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Distal arthrogryposis type 1

orphananesthesia

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

SUPPLEMENT NR. 7 | 2024

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 Patientinnen und Patienten mit seltenen Erkrankungen. Damit will OrphanAnesthesia einen wichtigen Beitrag zur Erhöhung der Patientensicherheit leisten.

Patientinnen und 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 Anästhesistinnen und Anästhesisten damit keine Erfahrungen gesammelt haben, sodass 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 eine Anästhesistin bzw. ein Anästhesist sowie eine weitere Krankheitsexpertin bzw. ein weiterer Krankheitsexperte (z. B. Pädiaterin bzw. Pädiater oder Neurologin bzw. Neurologe) beteiligt sind. Das Projekt ist international ausgerichtet, sodass 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:

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OrphanAnesthesia –
a 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.

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Anaesthesia guideline for **distal arthrogryposis type 1**

Disease name: Distal arthrogryposis type 1

ICD 10: Q74.3

Synonyms: Distal arthrogryposis multiplex congenita type I, distal arthrogryposis type 1A, distal arthrogryposis type 1B

Disease summary: Distal arthrogryposis type 1A (DA1A) and 1B (DA1B) – congenital non-progressive myopathies – manifested contractures of the hands and ankle-foot complex strongly resembling those observed in Freeman-Sheldon and Sheldon-Hall syndromes but lacked additional craniofacial findings. The limb malformations included in the diagnostic criteria include two or more of the following features: talipes equinovarus, metatarsus varus, vertical talus, talipes equinovalgus, calcaneovalgus, camptodactyly, ulnar deviation of wrists and fingers, overlapping fingers or toes, and hypoplastic or absent interphalangeal creases. DA1A and DA1B demonstrated an autosomal dominant inheritance pattern. There was no apparent gender, ethnic, or geographical preference, and environmental and parental factors were not implicated in pathogenesis.

Medicine is in constant progress; new clinical knowledge may not be in this guideline.

Guidelines are not rules or laws; they are a framework for clinical decision-making.

Every patient is unique; individual circumstances must guide clinical care.

The diagnosis may be wrong; if questionable, the diagnosis should be confirmed.

Find more information on the disease, referral centres, and patient organisations at Orphanet: www.orpha.net

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Background

Distal arthrogryposis type 1A (DA1A; MIM 108120) and 1B (DA1B; MIM 614335) – congenital non-progressive myopathies – manifested contractures of the hands and ankle-foot complex strongly resembling those observed in Freeman-Sheldon and Sheldon-Hall syndromes (FSS and SHS) but lacked additional craniofacial findings [1]. Limb malformations accepted in the diagnostic criteria that were common to FSS and the distal arthrogryposes included two or more of the following: talipes equinovarus, metatarsus varus, vertical talus, talipes equinovalgus, calcaneovalgus, camptodactyly, ulnar deviation of wrists and fingers, overlapping fingers or toes, and hypoplastic or absent interphalangeal creases[1].

DA1A and DA1B were considered identical (hence, DA1), except for genotype, and both demonstrated an autosomal dominant inheritance pattern [1]. There was no apparent gender, ethnic, or geographical preference, and environmental and parental factors were not implicated in pathogenesis [1]. DA1A was caused by allelic variations of the tropomyosin 2 (*TMP2*; MIM 190990) gene, located at 9p13.3 [2], and DA1B was caused by allelic variations of the slow type myosin-binding protein C (*MYBPC1*; MIM 160794) gene, located at 12q23.2[3]. DA1 was considered to belong to the group of phenotypically similar entities termed distal arthrogryposes [4,5], thought to be the most common of the arthrogryposes. Arthrogryposis multiplex congenita was a distinct entity from the conditions collectively considered as distal arthrogryposes [2]. Other differential diagnoses included distal arthrogryposis types 3, 7, and 8; Schwartz-Jampel syndrome; and non-syndromic distal extremity contractures. DA1 was primarily distinguished from all other conditions by a lack of additional findings but contractures were more treatment-resistant than in non-syndromic presentations.

Although literature on DA1 was negligible [6,7], general principles relevant to the care of patients with DA1 was deduced from the better documented experience with FSS. This guideline, developed through literature review and clinical experience, aimed to address the deficiency in available clinical guidance by providing essential outcome-directed advice for evaluation and management of anaesthetic care for patients with DA1. The protocol for and results of the systematic review and meta-analysis underpinning this guideline were described elsewhere [6,7]. AGREE II and GRADE Guidelines [8,9] were followed in the guideline development process, described elsewhere [10].

Typical surgeries

Though not as severe as FSS or SHS, patients with DA3 still frequently undergo many orthopaedic surgeries, because many of the attempts at operative deformity correction have suboptimal results and require subsequent revision. Due to the wide variability of DA3 presentation and the lack of any research, there is a great diversity of operative approaches employed for the following reasons: ankle-foot complex contracture correction, spinal curvature correction, and hand contracture correction. Less frequently, involvement of more proximal joints (e. g., dislocation or dysplasia of shoulders and hips, contracture of elbows) is the focus of operative interventions.

Type of anaesthesia

Although most case reports describe general anaesthesia, this is not meant to imply that general anaesthesia is always needed in DA1. While the anaesthetic approach is ultimately dictated by patient safety, patient's understanding and affect regarding surgery, and technical

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feasibility, it is possible and desirable to avoid premedication, sedation, and general anaesthesia for appropriately selected patients with DA1 [11]. Though mild spinal deformities are seen in DA1, this typically does not preclude epidural or spinal anaesthesia, which is still considered to have far fewer the syndromic-associated challenges and complications and overall a more favourable safety profile over sedation and general anaesthesia. Whenever possible, consider and explore local, regional, spinal, and epidural anaesthesia with patients during the pre-anaesthetic consultation [10]. Age is not necessarily a contraindication to any particular anaesthesia modality [11]. Many adults are poor candidates for local anaesthesia, and many children handle the experience very well[11]. Proper psychological preparation for patients undergoing surgery exclusively under local anaesthesia does not differ substantively from any other preoperative consent and preparation process [11].

Pre-operative testing

Anaesthetic care for patients with DA3 often presents with several potential challenges that requires pre-operative planning [10]. Anaesthesiologists caring for the patient should always evaluate this patient well in advance of proposed procedures, take a thorough and complete history of respiratory problems and prior anaesthesia, explain to the patient and family possible risks and ensure questions are answered, and discuss their findings, concerns, and management plans with the surgeons participating [10]. The preceding may seem obvious, but this is not the standard everywhere for assessment of potentially high-risk patients undergoing surgery [10]. In some places where pre-operative evaluations are done in advance, a different anaesthesiologist conducts the evaluation than the one who cares for the patient on the day of surgery [10].

Malignant hyperthermia (MH) has an observed association with certain myopathies and a potential biochemical and genetic relationship with neuroleptic malignant syndrome has also been suggested (Nanners, E., personal communication, June 2005). It has also been suggested that true MH is not associated with most myopathies in which anaesthetically-related hypermetabolic states resembling MH have been reported [10]. Irrespective of the actual aetiology, an expanded metabolic panel and 12-lead electrocardiogram are part of regular pre-operative screening for patients with DA3 to prevent misinterpretation of a pre-existing status as MH-related changes [10]. As arterial puncture for blood gases is infeasible, point-of-care capillary blood testing can be helpful for baseline and subsequent assessment, when available. Although MH susceptibility is considered a worthwhile assessment to make, it is not advised, due to the large muscle sample required for the *in vitro* caffeine-halothane contraction test [10]. Use of an MH-safe anaesthetic protocol (no volatile gasses or depolarising neuromuscular blockade), already in use routinely in many hospitals worldwide, is advised [10]. Notably, DA1 is not associated with any cardiac muscle pathology.

Airway management

Unlike many of the distal arthrogryposes (e.g., SHS and DA3) and phenotypically similar craniofacial syndromes (e.g., FSS), DA1 is limited to limb malformations. Craniofacial malformations exclude a diagnosis of DA1; therefore, no distinctive airway management issues in DA1 exist.

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Transfusion or administration of blood products

No reports in the literature or known clinical experience indicate any unusual problems or necessary precaution for patients with DA1 requiring either transfusion or administration of any blood components. Distal extremity contractures and the consequent poor quality of veins may make establishing peripheral intravenous access challenging in many patients with DA1 and require the use of a small-gauge catheter, 22 or less [10]. Need for the use of a small gauge vascular catheter may impair transfusion, intravenous hydration, medication administration, and blood draw efforts [10]. Vein cannulation or placement of a central line may be necessary if patients require a greater frequency [10].

Anticoagulation

While many patients have reduced pre-operative mobility and, therefore, are at somewhat higher pre-operative thrombogenic risk, no reports in the literature or known clinical experience indicate any coagulopathy associated with DA1.

Patient transportation and positioning

Carefully evaluate patients pre-operatively to assess the extent of contractures. Any range of motion limitations found should be discussed with surgeons to plan the best positioning of the patient during surgery. Patients should always be placed in a position of comfort, with avoidance of unnatural mobilisation under anaesthesia.

Interactions of chronic disease and anaesthesia medications

There are no syndrome-specific chronic medications for patients with DA1, and there is no syndrome-specific treatment. Therapeutic interventions focus on improving functional outcomes; there is no cure.

Anaesthetic procedure

Though any non-MH triggering agents are safely used in patients with DA1, the following agents are used extensively. Midazolam is routinely used for premedication or mild sedation in outpatient procedures. Induction of general anaesthesia is safely achieved with nitrous oxide, which is not a volatile MH-triggering gas. If maintenance of spontaneous respiration is essential, nitrous oxide is used in conjunction with ketamine to achieve and maintain surgical anaesthesia. If vascular access is established before induction, propofol is frequently used for the induction and maintenance of surgical anaesthesia.

Lidocaine is used with or without epinephrine for local anaesthesia in minor office procedures, whereas bupivacaine (0.5% strength) is used for local anaesthesia in minor office procedures and for spinal and epidural anaesthesia in major outpatient and inpatient orthopaedic surgeries. If performing spinal and epidural anaesthesia, a paediatric size needle and catheter is used, even for adults, as most patients with DA1 are small. When using lidocaine or bupivacaine for anaesthesia without adjuvants, no special precautions are required, except for precautions related to the actual operative intervention itself [10].

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Patient monitoring

Though no monitoring modalities not already standard in modern anaesthesia practice are needed, there are some special considerations for monitoring in patients with DA1. Heart rate, respiratory rate and depth, and temperature are important warnings of an impending MH crisis. Hyperpyrexia without MH and rhabdomyolysis without hyperpyrexia also present. Muscle rigidity is not a reliable indicator of anaesthesia depth, the effectiveness of neuromuscular blockade, or impending MH crisis, as syndromically affected muscles, especially those exhibiting overt contracture, are unaffected by anaesthesia and muscle relaxants. If a urinary catheter is used for monitoring or during a long surgery or when epidural anaesthesia-analgesia is performed, a paediatric size will sometimes be needed even for adults, as some patients with DA1 are small.

Complications

Potential complications of general anaesthesia or sedation in patients with DA1 include hyperpyrexia without the malignant hyperthermia triad, malignant hyperthermia, neuroleptic malignant syndrome (hypermetabolic syndrome similar to malignant hyperthermia), rhabdomyolysis without hyperpyrexia, challenging peripheral vascular access, and impaired operative access due to ineffectiveness of neuromuscular blockade [11]. Infrequent presence of mild abnormal spinal curvatures sometimes complicate epidural and spinal anaesthesia.

Postoperative care

Except as otherwise noted, no reports in the literature or known clinical experience indicate any unique problems or needed precaution for postoperative care in patients with DA1.

Disease-related acute problems and effect on anaesthesia and recovery

Except as previously discussed regarding potential non-MH hypermetabolism, true MH, and NMS, no reports in the literature or known clinical experience indicate any effect of DA1 on sedation, anaesthesia, and postoperative recovery concerning the differential diagnosis of possible acute problems. Due to the possibility of triggering an MH crisis, avoid fluoroquinolones [12].

Special settings or types of anaesthesia

The general principles for the anaesthetic care of patients with DA1 previously described apply with proper balancing of risks and benefits to all types and settings of anaesthesia, including obstetric, ambulatory, or emergent.

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