

Original Article

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Timing of inguinal hernia repair in children varies greatly among hernia surgeons

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ABSTRACT

INTRODUCTION: Due to disagreement on optimal timing of inguinal hernia repair in children, we explored how Danish surgeons plan repair in children at different ages and with different symptoms.

METHODS: A validated questionnaire on timing of inguinal hernia repair in children was sent to all surgeons performing paediatric hernia repair in Denmark. The surgeons were asked how they plan repair of asymptomatic reducible, symptomatic reducible, incarcerated, and strangulated hernias in children aged < 2, 2-12 and 13-18 years.

RESULTS: Forty-eight surgeons (81%) completed the questionnaire. Answers concerning the timing of repair of reducible and incarcerated hernias varied greatly for all age groups. For reducible hernias, the answers ranged from repairing within one week to considering watchful waiting. For incarcerated hernias, the answers ranged from repair within 12 hours to three months. There was broad agreement on the need for acute repair of strangulated hernias.

CONCLUSIONS: Timing of paediatric inguinal hernia repair was inconsistent for children of all age groups and in particular for those with reducible hernias. The results call for a new guideline to ensure consistent and optimal treatment as well as an educational effort about the pros and cons of early and delayed repair.

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Inguinal hernias are common in children with incidences of 4-5% in term children and 9-11% in preterm children [1]. Children awaiting repair of an inguinal hernia in general have a high risk of incarceration [2], which may lead to strangulation and intestinal necrosis. Multiple studies have argued that infants and young children with inguinal hernias should undergo early repair due to the risk of incarceration [3-6]. A database study of children < 1 year of age found that the risk of incarceration increased two-fold when surgery was delayed for more than two weeks [3]. Furthermore, a review of hospital records of children < 10 years old found that if surgery was performed within seven days from diagnosis, 92% of all emergency surgery in children with no history of incarceration could have been avoided [4]. Due to less intra-abdominal fat in infants and young children than in adults [7, 8], hernias in children will be expected more often to contain bowel than fat, which may support an aggressive surgical strategy. Still, there may be advantages of postponing surgery. Newborns have a higher risk of severe critical events due to general anaesthesia [9], which constitutes an apparent benefit of delaying surgery. Furthermore, if surgery in older children is delayed until they are fully grown, the hernia can be repaired with a mesh, which has been shown to lower the risk of recurrence in adults [10].

The aim of this study was to investigate how surgeons in Denmark plan repair of paediatric inguinal hernias according to the child's age and symptoms. This was done in order to analyse any variations and explore the need for a guideline.

METHODS

This questionnaire study is reported according to the Strengthening the Reporting of Observational Studies in Epidemiology statement [11]. The survey was created in Research Electronic Data Capture (REDCap), a secure web-based application used to collect and manage data in research studies [12], and it was developed in collaboration with two senior surgeons. First, the questionnaire was face validated with medical students and doctors not performing inguinal hernia repairs in children. Then a final face validation was performed by a senior surgeon with experience in repairing inguinal hernias in children. During the face validation, all questions were reviewed thoroughly to ensure correct interpretation in order to increase the validity of the questionnaire. The questionnaire was sent to all surgeons in Denmark repairing inguinal hernias in children. The surgeons were identified by contacting relevant departments' administrations. The questionnaire was sent by email, and non-responders were contacted by phone and/or email every 5-7 days until data collection ended.

The first part of the questionnaire involved questions about demographic information of the surgeons including their gender, age, education, speciality, position and experience. The second part included questions on how the surgeons plan inguinal hernia repairs in children depending on the clinical manifestations: asymptomatic reducible, symptomatic reducible, incarcerated, or with signs of strangulation. Regarding the terms *incarceration* and *strangulation*, we used the definitions presented in a recent guideline on inguinal hernia repair in adults [13]. *Incarceration* means inability to reduce the hernia mass into the abdomen, and *strangulation* means that blood supply to the herniated tissues is compromised. The presentations of the hypothetical cases were clearly explained in the questionnaire, and symptoms of strangulation were described as soreness, redness and oedema. The possible answer options were to perform surgery within 12 hours, 24 hours, seven days, 14 days, one month and three months, to delay surgery until the child is older or simple watchful waiting. All questions on timing were repeated for children aged < 2, 2-12 and 13-18 years. These intervals were chosen for two reasons: First, in Denmark, children < 2 years old are treated only at a few designated hospitals due to the challenging anaesthesia involved. Second, a recent publication on hernia surgery recommends a different treatment in children ≥ 13 years of age than in younger children [14]. Questions related to each age interval could be answered only by surgeons who had repaired inguinal hernias in children within the age interval.

Data were collected using REDCap and analysed in Microsoft Excel. Categorical data are presented as numbers and percentages and continuous data as medians and ranges. The study was approved by the Danish Data Protection Agency (Record No. VD-2018-294). Consent to participate was given by the included surgeons when answering the questionnaire. In agreement with the approval from the Danish Data Protection Agency, written consent was not needed, and according to Danish law, no approval from the ethics committee was needed for this study type.

Trial registration: not relevant.

RESULTS

A total of 59 surgeons from 14 public and five private hospitals were eligible for inclusion. In total, 48 surgeons completed the questionnaire (81%), including 37 males and 11 females. The median (range) age of the surgeons was 53 (36-68) years. Thirty-four surgeons were consultants and the rest were speciality registrars. More than

half of the surgeons had performed more than 100 inguinal hernia repairs in children, and 85% had performed more than 50 repairs. Demographic data and experience of the included surgeons are presented in Table 1.

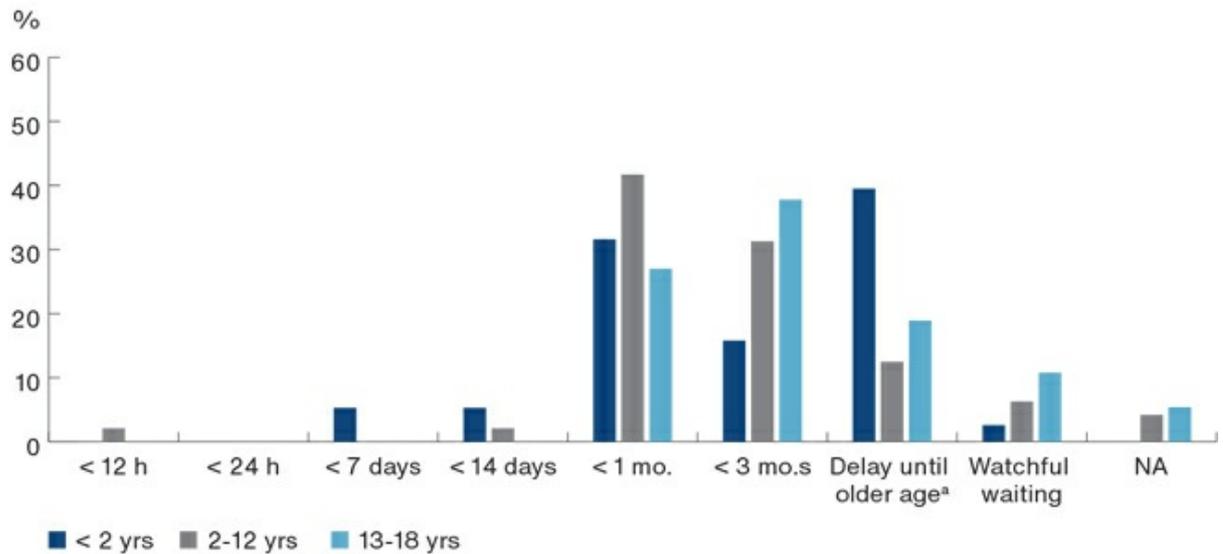
TABLE 1 Demographics and experience of included surgeons.

<i>Sex, n (%)</i>	
Female	11 (23)
Male	37 (77)
Surgeons' age, median (range), yrs	53 (36-68)
<i>Speciality, n (%)</i>	
Surgery	43 (90)
Urology	5 (10)
<i>Perform surgery, n (%)</i>	
Independently	45 (94)
Supervised	3 (6)
<i>Children age group, n (%)</i>	
< 2 yrs	38 (79)
2-12 yrs	48 (100)
13-18 yrs	37 (77)

Asymptomatic reducible inguinal hernias

Most surgeons would operate children with asymptomatic reducible inguinal hernias within one month, within three months or delay surgery until the child is older (Figure 1). For children < 2 years old, most surgeons would delay surgery until the child is older, but a third of the surgeons would plan surgery within one month after diagnosis. The surgeons who delay surgery would wait until the child is one (20%), two (27%), three (13%) or five years old (7%). Five surgeons (33%) did not specify at what age they would repair. For children aged 2-12 and 13-18 years, most surgeons would repair within one or three months, respectively. Still, for children \geq 13 years of age, a fifth of the surgeons would delay surgery until the child is fully grown. Furthermore, a tenth would choose watchful waiting for children aged 13-18 years, whereas watchful waiting seems to be a less common strategy for younger children.

FIGURE 1 Timing of repair of asymptomatic reducible inguinal hernias according to the age group of the patient.



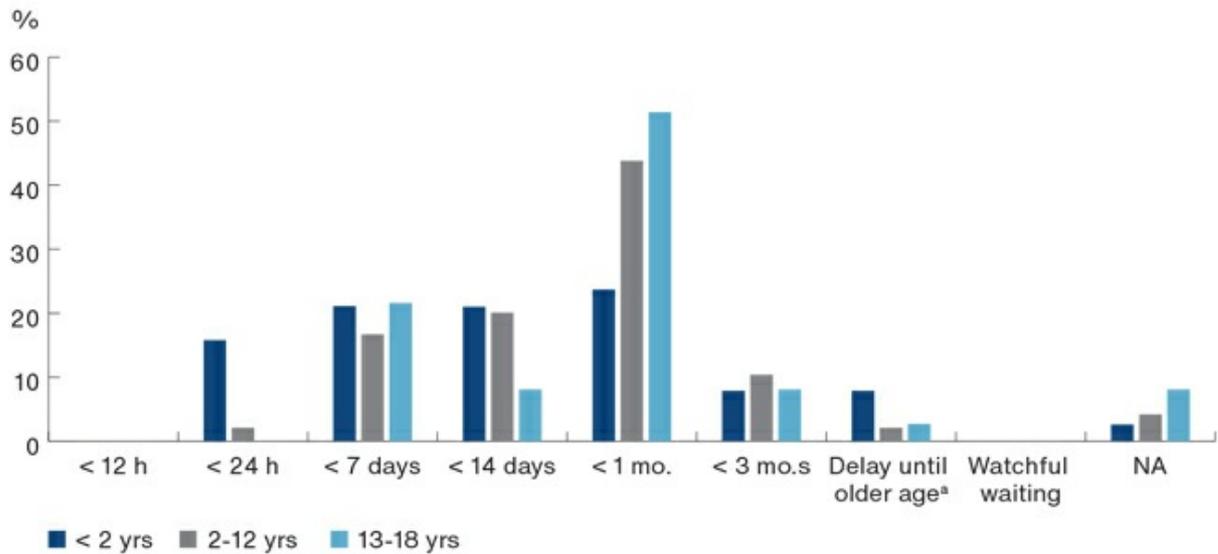
NA = no answer.

a) Surgery delayed until the patient is fully grown for children aged 13-18 yrs.

Symptomatic reducible inguinal hernias

For children < 2 years of age with symptomatic reducible inguinal hernias, there was an almost even distribution among surgeons who would repair within 24 hours, seven days, 14 days or one month (**Figure 2**). For children aged 2-12 years, just under half of the surgeons would repair within one month and a fifth would repair within 14 days. For children aged 13-18 years, half of the surgeons would repair within one month and a fifth within seven days.

FIGURE 2 Timing of repair of symptomatic reducible inguinal hernias according to the age group of the patient.



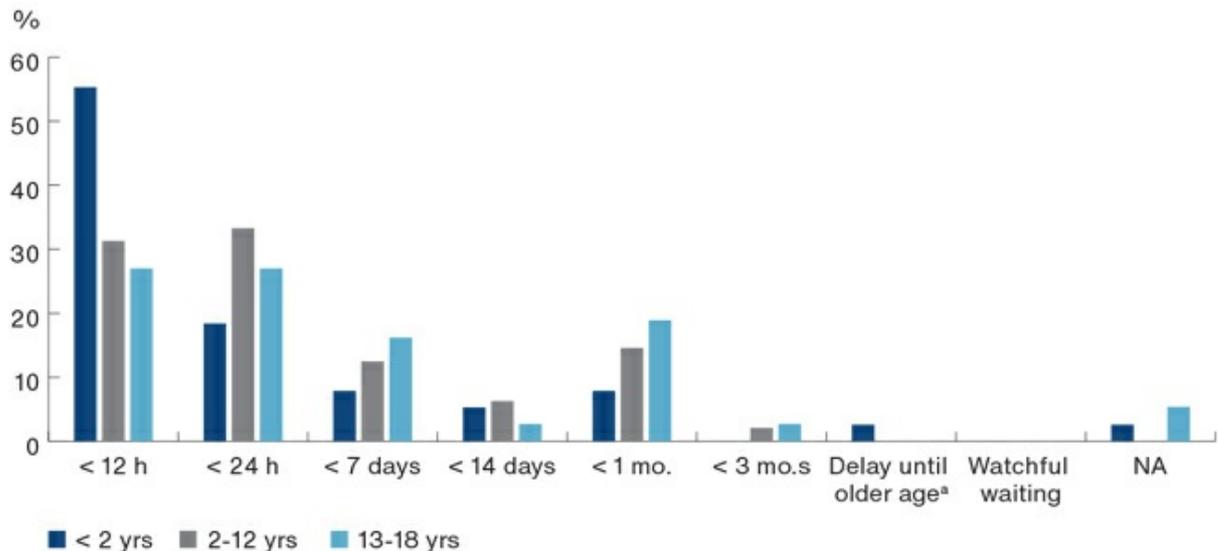
NA = no answer.

a) Surgery delayed until the patient is fully grown for children aged 13-18 yrs.

Incarcerated inguinal hernias

For children < 2 years of age, 74% of the surgeons would repair within 12 or 24 hours after diagnosis of an incarcerated hernia, and 16% would repair within two weeks or more (Figure 3). For children aged 2-12 years, 65% would repair within 12 or 24 hours, 13% within seven days and almost a fifth would repair within two weeks or more. For children aged 13-18 years, slightly more than half of the surgeons would repair within 12 or 24 hours, 16% within seven days and 19% within one month.

FIGURE 3 Timing of repair of incarcerated inguinal hernias according to the age group of the patient.



NA = no answer.

a) Surgery delayed until the patient is fully grown for children aged 13-18 yrs.

Strangulated inguinal hernias

Almost all surgeons would repair a strangulated inguinal hernia in children of all ages within 12 hours, and a few would repair within 24 hours.

DISCUSSION

In this nationwide questionnaire study, we found large variations among surgeons about the timing of paediatric inguinal hernia repair. In all age groups, the variations were greatest for children with reducible hernias, but the answers also varied considerably for incarcerated hernias. For children with strangulated hernias, there was agreement on acute repair.

For reducible hernias, it seems that the timing of repair depends on surgeon’s preferences. As children with inguinal hernia have a high risk of incarceration compared with asymptomatic male adults [2], postponing surgery may lead to an incarcerated hernia while awaiting surgery in some children. This can potentially lead to acute surgery due to strangulation, involving an increased risk of complications. We do not have data on the surgeons’ reasons for postponing repairs. For children < 2 years of age with asymptomatic hernias, 40% of the surgeons would delay surgery until the child is older, presumably to minimise the risk of anaesthesia-related complications such as respiratory and cardiac events [9]. To our knowledge, no study or guideline has stated how to assess when the risk of anaesthesiological complications exceeds the risk of incarceration due to delayed surgery. Thus, the surgeon needs to make the assessment from case to case. Since children < 2 years of age are repaired only at designated hospitals in Denmark, another reason for postponing surgery may be to enable repair at the hospital to which the child was initially referred.

For children aged 13-18 years with asymptomatic inguinal hernias, a fifth of the surgeons would delay surgery until the child is fully grown. This strategy may be adopted to enable mesh repair of the hernia. The benefits of

this strategy can be questioned as a Danish nationwide prospective study found that the risk of reoperation 12 months post-operatively for children aged 8-17 years with inguinal hernia was only 0.2% [15]. In contrast, the risk is about 1% in adults after open repair despite insertion of a mesh [16]. A tenth of surgeons would choose watchful waiting for children aged 13-18 years with an asymptomatic reducible hernia. Watchful waiting is an acceptable strategy for adult males with minimally symptomatic or asymptomatic inguinal hernia [13]. However, we have not been able to find any reports on the effects and harms of watchful waiting in children. We believe that it is important to consider the risk of strangulation versus the relatively low risk of perioperative complications [15].

For children of all age groups with incarcerated hernias, most surgeons would operate within 24 hours, but some surgeons would wait much longer. For children aged ≥ 13 years, a fifth would wait up to one month from the time of diagnosis. Postponing surgery of incarcerated hernias in children may pose an unnecessary risk of creating a life-threatening situation. For children with strangulated hernias, there was broad agreement among surgeons to repair acutely within 12 hours for all age groups as this may be a fatal state for the child.

One of the strengths in this study was the thorough face validation of the questionnaire, which ensured that the questions were interpreted as intended, which, in turn, reduced the risk of response bias. Furthermore, the nationwide design and high response rate reduced the risk of selection bias and non-response bias. However, this study also has limitations. As in all survey studies, there is a risk of recall bias. This is mostly evident for questions on surgical experience, as the questions about timing referred to future hypothetical cases and not to repairs that the surgeon had planned or performed in the past. The predefined age groups represent another limitation. These predefined groups were necessary to keep the questionnaire relatively simple and to enable analysis of the results. Even so, the categories may have introduced a risk of information bias if the surgeons usually do not categorise their patients in a similar manner when planning surgery.

Another limitation is that we were unable to stratify the results based on which hospital the individual surgeons worked at, as this information was not obtained. The answers may have differed between surgeons who work at public and private hospitals. Furthermore, the answers may depend on whether the hospitals were designated to operate on children aged < 2 years old or not. However, the surgeons only answered questions related to specific age groups if they had performed hernia repair in children within the age group. Therefore, results for children aged < 2 years old were not affected by surgeons not repairing hernias in this age group. Furthermore, the lowest option given in the questionnaire regarding wait time was repair within 12 hours. As repair of strangulated hernias should probably not be delayed for more than six hours, it would have been suitable to include this option as well.

This study showed large variations in how surgeons plan repair of both reducible and incarcerated inguinal hernias in children. Consequently, the treatment offered to children with inguinal hernia seems to be inconsistent and to depend on the surgeon at hand. These results may reflect a worldwide issue. The inconsistencies demonstrate a need for guidelines to ensure consistent and optimal care of inguinal hernias in children and thereby equality in healthcare. As it is currently not known what treatment is best for the child, research investigating the advantages and disadvantages of early and delayed repair is needed to rationalise new guidelines. Also, there may be a need for an educational effort to ensure that all surgeons repairing inguinal hernias in children know the pros and cons of early and delayed repair in order to optimise the process of planning surgery.

CONCLUSIONS

This nationwide questionnaire study showed that timing of inguinal hernia repair in children of all age groups

varies greatly among surgeons. The inconsistencies were greatest for reducible hernias, but there were also considerable inconsistencies for incarcerated hernias. Reassuringly, there was broad national agreement on acute repair for strangulated inguinal hernias in children of all ages.

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Conflicts of interest: Potential conflicts of interest have been declared. . Disclosure forms provided by the authors are available with the full text of this article at [Ugeskriftet.dk/dmj](https://ugeskriftet.dk/dmj)

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