiologic procedure

Glucose supply and perioperative fasting:

Standard therapy for the reduced fasting tolerance in GSD-I is enteral supplementation with cornstarch [20]. Continuous supply of glucose is warranted by delayed resorption of long-chained carbohydrates, which are delivered enterally by nasogastral tube feeding overnight [9]. In infancy, nasogastral feeding is performed as continuous feeding, later as intermittent feeding every 4 to 6 hours [21]. During the obligatory preoperative fasting period prior to

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planned surgery, glucose uptake must be switched to parenteral glucose infusion. The amount of glucose delivered can vary individually and has to be adapted based on the dosage used in long-term therapy for this specific patient [22]. For orientation, 0.5-0.6g/kg/h in infancy and 0.3-0.4g/kg/h for the older child seem to fit most patients [10]. Table 1 shows practicable dosage regimes.

		child	infant	neonate
require-ment	g/kg/h	0.3 – 0.4	0.5	0.6
	mg/kg/min	5.0 – 6.7	8.3	10.0
enteral	cornstarch g/kg every 4h	1.2 – 1.6	2.0	2.4
	cornstarch g/kg every 6h	1.8 – 2.4		
parenteral	G-5% in ml/kg/h	6.0 – 8.0	10.0	12.0
	G-10% in ml/kg/h	3 - 4	5	6
	G-12.5% in ml/kg/h	2.4 – 3.2	4	4.8
	G-17.5% in ml/kg/h	1.71 – 2.29	2.86	3.43
	G-20% in ml/kg/h	1.5 - 2	2.5	3

Table 1: glucose requirements in different age groups.

For an infusion, a standardized Ringer-acetate solution with additional glucose can be used. [8]. The infusion should be free of lactate, and the glucose should be concentrated as high as possible in order to avoid excess volume and lactate [6].

Table 2 demonstrates possible infusions. For use in peripheral veins, only solutions containing less than 12.5% glucose should be used.

	desired overall glucose concentration	using ringer-acetate's solution	using E148G1Paed
additional G40%	10%	375ml ringer-acetate + 125ml G40%	385ml E148G1Paed + 115ml G40%
	12.5%	345ml ringer-acetate + 155ml G40%	355ml E148G1Paed + 145ml G40%
	17.5%	280ml ringer-acetate + 220ml G40%	290ml E148G1Paed + 210ml G40%
additional G70%	10%	430ml ringer-acetate + 70ml G70%	435ml E148G1Paed + 65ml G70%
	12.5%	410ml ringer-acetate + 90ml G70%	420ml E148G1Paed + 80ml G70%
	17.5%	375ml ringer-acetate + 125ml G70%	380ml E148G1Paed + 120ml G70%

Table 2: possible infusions.

During parenteral substitution, blood glucose levels and lactate have to be monitored closely. Repeated measurements should be performed throughout the fasting period until oral cornstarch feeding is re-established. Aim for glucose levels > 70mg/dl, and avoid rapid glucose fluxes.

Different from other glycogen storage diseases like type III or type V, GSD-I does not involve skeletal muscle cell, and does not demonstrate signs of a myopathy [3]. GSD-I is not associated with mutations of the RYR-receptor [23], therefore not resulting in limitations for inhalative anaesthetics. There are case reports of an increased risk for rhabdomyolysis in GSD-I patients [24]. A restrictive use of suxamethonium, only in situations where it is explicitly needed, seems to be reasonable.

The associated neutrophil defect of phagocytosis in GSD subtype Ib leads to an increased risk of infections. Asepsis is obligatory for all invasive procedures. A perioperative antibiotic therapy should cover staphylococcus [25].

Particular or additional monitoring

Unreliable BIS-monitoring in GSD-I has been reported [26]. In the specific case, hypoglycemia led to lower BIS-levels, and masked insufficient anaesthesia depth. Providers should be aware of possible confounders, such as hypoglycemia, when applying BIS-monitoring or other techniques.

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Placement of invasive arterial catheters is suggested by many authors for frequent drawing of blood samples.

Possible complications

Maintaining metabolic homeostasis should be the primary target in order to avoid possible complications. Lactate acidosis can occur. A calculated sodium bicarbonate supplementation can be used for correction of acidosis [8, 27]. Controlled hyperventilation is not suggested, as it may lead to increased mobilization of lactate from muscle tissue, which cannot be metabolized when present in excess.

Postoperative care

Blood gas analysis, lactate, and blood glucose levels have to be measured repeatedly until 4 hours after re-establishment of oral feeding.

Information about emergency-like situations / Differential diagnostics

Seizures caused by hypoglycemia can occur. If signs of cerebral seizures are present, immediate measurement of blood gases and blood glucose level has to be performed. Seizure therapy, aside from giving additional glucose, is not different.

Ambulatory anaesthesia

In order to warrant continuous glucose supply and metabolic monitoring, ambulatory anaesthesia is not suggested.

Obstetrical anaesthesia

As patients with GSD-I have a normal fertility, pregnancies are possible and described [28]. A prenatal diagnosis is possible. For delivery, caesarian sections [11] and vaginal delivery is possible [29].

Literature and internet links

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