

Misdiagnosis and Quality of Management in Paediatric Surgical Patients Referred to a Tertiary Care Hospital

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ABSTRACT

Background: The literature on diagnosis and management prior to transfer paediatric surgical patients to a tertiary care center is scarce. In referral centers, it is common to receive patients previously subjected to inadequate or inappropriate health care.

Aim: Analyze the prevalence of misdiagnosis and quality of management in patients before being referred and factors related to misdiagnosis and inadequate management.

Design: Prospective, longitudinal, comparative study between patients with appropriate and inappropriate submission diagnosis and between patients with adequate or inadequate treatment.

Setting: Third level care hospital, Mexico City.

Participants: Newborn to adolescents referred to Paediatric Surgery Department.

Intervention(s): None.

Main Outcome Measure(s): Misdiagnosis and quality of management prior to being referred.

Result: Two hundred patients were evaluated. Correlation between submission diagnosis and final diagnosis showed that 70% were correct and 30% incorrect; 48.5% were properly managed and 51.5% inappropriately managed. Incorrect diagnosis was more frequent when referred from first or second-level hospitals and in inflammatory conditions. Patients referred by paediatricians had a higher rate of adequate management.

Conclusion: We present the frequency of incorrect diagnosis and inadequate patient management in a highly selected population. Sample size should be increased as well as performing these studies in other hospital settings in order to determine whether the results are reproducible.

Keywords: Diagnostic errors, Delayed diagnosis, Health care, Patient care management

INTRODUCTION

When a primary care physician treats a child, many circumstances influence their medical reasoning. The physician must usually make a diagnosis in order to initiate appropriate treatment. Medical error can result in health, time and financial consequences. Care consequences include delayed diagnosis and treatment and disruptions in the process of care that may even result in the hospitalization of a patient [1].

As a tertiary care center, our paediatric hospital usually receives patients transferred from other hospitals. In referral centers, it is common to receive patients previously subjected to inadequate or inappropriate health care [2]. It is well-known that experience plays an important role in quality of care [3,4].

Many published studies exist in regard to medical errors, mostly in hospitalized patients; however, there is no published literature about the quality of diagnoses in patients prior to transfer to a tertiary care center, specifically in paediatric surgery, raising the questions (1) how often misdiagnosis is presented and (2) how is the quality of management prior to being referred.

Paediatric surgery is a subspecialty involving specific and varied challenges. Patients of varied ages with diseases from congenital to acquired are managed. Although many surgical procedures actually performed in children were first described in adults, it should be emphasized that children are not "small adults." Due to the anatomic and physiological differences, the post-operative course as well as post-operative complications is often very different from that presented by adults; therefore, physicians who diagnose and treat paediatric patients need specialized training.

Referral of patients with tumours has increased; therefore, primary care physicians treating these patients must have up-to-date and sufficient preparation in order to make a correct diagnosis and offer appropriate treatment [5].

The main objective of this study was to analyze the prevalence of misdiagnosis and quality of management in patients prior to being referred to the Department of Paediatric Surgery at our hospital. Secondary objectives included identification of (1) diseases with higher rates of misdiagnosis, (2) diseases with correct or incorrect treatment prior to being referred, and (3) type of hospital and physician who initially managed the patient with misdiagnosis or therapeutic inappropriateness.

MATERIALS AND METHODS

We conducted a prospective, longitudinal, comparative study between patients with appropriate diagnosis and those who were misdiagnosed and between patients with adequate treatment and those who were mismanaged over a 2-year period (May 2009 to April 2011).

Inclusion and Exclusion Criteria

Inclusion criteria were as follows: (1) age 1 day–18 years; (2) patients referred to the Paediatric Surgery Department, and (3) patients admitted for the first time during the study period. Exclusion criteria were (1) patients who arrived on their own to our hospital and (2) patients with incomplete records.

Description of the Procedure

Data were collected by one of the investigators using patient clinical files and parental interviews, whereas another investigator

conducted analysis and classification. Each patient was qualified in relation to diagnosis and management as follows.

Diagnosis was classified as correct or incorrect based on concordance of submission diagnosis with the diagnosis made in our hospital. Based on the above, all Correct Diagnoses (CD) were subclassified into timely submission (CD-TS or Group 1), inadequate medical treatment (CD-IMT or Group 2), delayed surgical treatment (CD-DST or Group 3), inadequate surgical treatment (CD-IST or Group 4) and adequate surgical treatment (CD-AST or Group 5).

Similarly, all the Incorrect Diagnoses (ID) were subclassified as timely submission (ID-TS or Group 6), inadequate medical treatment (ID-IMT or Group 7), inadequate surgical treatment (ID-IST or Group 8), and those with inadequate treatment and delayed submission (ID-ITDS or Group 9).

Overall patient management was classified according to appropriate and inappropriate management, proper management indicating timely submission plus appropriate medical and/or surgical treatment, and inappropriate management indicated by late referrals or patients with inadequate medical and/or surgical treatment, in addition to all patients with incorrect diagnosis. Final outcome was also recorded.

Variables studied prior to hospital admission were age, gender, referral hospital (public or private/level of care), referring physician (general practitioner, Paediatrician, general surgeon, or paediatric surgeon), submission diagnosis, and previous treatment (medical/surgical). In-hospital variables studied were definitive diagnosis, complications, and final outcome.

Statistical Methods

Frequencies and percentages were used for descriptive statistics. Categorical data were compared using χ^2 and Fisher exact test. Data were analyzed by using SPSS v.17 for Windows.

RESULTS

During the study period, 200 patients met the inclusion criteria. The age group was as follows: neonates 11 (5.5%), infants 111 (55.5%), preschool-age 16 (8%), school-age 36 (18%) and teenagers 26 (13%). There was no difference according to gender (106 males and 94 females).

The referral hospital was public in 167 cases and private in 33 cases. The level of care was first-level in 30 patients, second-level 99 and third-level 71. Referring physicians were Paediatricians 110, paediatric surgeons 51, general practitioners 23 and general surgeons 16.

The most frequent submission diagnoses were abdominal tumour (20 patients, 10%), anorectal malformation (14 patients, 7%), cholestatic syndrome (8 patients, 4%), renal tumour (8 patients, 4%), appendicitis (7 patients, 3.5%), intussusception (6 patients, 3%), Hirschsprung's disease (4 patient, 2%) and oesophageal atresia (3 patients, 1.5%) among others. These were divided into 4 diagnostic groups: tumours (68 patients, 34%), congenital malformations (64 patients, 32%), inflammatory diseases (60 patients, 30%) and without diagnosis (8 patients, 4%).

The most frequent final diagnoses in the Hospital Infantil de México Federico Gómez (HIMFG) were appendicitis (17, 8.5%), anorectal malformation (15, 7.5%), intussusception (14, 7%), Wilms tumour (14, 7%), hepatoblastoma (11, 5.5%), biliary atresia (9, 4.5%), hypertrophic pyloric stenosis (5, 2.5%), Hirschsprung disease and oesophageal atresia (4, 2%), among others.

In the same manner, patients were also divided into the same 4 groups: tumours 78 patients (39%), congenital malformations 66 patients (33%), inflammatory diseases 50 patients (25%) and other diagnoses 6 patients (3%).

Sixty-six patients (33%) were previously operated of which 39 patients were operated on once, 16 twice and 11 three or more

times. Of these surgeries, 19 were performed by general surgeons (28.7%) and 47 by paediatric surgeons (71.3%). Out of the 66 patients with previous surgeries, 44 had surgical complications (66.6%) and 22 had no surgical complications (33.3%).

By correlating the submission with final diagnoses, there were 140 correct (70%) and 60 that were incorrect (30%). According to subtypes of correct diagnosis, there were 85 patients in Group 1 (42.5%), 14 in Group 2 (7%), 9 in Group 3 (4.5%), 20 in Group 4 (10%) and 12 in Group 5 (6%) [Table/Fig-1].

According to subtypes of incorrect diagnoses, there were 3 patients in group 6 (1.5%), 20 patients in Group 7 (10%), 4 in Group 8 (2%), and 33 in Group 9 (16.5%) [Table/Fig-2].

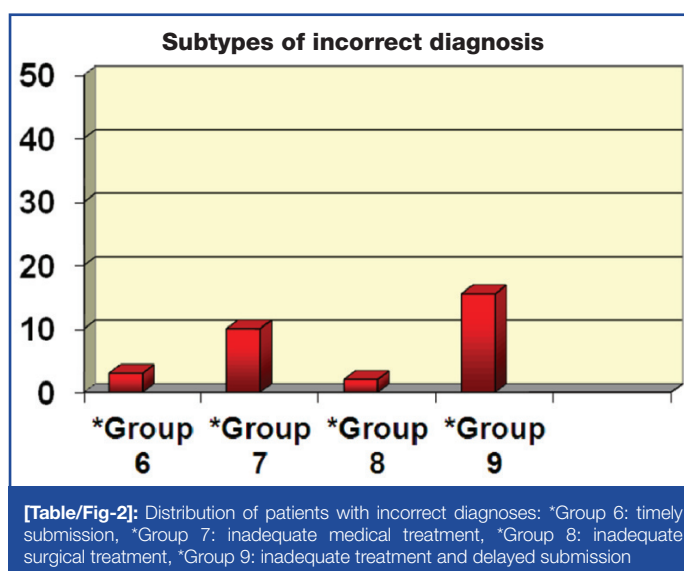
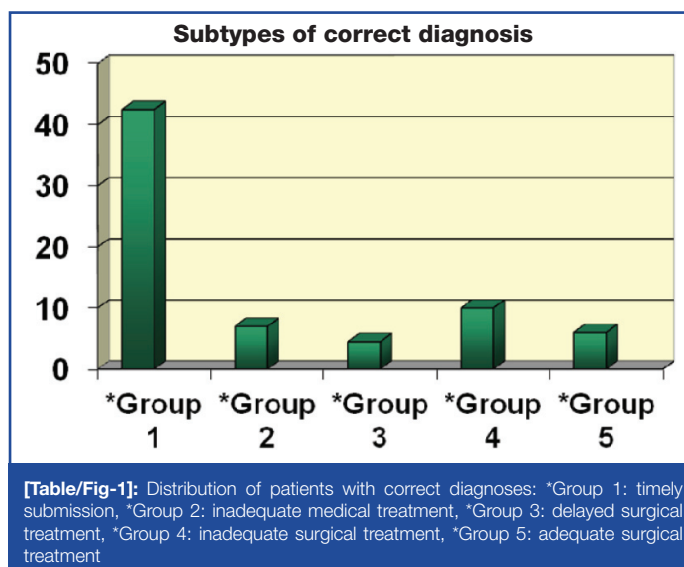
Based on the fact that any patient with an incorrect diagnosis was inadequately managed and with the previous definitions in regard to the correct diagnostic subtypes, we conclude that the sum of group 1 plus Group 5 were the only patients with appropriate management (97 patients = 48.5%) in the global series. Therefore, the remaining patients were classified as being inappropriately managed (51.5%), either by being misdiagnosed or due to mismanagement.

Final Outcome

One hundred forty five patients were cured (72.5%), 50 patients improved (25%) and 5 patients died (2.5%).

Analysis of Factors Related with Incorrect Diagnosis

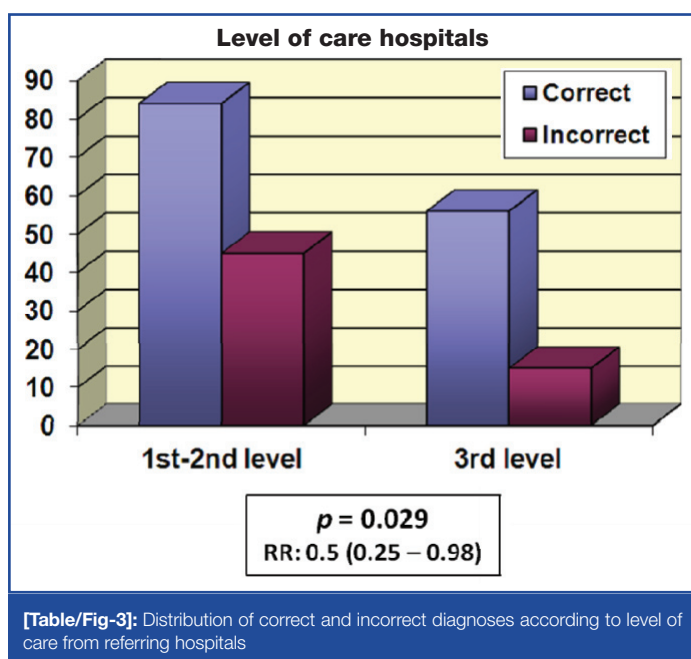
The frequency of incorrect diagnosis was similar across age groups: 36.4% in neonates, 31.5% in infants, 12.5% in preschool-age



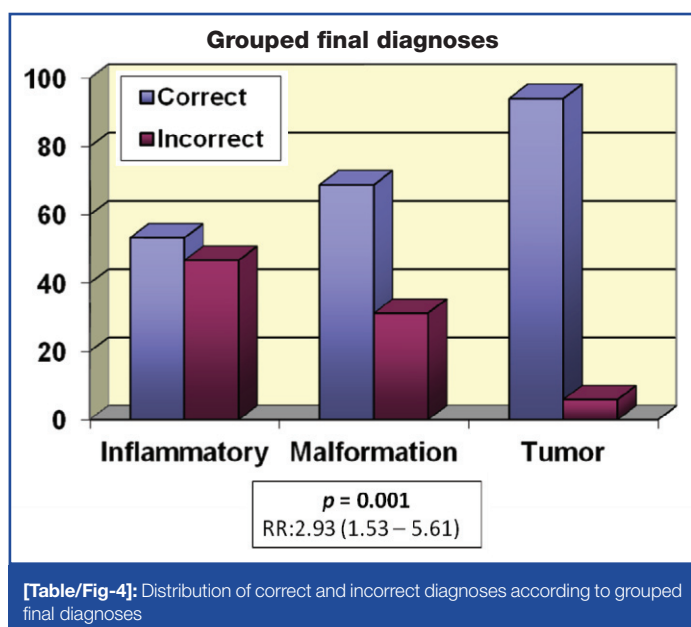
children, 36.1% in school-age children, and 23.1% in adolescents ($p = 0.41$).

Incorrect diagnosis was made in 30% of males and in 34% of females, without statistical difference ($p = 0.46$). There was a statistically significant difference in favor of third-level care hospitals as there were fewer incorrect diagnoses vs. first and second-level care hospitals (21.1 vs. 34.9%, $p = 0.029$) and relative risk (RR) = 0.5 with 95% confidence interval (CI): 0.25–0.98 [Table/Fig-3]. The frequency of incorrect diagnosis was similar across public and private hospitals (28.7% vs. 36.4%, $p = 0.25$). The frequency was not different between Paediatrician (26.4%), general surgeon (31.2%), paediatric surgeon (31.4%) and general practitioner (43.5%) ($p = 0.43$).

By correlating the frequency of grouped diagnoses with incorrect diagnoses, we found this to be higher in inflammatory conditions vs. congenital malformations or tumours (46.7%, 31.3% and 5.9% respectively, $p = 0.001$, RR: 2.93, 95% CI = 1.53–5.61) [Table/Fig-4]. In patients with previous surgeries, 33.3% had incorrect diagnoses, and those without previous surgeries had incorrect diagnoses in 28% ($p = 0.28$). There was a rate of 34% of incorrect diagnoses with the paediatric surgeon, whereas the general surgeon had a rate of 31.6% ($p = 0.54$).



[Table/Fig-3]: Distribution of correct and incorrect diagnoses according to level of care from referring hospitals



[Table/Fig-4]: Distribution of correct and incorrect diagnoses according to grouped final diagnoses

Diagnosis	Paediatric surgeon	General surgeon
Anorectal malformation	7	0
Tumor	4	3
Intestinal ischemia	3	1
Hirschsprung's disease	3	0
Hiatal hernia	2	1
Oesophageal atresia	2	0
Choledocal cyst	2	0
Gastric volvulus	1	0
Cholecystitis	1	1
Malrotation	1	0
Intestinal atresia	1	0
Appendicitis	1	5
Abscess	0	1
Pancreatitis	0	1
Wound dehiscence	1	1

[Table/Fig 5]: Distribution of diagnoses by type of surgeon in patients with surgical complications

Patients with surgical complications had an incorrect diagnosis rate of 38.6% and those operated without complications showed an incorrect diagnosis rate of 22.7% ($p = 0.15$).

Out of the patients with surgical complications, 14 were operated by general surgeons (14/19 surgeries = 73%) and 30 were operated by paediatric surgeons (30/47 surgeries = 63.8%) without significant difference ($p = 0.59$).

The most-often complicated diseases for paediatric surgeons were anorectal malformations, tumours, inflammatory diseases, and Hirschsprung disease. The most complicated diseases for general surgeons were appendicitis and tumours [Table/Fig-5].

Analysis of Factors Associated with Inadequate Management

By correlating the frequency of grouped diagnoses with inadequate management, we found that although poor management was more common in inflammatory conditions, there was no statistically significant difference compared to congenital malformations or tumours (60% vs. 56.1% and 38.5%, respectively).

Comparing adequate vs. inadequate management, we found that paediatricians had a higher rate of adequate management (61.8% vs. 38.1%, $p = 0.001$). Both types of surgeons demonstrated more inadequate management (paediatric surgeon 29.4% vs. 70.6%, $p = 0.003$ and general surgeon 25% vs. 75%, $p = 0.052$), whereas general practitioners showed an equal distribution in their management rates (43.5% vs. 56.5%, $p = 0.32$).

DISCUSSION

Clinical decision making requires two distinct cognitive skills: ability to classify patients' conditions into diagnostic and management categories and ability to individualize or-more precisely-contextualize the better care for each patient whose circumstances and needs require variation from the standard approach to care [6]. In order to offer appropriate treatment, it is necessary to have a previously correct diagnosis. If the diagnosis is incorrect, patient management will be inadequate.

The limited published literature on diagnostic errors in paediatric patients with surgically treated diseases usually is restricted to reasons of delay in diagnosis of acute appendicitis or anorectal malformations [7,8], but the causes may be varied. England and Crabbe published a retrospective review of 311 children treated for appendicitis, finding that perforation and complication rates were significantly greater in children who received antibiotics prior

to a definitive diagnosis of appendicitis, concluding that signs of appendicitis may be masked by prior treatment with antibiotics [9]. Turowski and Dingemann found that one in five neonates with imperforate anus had a delayed diagnosis, even with symptoms such as abdominal distension, bilious vomiting and delayed passage of meconium, emphasizing thorough perineal examination in the newborn [10]. One cause of incorrect management may be due to the volume of surgical procedures of a particular surgeon that can influence the results [11].

There are no data showing the frequency of misdiagnosis in paediatric surgical patients; therefore, our study becomes important in providing data to help understand the problem of incorrect diagnosis in these patients.

It is worth noting that our study population was unique in the sense that only referral patients were included and only to our department because we wanted the opportunity to confirm the final diagnosis and outcome. All referred patients with inflammatory diseases or tumours arrive at our department, but many neonates with surgical diseases are referred to the Neonatology Department. Therefore, not all neonates with surgical diseases were included, which may bias our experience in this age group.

Most of the patients came from secondary and tertiary care hospitals, mainly public facilities because our center is a public hospital. Although most cases were referred by paediatric specialists, 19.5% of patients were referred by physicians without a paediatric specialty (general practitioners and general surgeons).

In relation to submission diagnoses, due to the wide variety we decided to group these and found that approximately one-third represented tumours, one-third congenital malformations and one-third inflammatory conditions. In relation to the final diagnosis, in our hospital there was a slight increase in tumours and some decrease in the frequency of inflammatory conditions with congenital malformations remaining unchanged.

When making a correlation between submission and final diagnosis, it was found that 70% were correct and 30% incorrect. Because there are no reports in the literature in regard to the frequency of correct diagnosis, it was our aim to contribute our data to the existing medical data, noting that it is a highly selected population. However, having a correct diagnosis does not necessarily mean that treatment is always appropriate. We classified as adequate treatment only those patients who were promptly referred and those in whom medical or surgical management would have been appropriate. We believe that, even with a correct diagnosis, management is inadequate if the patient receives incorrect or inappropriate or delayed medical or surgical treatment. According to these definitions, the frequency of inadequate management in our series was 51.5%, which seems high even with the level of complexity of patient conditions received at our hospital.

In an attempt to investigate the factors that may lead to incorrect diagnosis, it was found that there were fewer incorrect diagnoses when the patient was referred from a tertiary care center vs. first- or second-level care hospitals. This is explained by the increased specialization of physicians and the resources available to these centers. Interestingly, although there was no statistical difference in the frequency of misdiagnosis in relation to the degree of specialization, Paediatricians had a lower rate of incorrect diagnoses. This may be explained by the fact that when the Paediatrician makes a diagnosis that may require surgery, the patient is sent promptly for consultation. In contrast, general practitioners had a very high rate of incorrect diagnoses, probably due to lack of knowledge of paediatric surgical conditions.

In the case of tumours, we found that the frequency of misdiagnosis is very low. This is probably due to the fact that when a tumour is suspected, the patient is referred promptly, even without a precise diagnosis. It is worth mentioning that if the referral diagnosis was

“abdominal tumour” and the final diagnosis represented one of the multiple specific tumours, then this was classified as a correct diagnosis. However, when compared with inflammatory diseases, there is an almost threefold risk of making an incorrect diagnosis. This is probably due to the fact that these are diseases in which any type of physician attempts to make a diagnosis, but also because of the misconception that “every acute abdomen in children is appendicitis”. There are many surgical entities that may cause acute abdominal pain in children but are unknown to general surgeons or general practitioners.

One of every 3 patients underwent surgery prior to arriving at our hospital; 40.9% of these patients underwent more than one surgery. In Mexico, unlike other countries, the course for the specialty of paediatric surgery includes 2 or 3 years previous of paediatric specialization, without requirement for prior studies in general surgery. Similarly, general surgeons are not required to have any paediatric surgery practice during their specialization. Although it is desirable for all children to be operated on by a paediatric surgeon, in fact, many paediatric patients in our country are being operated by general surgeons. This is demonstrated by the fact that 28.7% of patients with previous surgery were operated on by general surgeons. Although the frequency of incorrect diagnosis was similar between general surgeons and paediatric surgeons, it is worth mentioning that paediatric surgeons managed diseases with greater complexity than general surgeons because general surgeons operate mostly on patients with inflammatory conditions and virtually no congenital malformations. If we add patients with tumours plus those with congenital malformations, we arrive at a total of 66% of patients who must be managed exclusively by paediatric surgeons. General surgeons are more involved in patients with inflammatory conditions, that have a relative risk of incorrect diagnosis of 2.93. In addition, how to address medical errors is often influenced by parental educational level, as reported by Ceriani [12].

In relation to the factors associated with inadequate management, we found that there was a higher frequency of inadequate management in inflammatory conditions, although not statistically significant, in accordance with being the group with the highest rate of incorrect diagnoses.

It is noteworthy that although there were 43 patients (21.5%) who were diagnosed correctly, their management was poor—surgical, medical or delayed. Therefore, it is necessary to emphasize the importance of determining the most optimal surgical management for paediatric conditions as well as the need to promptly refer the patient if the treating physician does not have all available resources to provide the most optimal treatment.

A higher proportion of poor management was found in both categories of surgeons as compared to non-surgeons, probably due to the fact that surgery presents a higher risk than simply making a medical diagnosis to refer the patient, as is often the case with general practitioners and Paediatricians.

Finally, it is important to emphasize that, although the paediatric surgeon should have the most optimal experience for treating the paediatric surgical problems, our data actually demonstrated a high rate of incorrect diagnoses or inadequate management. This fact should prompt us to investigate whether these results are repeated in other samples in Mexico or in other, better-developed countries in order to determine the reasons for this intriguing problem and find the causes. Halsted et al., found that the most common errors of radiology residents were in the interpretation of fractures [13]; the effects that a medical error has on the child's family has been published [14].

In conclusion, we present the frequency of incorrect diagnosis and inadequate patient management in a highly selected population. Sample size should be increased as well as performing these studies in other hospital settings in order to determine whether the results are reproducible.

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