



## Risk Evaluation of General Anesthesia in Pediatric Skin Surgeries: A Retrospective Cohort Study in Saudi Arabia

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### Abstract

**Background:** Use of general anaesthesia in outpatient invasive procedures has increased, especially in the field of dermatology. Being uncooperative, children often require general anaesthesia. Especially since surgical skin operations are painful and lengthy, dictating the use of general anaesthesia.

**Aim:** The purpose of this study was to evaluate the safety, significant adverse events, and the complication rates related to general anaesthesia, when used among pediatric population underwent skin surgeries.

**Methods:** We conducted a retrospective cohort study in the form of randomly selected patient chart review, with a surgical code in the array of 8,539–16,782 for 2 years. We reviewed registers to document any unexpected admissions, adverse events or complications. Surgical outcomes and anaesthesia complications were reviewed by three anaesthesia consultants. We conducted Inter-rater reliability test analysis and per cent agreement to determine the level of agreement between raters.

**Results:** A total of 211 procedures were reported for 211 patients with 19 diagnoses. No adverse events related to anesthesia were recognized in any of those selected patients, apart from minor complications noticed in twelve patients (P value < 0.03). Kappa value range between 0.78-1.00 (95% CI, 0.46809 to 1.00)

**Conclusion:** In case of proper deploying of staff experience, appropriateness of choice of surgical procedure, patient selection, and modern technology as non-dependent confounding variables. Pediatric-trained anesthesiologists can safely use general anaesthesia in dermatological invasive procedures without significant complications.

## Keywords

General Anesthesia; Pediatric; Dermatologic Surgeries; Complications; Adverse Events

## Introduction

Recently, the use of general anaesthesia in pediatric invasive skin procedures has increased [1,2]. It is quite challenging to mollify a child while you are doing an invasive procedure, even with local anaesthesia. Surgeons have to operate young children using general anaesthesia to avoid frequent painful procedures due to non-compliance and non-cooperation [1]. Surgical skin procedures are almost done as outpatient service and accompanied by a few trivial complications [3]. Bari et al conducted a multicenter retrospective review that found a 0% rate of serious complications among pediatric patients [1]. Randomized control trials evaluating general anaesthesia in pediatric invasive skin procedures in comparison with local anaesthesia or any other approach are sparse. We conducted this retrospective cohort study to approve the safety of general anaesthesia in the pediatric population undergoing dermatologic surgeries.

## Material and Method

Patients were nominated through the electronic system for integrated health information in our tertiary hospital in Riyadh, Saudi Arabia. Patients who had surgeries under general anesthesia done by pediatric dermatology consultant from the period September 1, 2017 through September 2019 at King Salman hospital were eligible to be included in the study. An adverse event was defined as any complication related to the general anesthesia during the operation or immediately postoperative, or an unplanned readmission within one week of the operation due to a cause related to anesthesia, either to the clinic, or pediatric emergency department. Substantial adverse events were described as any complication which lead to undesirable outcomes or medical intervention leading to extended length of stay. We conducted a retrospective file review to gather patients' demographic criteria such as; age, gender, diagnosis and performed procedures, and unexpected admissions, incidents, or complications. We obtained the approval of Institutional Review Board.

Pediatric anesthesia consultant was the cadre who administered the general anesthesia to all our patients. Our patients were provided strict regulations prohibited them to eat or drink anything, two hours before the procedure, unless being an infant <5 months, only clear fluids allowed. Easily digestible solids are not allowed 4-6 hours before surgery. Also milk products are not allowed eight hours before surgery. We used nitrous oxide, oxygen, and sevoflurane in the process of induction of anaesthesia as well as maintenance. We administered frequently in addition some other agents, during the procedure, like ondansetron, ketorolac, or dolasetron. Morphine or fentanyl were also given. Midazolam, acetaminophen, in solo or in combination with codeine were also administered occasionally as premedication. Marcaine 0.25% was locally infiltrated around the surgical incision in case of excision-repair procedures. We gave our patients morphine or fentanyl postoperatively for pain control, if required. Ibuprofen or acetaminophen was prescribed as home medication upon discharge for pain control if necessary.

Post-operative complications were classified in terms of severity in to minor and major complications related to anesthesia, and they were assessed by three pediatric anaesthesia consultants to reach a consensus about the level of severity of post-operative complications, either to be proved as minor or major according to results.

Each consultant evaluated the post-operative complication against pre-specified criteria adopted from J. E. Riding 1975 used for severity assessment and gave a score from one to five (Likert scale) [4]. "One" was interpreted as strongly disagree and "five" as strongly agree.

We conducted inter-rater reliability tests (IRR), to determine the level of agreement between raters. We also used the Intra-class correlation and measured the consistency of ratings because we have more than

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two raters. The inter-rater agreement was appraised by calculating the “Fleiss’ kappa statistic” for each contributor [5]. The estimation of the statistic was established to be 1.00, when there was comprehensive agreement and “zero” when the rate was alike to that perceived by chance. Intermediary rates were defined in **Table-1**.

The correlation between contributors’ responses was statistically analyzed with the “chi-square non-parametric test”, with a level of significance of 5%, with 95% confidence interval (CI). The research has been fully premeditated in advance, including the

calculation of the minimum “n” and the “factor beta” statistical error, which was lower than 20%. According to this mentioned statistical manipulations, the sample size is in congruence to the results and conclusion. We performed the statistical analysis by means of the IBM-SPSS “version 20.0” software (IBM-Corp, Armonk, NY, USA). Descriptive data were demonstrated in median, minimum and maximum values. The kappa correlation coefficient “k” was used to specify inter-observer-reliability. Based on kappa correlation coefficient, the results were categorized as “excellent, very good, good, moderate, fair and poor”.

Value of K	Strength of Agreement
< 0.20	Poor
0.21 - 0.30	Fair
0.31 - 0.40	Moderate
0.41 - 0.60	Good
0.61 - 0.80	Very good
0.81 - 1.00	Excellent

The weights are calculated as follows: Using the notation from Cohen’s Kappa where  $p_{ij}$  are the observed probabilities,  $e_{ij} = p_{ij}$  are the expected probabilities and  $w_{ij}$  are the weights (with  $w_{ji} = w_{ij}$ ) then [6]:

$$\kappa_w = 1 - \frac{\sum_{i,j} w_{ij} p_{ij}}{\sum_{i,j} w_{ij} e_{ij}}$$

The standard error is given by the following formula:

$$se_w = \frac{1}{1 - p_{e(w)}} \sqrt{\frac{\sum_{i,j} p_{ij} [v_{ij} - u_{ij}(1 - \kappa_w)]^2 - [\kappa_w - p_{e(w)}(1 - \kappa_w)]^2}{n}}$$

**Results**

A total of 211 procedures under general anesthesia were performed on 211 unique pediatric patients with a total of 19 dermatological diagnoses. The patients ranged in age from 4 months to 17 years of age, with a mean age of 4.7 years. A total of 111 (52.6%) patients

were males and 100 (47.3%) were females (**Table-2**). All the patients had an American Society of Anesthesiologists (ASA) status I or II.

Characteristics	Finding
Sex, No (%)	
Male	111 (52.6)
Female	100 (47.3)
Age	
Mean	4.7 years
Range	4 months - 17 years
Total number of procedures	211
Total number of diagnoses	19

Of the 211 procedures performed under general anesthesia, 88 (41.6%) were flash lamp pulsed dye laser, 123 (58.3%) excisional surgical procedures (excision and or repair of wounds or lesions). The most common diagnoses were congenital melanocytic nevi (23%), nevus sebaceous (21%), port wine stain (19%), infantile hemangioma (8%), dermoid cysts (7%), and pilomatricomas (4%). Other diagnoses represented (18%) and summarized in **Table-3**.

Diagnosis	N° of Patients (%)
Congenital melanocytic nevus	49 (23)
Nevus sebaceous	45 (21)
Port wine stain	41 (19)
Infantile hemangioma	16 (8)
Dermoid cyst	14 (7)
Pilomatricoma	8 (4)
Juvenile aponeurotic fibroma	5 (2.3)
Halo scalp ring	5 (2.3)
Cyst	5 (2.3)
Epidermal nevus	4 (1.9)
Vascular malformation	3 (1.4)
Dermatofibroma	2 (0.9)
Atypical nevus	2 (0.9)
Myofibromatosis	2 (0.9)
Verruca vulgaris or condyloma	2 (0.9)
Spitz nevus	2 (0.9)
Nevus	2 (0.9)
Pyogenic granuloma	2 (0.9)
Foreign body	2 (0.9)
Total	211

A total of 12 of the 211 patients (5.6%) had clinically relevant complications related to anesthesia (Table-4), of which, 4 patients developed post-operative Sore throat, nausea and vomiting. 3 patients developed mild to moderate post-operative frontal headache. 2 patients developed post-operative minor trauma to the teeth and lips. One patient developed post-operative "Bruising" from IV injection. One patient developed post-operative painful neck muscles. One patient experienced recall of unpleasant dreams, and return to consciousness before completion of pharyngeal suction and extubating. No venous complications noted like ecchymosis, tenderness, thrombosis, or thrombophlebitis. No nerve complications arise from mal-positioning of the patient on the operating table. Also no eye complications noted like corneal abrasions.

No immediate intra- or postoperative complications such as bradycardia, tachycardia and apnea in our patient population were observed. No adverse events were identified in any of these patients and no mortalities were observed. No admissions for dehydration from nausea and vomiting were

N°	Complications	N° of Patients (%)	P value
1	Sore throat, nausea and vomiting	4 (33)	0.04
2	Mild to moderate frontal headache	3 (25)	0.02
3	Minor trauma to the teeth and lips	2 (17)	0.002
4	"Bruising" from IV injection	1 (8.3)	0.01
5	Painful neck muscles	1 (8.3)	0.008
6	Recall of unpleasant dreams, and return to consciousness	1 (8.3)	0.05
<b>Total</b>		12/211 (5.6)	0.029

recorded.

Three pediatric anesthesia consultants evaluate the twelve patients and their complications, against pre-specified adopted criteria (Table-5). All the complications were classified as minor complications and scored by Likert scale from 1-5, where 5 is strongly agree and one is strongly disagree. The data revealed from the Likert scale used in assessment of

the level of agreement among raters by inter-rater reliability tests and determination of intra-class correlation coefficient (Kappa value). We determined the level of percent agreement between raters. The results of the inter-rater reliability tests, showed high strength of agreement, for every question in the evaluation criteria and for every patient. Most of the Kappa values were between (0.70-1.00, 95% CI, 0.46809 to 1.00) denoting very good to excellent

agreement, as shown in Fig-1,2.

Table-5: Pre-Specified Adopted Criteria against Which the Complications Were Evaluated	
Criteria	N of Patients
Lasted more than 3 hours either by observation or medication	0
Caused annoyance, discomfort and anxiety to the patient	0
Affected the resumption of normal activities on returning home.	0
Resolved by analgesia or medication	2
Patient complained from the complication	2
Patient complained only when asked and interviewed	10
Settled with observation	10
Constitute no threat to the long-term health and well-being of the patient	12

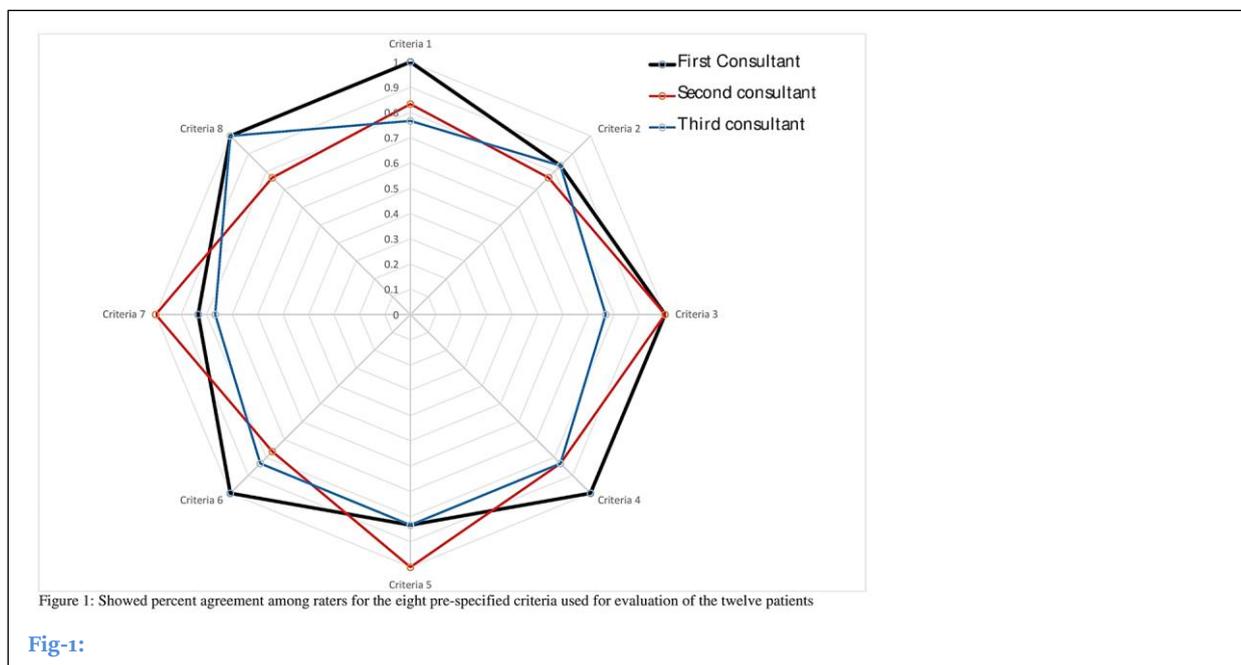


Fig-1:

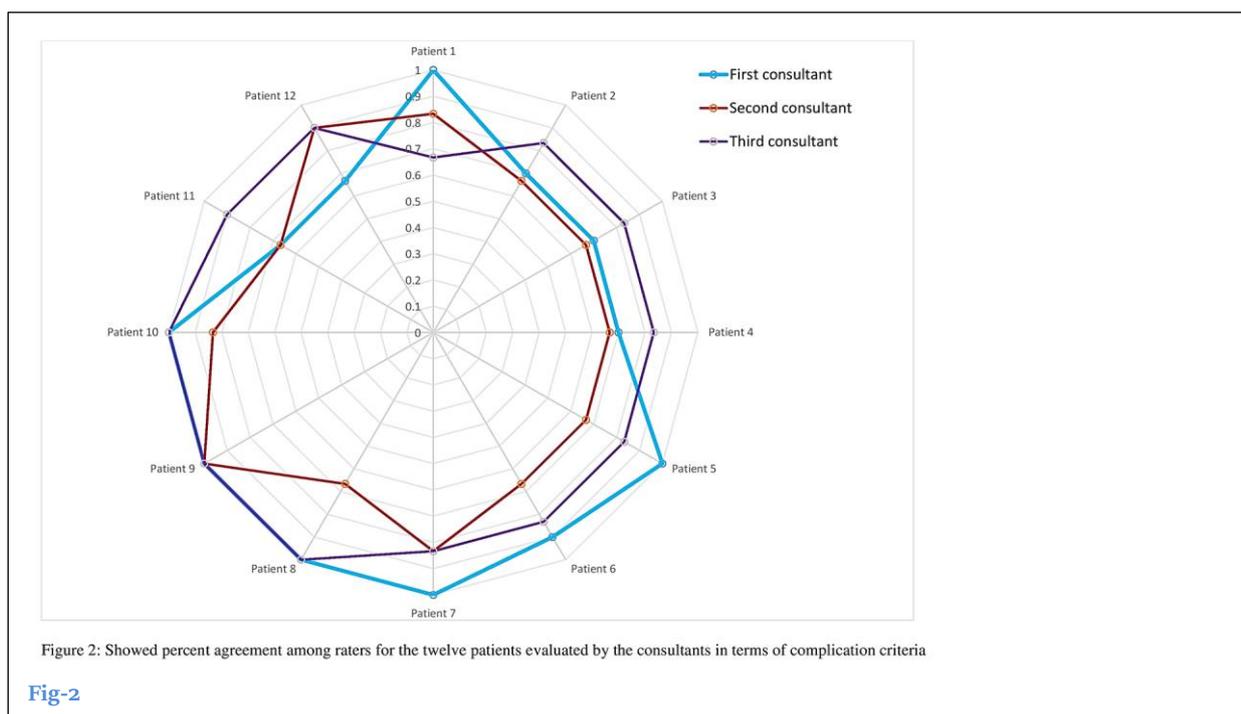


Fig-2

## Discussion

The significance of safety evaluation of general anaesthesia in paediatrics has been addressed in the past [7]. However, recent epidemiological researches concerning with general anaesthesia-related complications particularly in pediatric skin surgeries were scarce [8]. The available literature usually emphasizing on the usage of general anaesthesia in major operations such as neurosurgery, cardiovascular surgery, and abdominal surgery in adults and children [9]. Little number of articles on the web have addressed the safety of general anaesthesia in pediatric dermatologic surgeries. The available information from the review of the literature shows that morbidity and mortality from general anaesthesia in skin surgeries among children are very rare and clinically insignificant [9,10].

The incidence of post-operative headache as a minor complication related to anesthesia ranges between 2 to 70% [11]. Substantial reasons for this wide range in fallouts are not ostensible [12]. However, short-lived or mild headache may go unremarkable by patient or observer [13]. Our results showed low incidence of headache in spite of patient interviewing. Our study results reported here are a little different from the published literature. However, there was no serious complications or mortalities were noted. The findings of our study are not similar but consistent with the foregoing publications. A multicenter study was done to evaluate the safety and adverse events linked to general anaesthesia in pediatric patients undergoing elective surgeries was conducted as a retrospective review of 270 children between two months and eighteen years old [1]. The complications of general anaesthesia after elective pediatric dermatologic operations were very low and 95% of children did not experience clinically significant complications [14]. An editorial article by Dinulos et al also reported that deep sedation and general anaesthesia are safe and cost-effective approaches to control pain [15]. Under calm and quiet conditions, Dinulos encouraged other surgeons to perform cutaneous surgical procedures on children under general anaesthesia. To report their suggestions, to improve their practice, and to establish recommendations to advance their management.

Another study found that laryngospasm and transient apnea were the most common complications noted, however, the results were statistically insignificant [16]. Our findings did not show any incidents of laryngospasm or apnea. Wound infection was a common complication after skin surgeries, however, it is far away to be classified as a complication related to anaesthesia, it could happen either under general or local anaesthesia [17]. Regarding the appropriateness and timing of the use of general anaesthesia for children in surgical dermatology. Authors and surgeons have settled that general anaesthesia is safe and appropriate for different pediatric dermatologic operations, regardless of the factor of age [18,19]. Especially, Chen who suggested that timely surgical intervention under general anaesthesia will be the best option in children with lesions that; associated with substantial health risks or result in deformity or functional impairment [19]. Also, children who will definitely benefit from early surgical intervention because of the superior cosmetic outcome which will be obtained [20]. Also, in children where the timely surgical correction will positively affect their psychosocial status and self-esteem [15,21].

Fortunately, malignant skin lesions in children are very rare [22,23]. Also, operable skin lesions that may lead to functional impairment are quite infrequent [24]. Dysplastic nevus, congenital nevus, and spindle-cell nevus represent the bulk of the skin conditions which may lead to significant complications if neglected and left untreated [25]. Sebaceous nevus can also turn malignant if left untreated. Excisional biopsies are essential in the diagnosis of such indistinct skin lesions. On the other hand, most of the skin lesions in children are typically benign, in spite of being symptomatic [26]. Symptoms associated, such as; itching pain, growth, or infection. Growth of benign skin lesions in children is usually very slow, however, it may lead to deformation, which is a common complication. All these skin problems can often be treated by surgical interference [27].

Many conditions should be fulfilled first, before the use of general anaesthesia, such as a healthy patient,

appropriate choice of surgery, promising outcome, benefits of early surgical intervention in children and right anaesthesia setting [12]. The skin of children is much more pliable, with good healing properties. These advantages allow the surgeon to remove large lesions with primary closure. This makes the skin of children different from the skin of adults [17]. This is clearly shown in the excision of scalp lesions in adults compared with the same procedure in children [15]. The elasticity of the skin in children plays an important role in healing and ease of manipulation than inelastic skin. Inelastic skin in adults sometimes leads the surgeon to perform multiple surgeries, while waiting for better wound healing and skin growth [8].

To avoid postoperative complications such as large scarring, spread scar or wound dehiscence, surgeons should consider an early intervention at a young age [10]. The skin lesion at a young age is not under big tension, so it can be easily closed [14]. When a large skin lesion ought to be removed, in the thigh of a young child. It can be closed primarily without any complications, because of elastic redundant skin and less muscle mass. Similarly, we can avoid surgical complications significantly associated with the usage of skin flaps, tissue expanders or grafts, by early intervention at a young age. All those assistant factors, it is possible to do without them unless you have an older patient with skin lesion under tension [20,21].

In children, sedation is more problematic than in adults because sedation levels are not as obviously distinct [28]. Especially, deep sedation is commonly unclear from general anaesthesia in children. Also, sedation does not provide characteristic airway protection in comparison to general anaesthesia [29]. Repair procedures and large excisions are too painful to be controlled by light sedation. And even small excision with little pain is also difficult to be controlled by light sedation because of the fear and uncooperative behaviour of the child [30]. Especially, if the procedure takes a long duration. Death of children has occurred because the anesthesiologists failed to save the airway in spite of safe sedation [31].

Children go beyond from one sedation level to another with no clear signs, and that increases the

likelihood of more risk during the sedation when compared to adults. Moreover, it will be difficult to secure the airway during the procedure done under sedation [32]. Because children have compromised airway due to anatomical variation that makes their airway more prone to obstruction or injury. In addition to the relatively large tongue and small oral cavity which make the procedure of accurate evaluation very difficult. Other factors that make the process of airway protection in children impossible, such as prominent laryngeal and pharyngeal structures, short trachea and neck flexion due to projecting occipital bulge [33].

Sedation may be valuable only in case of minor procedures with short duration provided that, there is an adequate number of well-trained personnel and equipment to ensure the safety and proper management of the airway [30]. On the other hand, procedures concerned with excision and repair should be done under general anaesthesia in the operating room. Generally, the usage of general anaesthesia in pediatric surgeries is favourable and safer than sedation [32].

Trained anesthesiologists ensure the proper position of the endotracheal tube by proper positioning of the patients head, to avoid displacement of the tube in to the right bronchus, or dislodgement. Trained staff, beside their experience of at least 250 pediatric performed cases per year, have shown a lower incidence of anesthesia related complications compared with children treated by non-trained anesthesiologists. Previous literature have shown that the associated comorbidities together with prolonged procedures and lack of trained staff, increased the anesthesia related complications by 300% [21]. The usage of the fast-acting anesthetic agent by inhalation, was associated significantly with low risk of general anesthesia [22]. The ASA (American Society of Anesthesiologists) assesses the probability of severe complications in a fit youngster undergoing general anesthesia due to any reason to be one case per 20,000, a tremendously low risk [24].

Our findings revealed minor anesthesia related

complications. And this information offers more evidence that general anesthesia is a safe approach. Provided that there are other precautions should be considered such as appropriate patient selection, well trained staff, full equipped theater, right setting, elective procedures and promising outcome due to early intervention. Relatives must always be directed regarding the probable consequence of these risks. We concluded that general anesthesia is a safe approach to perform pediatric dermatologic surgeries, in well-equipped appropriate setting, proper selection of patient population, between the hands of experienced anesthesiologist.

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