

Original Article

Risk of Incarceration of Inguinal Hernias among Paediatric Patients awaiting elective surgery at the University Teaching Hospital, Lusaka, Zambia

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ABSTRACT

Background: This study was conducted to determine our own institutional rate and risk of inguinal hernia incarceration among infants and children awaiting elective surgery.

Inguinal hernias in infants and children are very common. One of their common complications before surgery is incarceration. Rate and risk of incarceration among our patients awaiting surgical care was not known.

Method: A retrospective review of infants and children under the age of 17 years, who had undergone inguinal hernia repair or had incarcerated, from January 2015 to January 2017 was performed. Interviewer completed questionnaires were used to abstract data from the clinical records. A total of 364 patients were included for analysis, in this study. Descriptive statistics, Regression Analysis and Kaplan Meiers Survival Analysis were employed.

Results: The infants and children were stratified into seven age groups. The overall incarceration rate was 13.45%. The risk of incarceration was age

dependent. It ranged from 0.52 daily risk of incarceration, among neonates, to zero daily risk of incarceration among older children. Longer wait times were associated with increased rate and risk of inguinal hernia incarceration.

Conclusion: The overall rate of incarceration was high (13.45%). Longer wait times, infants and younger children, male sex, right sided hernias were associated with unacceptably higher rates & risks. Neonates had as much as 5 times higher risk of incarceration than other children. The best time to operate is before 3 weeks for neonates, before 2 months for infants & before 4 months for younger children to prevent incarceration.

INTRODUCTION

Paediatric inguinal hernias are a common inguinoscrotal abnormality in infants and children [1]. They occur in 1% to 4% of children aged 1 to 4 years; the incidence may reach 30% in premature infants [2].

Because of their frequency, potential morbidity, and the magnitude of repair, hernias constitute a major health problem that has attracted the attention of the researchers and authorities in health economics [3,4].

One of the main complications prior to planned surgery is incarceration [5] – on of the commonest reasons for emergency surgical admission of young children.

Surgery is the treatment of choice for the inguinal hernias in children. The aim of an operation is to

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reduce symptoms and to prevent acute complications. Watchful waiting is an acceptable short term alternative, but in the long run patients need to be operated upon because of development of symptoms [1]

In a patient with acute symptoms of incarceration, reduction of an incarcerated hernia should be attempted, and it can be achieved in the majority of cases. Sedation (with an opiate or short acting benzodiazepine and firm, steady pressure over the hernia for up to half an hour may be necessary. If reduction is successful, the child should be admitted to hospital (because of high risk of recurrence), and surgical correction undertaken one to two days later (to allow oedema to resolve) [28]. If it cannot be reduced or if the signs of strangulation are present, emergency surgical intervention is mandatory [28].

In this study incarceration was defined according to Lau [27] who defined it as the need for gentle compression with or without the use of analgesia or sedation to aid reduction of the irreducible hernia. Incarceration risk will be defined according to Gholoum[8] who defined daily risk as total number of incarcerations that were not index presentations, divided by the total number of days waiting for elective repair.

Studies have shown that there is institutional variability in the rates and risks of inguinal hernia incarceration; and consequently, in optimal timing of hernia surgeries, to prevent the inguinal hernia incarcerations [6,7,8,9]. This study was done to review our own institutional experience of the rate and risk of inguinal hernia incarceration among infants and children. This was necessary to help inform practice and policy.

METHODS

This study employed quantitative research methods to acquire data that was statistically significant.

Study design

To determine the rate and risk of incarceration of inguinal hernias in infants and children at the UTH,

this retrospective cohort study was performed using retrospective reviews of the records of all children under the age of 17 years, who were diagnosed with inguinal hernia at UTH, from January 2015 to January 2017. This 2-year time frame was chosen assuming that any infant or child with a diagnosis of inguinal hernia during this period, who was otherwise healthy, would under-go hernia surgery within a maximum of 2 years. This method was adopted from Zamakhshary [6], Lautz [9], Baird [10].

Patients who had inguinal hernia recurrences or incarcerated before surgery were included in the study, whilst those that had an initial diagnosis of hydrocele but were intra-operatively found to have had inguinal hernia were excluded. Similarly, patients whose post-operative diagnosis was inconsistent with inguinal hernia were excluded.

A consecutive series sampling method was used to recruit all infants and children who were operated on for inguinal hernia or presented with inguinal hernia incarceration between January 2015 and January 2017. This sampling method was used to eliminate bias.

Data collection tools

Interviewer completed questionnaires were used. The questionnaires contained instruments adopted from Zamakhshary [6], Lautz [9] and Zendejas [11]. These instruments contained items that measured the inguinal hernia incarceration rate, incarceration risk and time to inguinal hernia incarceration.

Data Collection Procedure

Clinical registers patient files were also used to abstract data.

The patients were stratified into 7 groups according to their age at the time of inguinal hernia diagnosis and booking for surgery.

The statistical analysis was conducted using descriptive statistics, Pearson correlation, logistic regression analysis and Kaplan Meier Survival Curve, using SPSS version 20. The rate and daily risk of incarceration was evaluated for each group.

RESULTS

A total of 364 patients were identified; the majority of whom were male 335 (92%). Three (4.8%) of the patients were premature. Three hundred and forty-five (94.8%) of the patients had unilateral inguinal hernia; 287 (78.8%) of whom had right inguinal hernia while 19 (5.2%) had bilateral inguinal hernias.

Table 1 summarises the incarceration data for the infants and children waiting for surgery between January 2015 and January 2017. The overall rate of incarceration was 13.45% (p = 0.002). The rate of incarceration was significantly higher in infants and children below 2 years of age (above 12% as shown in table1). There was no hernia incarceration recorded among children above 5 years (see table1).

Table 1: Incarceration data for infants and children awaiting surgical repair of inguinal hernias from January 2015 to January 2017

| Age Group (in weeks) | Total n = | Non-Incarcerated n = | Incarcerated n = | Rate of Incarceration | Risk of Incarceration (95% CI) | P value |
|----------------------|-----------|----------------------|------------------|-----------------------|--------------------------------|---------|
| (1) < 4 | 62 | 47 | 15 | 24.2% | 0.52 | .05 |
| 4 - 24 | 104 | 86 | 18 | 17.3% | 0.17 | .004 |
| (3) 25 - 48 | 82 | 72 | 10 | 12.2% | 0.08 | .081 |
| (4) 49 - 96 | 53 | 49 | 4 | 7.9% | 0.02 | .028 |
| (5) 97 - 240 | 47 | 45 | 2 | 4.3% | 0.01 | .637 |
| (6) 241 - 384 | 10 | 10 | 0 | 0% | Approaches 0 | .13 |
| (7) > 384 | 6 | 6 | 0 | 0% | Approaches 0 | .486 |

At the time of hernia repair, the mean wait time from diagnosis to surgery was 25 days, 5 months, 7 months, and 12 months; for the neonates, the up to 6 months, for the up to 12 months and for the up to 5 years old respectively, as has been shown in table 2.

Longer wait times were associated with increased rate and risk of inguinal hernia incarceration.

Likewise, there was a positive correlation between the risk of hernia incarceration and wait times from time of hernia diagnosis to time of hernia repair

(Pearson correlation 0.407). For example, the cumulative risk of hernia incarceration was 9.88% at wait time of 20 days compared to 13.47% at wait times of greater than 6 weeks (see table 3).

Table 2: Mean wait time and time to event (incarceration) in infants and children waiting for inguinal hernia repair from January 2015 to 2017

| Group (age in weeks) | <4 | 4 - 24 | 25 - 48 | 49 - 96 | 97 - 240 | 241 - 384 | >384 |
|-----------------------------------|-----------|-------------|-------------|-------------|--------------|------------------|------------------|
| Mean Wait Time to surgery | 24.8 days | 4.77 months | 5.16 months | 7.26 months | 11.77 months | 10 months | 10.5 months |
| Mean Time to hernia Incarceration | 23 days | 3 months | 4.25 months | 6.25 months | 10.43 months | No incarceration | No incarceration |

Table 3: Relationship between wait time to surgery, and the rate and risk of inguinal hernia incarceration

| Characteristic | Total n = 364 | Incarcerated n = 49 | Non Incarcerated n = 315 | Cumulative Rate of Hernia Incarceration | Cumulative Risk of Hernia Incarceration | P value |
|--|---------------|---------------------|--------------------------|---|---|---------|
| Time from diagnosis to surgery (weeks) | | | | | | 0.505 |
| <1 | 8 (Index) | 8 (index) | 356 | 2.20% | 0% | |
| 1 - 2 | 3 | 2 | 354 | 2.75% | 9.88% | |
| 3 - 4 | 49 | 10 | 344 | 6.04% | 12.09% | |
| 5 - 6 | 3 | 2 | 342 | 6.32% | 14.64% | |
| >6 | 302 | 27 | 315 | 7.14% | 13.47% | |

Table 4 shows the relationship between various clinical characteristics and the risk of incarceration. Patients born prematurely showed lower risk of incarceration (0%) compared to those born at term (0.011%). Among the neonates born at term, however, the incarceration risk was higher in those infants less than 41 weeks post conceptual age (0.043%) compared to those older than 41 weeks post conceptual age (0.009% daily risk of incarceration).

Table 4: Factors associated with increased risk of inguinal hernia incarceration among infants and children awaiting surgical repair from January 2015 to January 2017

| Characteristic | Total n = 364 | Incarcerated n = 49 | Non Incarcerated n = 315 | Risk of Hernia Incarceration | P value |
|--|------------------|------------------------|--------------------------------|------------------------------------|---------|
| Gestational Age (obstetric weeks) | | | | | 0.54 |
| < 37 | 13 | 0 (0%) | 13 (4.13%) | 0 | |
| 37 + | 351 | 49 (100%) | 302 (95.87%) | 0.011 | |
| Post conceptual Age (Weeks) | | | | | 0.02 |
| <41 | 55 | 12 (24.49%) | 43 (13.65%) | 0.043 | |
| 41 + | 309 | 37 (75.51%) | 272 (86.35%) | 0.009 | |
| Birth Weight | | | | | 0.42 |
| <2.5Kg | 19 | 7 (14.29%) | 12 (3.81%) | 0.016 | |
| 2.5 – 3.5Kg | 332 | 38 (77.55%) | 294 (93.33%) | 0.010 | |
| >3.5Kg | 13 | 4 (8.16%) | 9 (2.86%) | 0.022 | |
| Weight at Surgery | | | | | 0.68 |
| Underweight | 15 | 4 (8.16%) | 11 (3.49%) | 0.008 | |
| Normal Weight | 340 | 42 (85.72%) | 298 (94.60%) | 0.012 | |
| Overweight | 9 | 3 (6.12%) | 6 (1.91%) | 0.011 | |

Comparing birth weight and risk of incarceration, in table 4, patients with low birth weight had a higher risk of inguinal hernia incarceration (0.016 %) than those with normal birth weight. This was also true in the higher birth weight babies who demonstrated a higher daily risk of incarceration of 0.022%.

As has been shown in table 4, infants and children with normal body weight at time of surgery showed a higher daily risk of hernia incarceration (0.012%) compared to the underweight and overweight (with risks 0.008 and 0.011 respectively).

Other clinical characteristics (sex and laterality) and their relationship with the incarceration rate and risk, have been shown in table in table 5. Male infants and children showed an increased rate of incarceration (93.33%) compared to females (6.67%). Similarly, the daily risk of incarceration was higher for male infants and children (0.012%) than females

(0.008%). The rate of incarceration was higher among infants and children with right inguinal hernia (79.37%). This was also true for the daily risk of incarceration which was 0.013% among the right inguinal hernia patients; compared to left inguinal hernia (0.011%) and bilateral inguinal hernia patients (0%).

Table 5: Relationship between clinical characteristics (sex, laterality), and the rate and risk of inguinal hernia incarceration

| Characteristic | Total n = 364 | Incarcerated n = 49 | Non Incarcerated n = 315 | Risk of Hernia Incarceration (95% CI) | P value |
|-------------------|------------------|------------------------|--------------------------------|---|---------|
| Sex | | | | | 0.002 |
| male | 337 (92.58%) | 43 (87.76%) | 294 (93.33%) | 0.012 | |
| female | 27 (7.42%) | 6 (12.24%) | 21 (6.67%) | 0.008 | |
| Laterality | | | | | 0.014 |
| Left | 58 (15.93%) | 12 (24.49%) | 46 (14.60%) | 0.011 | |
| Right | 287 (78.84%) | 37 (75.51%) | 250 (79.37%) | 0.013 | |
| Bilateral | 19 (5.2%) | 0 | 19 (6.03%) | 0 | |

Overall, risk reduction, of inguinal hernia incarceration, of more than 50% could be achieved if inguinal hernia repair was done within 14 days of diagnosis (see figure 1).

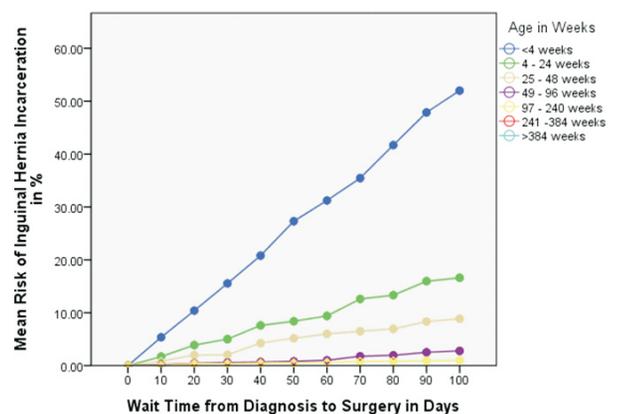


Figure 1: Risk of inguinal hernia incarceration by wait time and group among 364 infants and children awaiting surgical repair of inguinal hernia(s) in the period January, 2015 to January, 2017

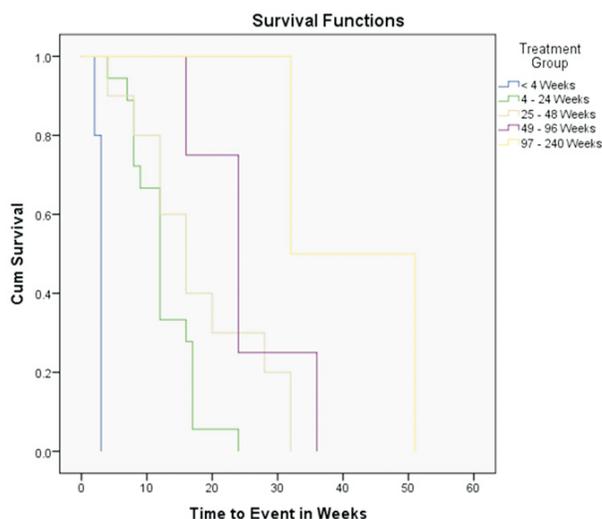


Figure 2: Times at which inguinal hernia incarceration occurred for different age groups among the 364 infants and children awaiting surgical repair of inguinal hernias in period January, 2015 to January, 2017

DISCUSSION

Inguinal hernias are common in infants and children. They affect approximately 5% of all children [12]. An inguinal hernia will not resolve spontaneously. This necessitates that it be repaired as soon as possible, after diagnosis, to avoid the risk of incarceration or strangulation [13]. This single centre study demonstrates some findings worth noting: Firstly, predominance in males was noted, in agreement with Patkowski [14], Ghoroubi [15] and Nassiri [16]. Many researchers [17,18,19] found male to female ratio ranging from 6:1 to 7:1. Our patients' ratio was much higher (12:1). Hassan [20] found the same ratio among the Nairobi hernia patients. This could be pointing to a regional ratio, although, these patients were adult inguinal hernia patients. Secondly, the right inguinal hernia rates were higher than that of the left (see table 2). Bilateral inguinal hernias constituted 6.03% of all the inguinal hernia. This was comparable with many researchers [13,21] findings of approximately 4% to 8% of bilateral inguinal hernias. Askarpour [22]

found a much higher figure of 15.24%. This could be as a result of possible over reporting. Thirdly, the overall rate of hernia incarceration was 13.45% in this study. This is comparable to those rates reported by others [8,23,24]. These researchers reported rates between 9% and 34%, depending on the age groups. Our findings are in contrast with Sulkowski [25] and Lee [26] who reported no incarcerations in their studies. Fourthly, the rate and risk for inguinal incarceration was found to be age dependent. The variations based on age were significant. This is in contrast to Gholoum et al [8] who noted no difference in incarceration rates between different age groups. Infants and children below 2 years had increased rates and risk of incarceration. This is in agreement with other studies [23,24] which have demonstrated this. Though, the mounting evidence suggests that incarceration is more frequent in the general population of infants with inguinal hernia than in neonates who undergo repair during the initial hospitalisation in previous studies, our neonates had significantly higher rates than the older infants. However, the overall rate was lower than that reported by Lautz [9]. There was no incarceration among premature neonates and ex-premature inguinal hernia patients. Like in Lee [26] our risk of incarceration among premature neonates was low compared to term infants. This could mean that more time could be given to the premature infants to allow for maturity to take place before elective repair of their hernias is done.

Lastly, underweight did not increase the risk. In fact, the opposite was true, as the overweight infants and children demonstrated a higher risk. This finding seems to be particular to this study.

In contrast to Gholoum et al [8] most of the incarceration (83.67%) occurred while patients awaited elective surgical repair. This is probably because most of our infants and children wait times are greater than 6 weeks to get elective surgical repair. Longer wait times and male gender increased the risk of incarceration. This has also been demonstrated in other studies [6,9].

Our wait times were comparable to Dinesh [13] who reported duration of symptoms ranging from 1 month to 5 years. Young infants, generally had a higher risk of incarceration. No incarceration occurred in children older than 5 years. This could mean that the incidence of hernias incarceration is significantly lower, if not inconsequential, in older children.

Though there is no clear consensus as to optimal timing of hernia repair [8], there is need for our institutions to reduce wait time for surgery, to 3 weeks or even less, as this could reduce the incarceration rates to more than half the current numbers. Reduction in the incarceration rates would mean reduction in complications of surgery such as injury to the cord complex. The survival curve in figure 2 shows the times that each age group starts to incarcerate.

Therefore, these times could be used to book the patients and prevent incarcerations.

There was a negative correlation between the risk and age at operation. There was a positive correlation between risk of incarceration and wait time, male sex, gestational age and laterality. This is in agreement with what other previous studies [6,9] have demonstrated. The strength of the relationship was weak for the latter four, though.

LIMITATIONS

This study was done in retrospect and therefore, may have inherent biases of such methodology.

CONCLUSION

Inguinal hernia incarceration in infants and children on the wait list for surgery was common in our cohort. The rate of incarceration was high (13.45%). The risk of incarceration was age dependent & higher in neonates (0.52), infants & younger children (0.01). Neonates had as much as 5 times higher risk as other children. Mean wait time was age dependent and ranged from 24.8 days to 10.5 months. Longer wait times, male sex, right sided hernias were associated with higher rates & risks.

Mean time to incarceration was age dependent and ranged from 23 days in neonates to up to 10.43 months in children under 5 years. Older children had no incarceration. The best time to operate is before 3 weeks for neonates, before 2 months for infants & before 4 months for younger children to prevent incarceration.

By reducing the wait times to 3 weeks or less, especially for infants and young children, may reduce the number of incarcerations by more than half of the current numbers.

RECOMMENDATIONS

1. Surgeons should reduce wait time to less than 3 weeks for neonates and less than 2 months for infants and younger children to prevent incarceration.
2. Hospitals should refer neonates born with inguinal hernias to tertiary hospitals for early surgery (before they are 3 weeks old).

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