Sedation practice for paediatric nuclear medicine procedures in Denmark related to EANM guidelines

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Abstract

Objective: The objective of this study was to examine sedation practices for paediatric nuclear medicine examinations. **Methods:** A questionnaire was sent to all nuclear medicine departments in Denmark about sedation practices during 2012. **Results:** The response rate was 100% (18 departments). Three departments did not examine children at all. The total number of paediatric examinations among the remaining 15 sites varied from 20 to 1,583 (median 191). Sedation practice showed that approximately 50% of the sites regularly (>50% of the patients) used pharmacological sedation for renography in children aged 6-12 months and 1-3 years. A minority of centres (~15%) regularly used sedation in children aged 0-6 months, and no sites regularly used sedation in children aged and 4-6 years. Similar findings were found for renal scintigraphy. However, one large site used no sedation in children aged 1-3 years for renography but approximately 50% of patients used it in the same age group receiving renal scintigraphy with SPET. There was a trend for reduced use of sedation with increasing total number of paediatric medicine procedures. The most frequently used agents were benzodiazepines and barbiturates. The most common route of administration was rectal, oral, and intravenous. **Conclusions:** The sedation practices varied considerably among Danish nuclear medicine departments. The sedation of children in clinical practice seemed to be more prevalent than is recommended by guidelines.

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Introduction

Renal nuclear medical examinations in children are very common [1, 2]. Information adapted to both the parents and the child combined with the use of toys and visual entertainment play (played) a major role in conducting the examination with a low level of stress and with minimal use of pharmacological sedation. However, despite such preparations, sedation at examination was sometimes required , for instance due to an inability to cooperate, anxiety, pain, a previous bad experience, or to minimize motion during the examination . Logistical issues may lead some departments to use sedation to optimize patient flow, however, which carries an increased risk of complications .

The safety of sedation in children in general has gained much interest from many medical specialities . Several guidelines on the use of sedation in the paediatric population referred for nuclear medicine examinations have been published , but adherence to those guidelines remains to be demonstrated.

The purpose of this survey was to examine the sedation practices for children undergoing nuclear medicine examinations in Denmark, in particular in renography and renal scintigraphy, some of the most common procedures in the paediatric population.

Materials and Methods

A questionnaire in Danish was sent out in April 2013 to all 18 nuclear medicine departments in Denmark. The questionnaire addressed: a) the number of paediatric nuclear medicine examinations for which international societies (European Association of Nuclear Medicine (EANM) and/or Society of Nuclear Medicine and Molecular Imaging) have issued paediatric procedure guidelines, b) procedures for sedation practices in general, and c) specific information on sedation for renal scintigraphy (static scintigraphy with technetium-99m-dimercaptosuccinic acid (^{99m}Tc-DMSA)) and renography (dynamic

scintigraphy with ^{99m}Tc mercaptoacetyltriglycine (^{99m}Tc MA-G3) or diethylene triamino penta acetic acid (DTPA)) for the year 2012. Non-responding departments received two consecutive written notifications and eventually a phone call to ensure return of the questionnaire. This study did not require ethical approval in accordance with national legislation. The study was approved by the Danish Data Protection Agency.

Results

Completion of questionnaires

The response rate was 100%. Three departments did not perform any paediatric investigations, so 15 departments took part in this study.

Number of paediatric investigations

TThirteen departments reported the total number of paediatric investigations for 2012, which ranged from 20 to 1,583 (median=191; mean=321). Exact data for each procedure was not available. Renography was performed on at least a weekly basis in most centres, whereas renal scintigraphy, indirect radionuclide cystography, and measurement of glomerular filtration rate (GFR) were performed at least monthly for the majority of the departments (Table 1).

Sedation practices in renography and renal scintigraphy

Thirteen departments provided data on the use of sedation with these procedures. Departments that reported always to use sedation or claimed to use it on demand in >50% of the patients were classified as using sedation regularly. In the age-groups of 0-6 months, most departments did not regularly use sedation for renography (10 of 12 sites, 83%) (Table 2). No sites regularly used sedation in children aged 4-6 years. However, 6/12 sites (50%) used sedation regularly in children aged 6-12 months and 7 of 12 sites (58%) used sedation regularly in children 1-3 years. The data for renal scintigraphy was very similar to those for renography (data not shown). Most sites never or seldomly used single photon emission tomography (SPET) for renal scintigraphy.

Based on the exact number of paediatric procedures, departments were divided into four groups (<100, 100-200, 200-500, and >500 examinations per year). The sedation practices indicated a differential pattern among high and low volume departments, particularly for children aged 6 months to 3 years, with decreased use of sedation with increasing number of procedures (Table 3). The same pattern was observed for renal scintigraphy (data not shown). However, despite the fact that the high volume site (>500 examinations per year) never used sedation in any age groups for renography, this site used sedation in 50% of 1-3 year old children referred for renal scintigraphy. Renal scintigraphy was always conducted with SPET at this site.

Dosing and administration

The majority of the responding departments (11 of 14 sites) provided information about the pharmaceuticals utilized for sedation; two departments never used sedation and one site did not reveal the agent used. The most frequently used agents were benzodiazepines (n=5), barbiturates (n=3), chloral hydrate (n=1), combinations of pharmaceuticals (n=1)

Table 1. *Distribution of the frequency of paediatric investigations among 15 departments performing paediatric nuclear medicine procedures in Denmark during 2012.*

	Daily	Weekly	Monthly	Yearly	Never
Renography	1	9	5	0	0
Renal scintigraphy	0	6	7	1	1
Direct radionuclide cystography	0	0	1	3	11
Indirect radionuclide cystography	0	0	9	5	1
GFR	1	5	7	1	1
Bone scintigraphy	0	2	3	8	2
PET/CT*	0	1	2	2	10
Lung scintigraphy	0	1	0	2	12
MIBG	0	1	1	1	12

*Abbreviations: GFR, Glomerular filtration rate; MIBG, metaiodobenzylguanidine; PET/CT, Positron emission tomography/ computerized tomography. *9 of 15 departments have PET/CT facilities.*

Table 2. *Self-reported sedation practices for renography among 13 nuclear medicine departments in Denmark during 2012 distributed by the age of the children examined.*

Use of sedation	Age of the children			
	0-6 months	6-12 months	1-3 years	4-6 years
Never	7	4	3	4
Always	0	3	2	0
On demand	6	6	8	9
1%-10%	3	2	2	5
11%-20%	0	0	0	3
21%-50%	0	0	0	0
51%-60%	0	1	3	0
61%-70%	0	1	0	0
71%-80%	1	0	1	0
81%-90%	0	1	0	0
91%-99%	1	0	1	0
Not specified	1	1	1	1

Table 3. *Proportion of departments with regular use of sedation, i.e. sedation used in at least 50% of the patients, in renography distributed by age of the children and the total number of paediatric nuclear medicine procedures made in 2012.*

Number of examinations per year	Age of children			
	0-6 months	6-12 months	1-3 years	4-6 years
<100	0/2 (0%)	2/2 (100%)	2/2 (100%)	0/2 (0%)
100-200	2/4 (50%)	2/4 (50%)	3/4 (75%)	0/4 (0%)
200-500	0/4 (0%)	2/4 (50%)	2/4 (50%)	0/4 (0%)
>500	0/1 (0%)	0/1 (0%)	0/1 (0%)	0/1 (0%)

or unspecified pharmaceuticals (n=1).

The dosing regimen was reported by ten centres. Doses were weight-based in seven centres whereas three sites used either two fixed doses (e.g., below or above 10kg) or they were unaware of the dosing details.

The routes of administration of the sedatives were reported by eleven departments. The most common routes of administration were rectal (n=4), oral (n=3), intravenous (n=3) or a combination of oral and rectal (n=1). In most departments the sedation was a multidisciplinary procedure performed in cooperation with paediatricians or anaesthesiologists; one nuclear medicine department performed the sedation without external assistance.

Information practices

The majority of the departments provided written information to the parents and/or the referring department. Most departments also informed the parents about an internet source for information about the specific nuclear medicine procedure (12 departments). Four centres provided written information targeted to the children. Similar data were found with renography and renal scintigraphy (data not shown).

Discussion

The use of sedation for nuclear medicine procedures on children has been debated for decades. In this nation-wide survey in Denmark, sedation practices in renography and renal scintigraphy, two common paediatric nuclear medicine procedures, were studied in detail. It was revealed that sedation was used on a regular basis in a large portion of children referred for renography and renal scintigraphy.

Most nuclear medicine paediatric guidelines advocate against the use of sedation. The EANM guideline for renal scintigraphy recommends that a maximum of 5% of paediatric patients should receive sedation. The figures from Denmark seemed to be higher than previously reported. These data are in contrast to several previous reports. A study from Children´s Hospital in Gothenburg, Sweden reported that 4%-5% of the children needed sedation when considering all types of nuclear medicine examinations . These data are comparable with those of a study from Hospital for Children, Great Ormond Street, London, which reported using sedation in 4% of children undergoing nuclear medicine procedures . Both of these departments conducted a high number of examinations each year (550 and 1300 renographies per year). The age distribution of the populations as well as the types of investigations may differ among those reports, making direct comparisons difficult. Since SPET was rarely used with renal scintigraphy, this cannot explain the frequently use of sedation in Denmark versus previous publications.

The majority of the departments in our study performed less than 200 investigations in children per year. A trend of less frequent use of sedation with increasing number of inve-

stigations was observed. However, infrequent use of sedation may be possible in low-volume departments. A prospective study including 210 children studies over a period of 18 months reported that sedation was used in only 4% of patients who underwent renography, renal scintigraphy and GFR . Only one department in our survey performed more than 1,000 paediatric nuclear medicine investigations per year. This department never used sedation during renography, but they sedated half of the children aged 1-3 years for renal scintigraphy. In contrast to most other departments, this site always used SPET for renal scintigraphy.

European Association of Nuclear Medicine (EANM) recommends that the parents and the child should receive written information about the procedure before arriving at the department. Such information was generally provided to the parents and to a lesser extent to the children. Depending on age of the patient, pictorial information and child adapted communication may be necessary. This survey indicates that there is room for improvements regarding information aimed at children. Well informed children and parents are likely factors that increase the rate of sedation free nuclear medicine examinations .

The safety of the sedation of children has gained much interest. Different models driven by anaesthesiologists, paediatricians, critical care physicians and others have been proposed . In our study, generally all sedations and/or anxiolytic procedures were managed by anaesthesiologists or paediatricians with solid experience sedating children. Orally and rectally administered drugs are sufficient for young children and infants; however, oral administration is generally preferable because rectal absorption can be unpredictable. Both chloral hydrates and benzodiazepines are commonly used in young children. The EANM guidelines suggest that midazolam is administered intranasally or rectally. We found that benzodiazepines and barbiturates were the most used compounds. The method of administration was almost equally divided between oral, rectal, and intra-venous. This is largely consistent with the recommended sedation guidelines.

In conclusion, this survey showed that sedation practices in children varied considerably among Danish nuclear medicine departments; the frequency of sedation in clinical practice in common urological procedures was higher than recommended by guidelines and documented by previous reports. We suggest inter-departmental communication and knowledge-sharing on this topic and recommend departments to explore all opportunities to maximize non-pharmacological sedation in children.

The authors declare that they have no conflicts of interest

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