ORIGINAL ARTICLE

Retrospective study of Perioperative Antibiotic Prophylaxis of pediatric patients in a tertiary care hospital

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ABSTRACT

Back ground: In these troubled days of antibiotic resistance, it is imperative that clinicians use antibiotics judiciously to prevent infection in patients and to avoid community wide resistance that threatens public health. Its use is, when indicated, choice of antibiotic keeping in view the sensitivity, correct dose, frequency, route and duration. Misuse of antibiotics when not indicated puts patients at risk with no clinical benefit.
Aim: To assess the use of antibiotics (choice for type of surgery, dose, timing, re-dosing and duration of antibiotic) in perioperative time period for surgical prophylaxis of pediatric patients.
Methods: It is a retrospective study of one year from 1st June 2018- 31st May 2019. Data is collected of paediatric patients (≤18 years) undergoing surgery under general anaesthesia from their perioperative record, and Anaesthesia record chart.
Results: In 225 cases antibiotic was given, the most frequently used antibiotic is Cefuroxime 41.8% (94/225). The other antibiotics used are: Cephazolin (31.6%), Coamoxiclav (19.6%), Ceftriaxone (4%), and all others 3.1% (Ciprofloxacin, Metronidazole, Meropenem and Piptaz). All antibiotics are given intravenously.
Conclusion: As an additional support measure to health care practitioners, it is made available on intranet and on the computer desktop of each operating theatre, to further improve its awareness and utility.
Keywords: Study of antibiotic, type of surgery, general anaesthesia

INTRODUCTION

In order to emphasize and implement proper use of antibiotics, hospitals have launched 'Antibiotic stewardship programs' (ASP) following the advice of Centre for Disease Control and Prevention CDC (2014) whereby all acute hospitals are to implement ASP.

Surgical procedures are a time of increased vulnerability to infection, especially in immunocompromised either due to disease or drugs treatment. Upto one-fifth[1] of hospital acquired infections (HAI) and the commonest cause of HAI in surgical patients is surgical site infection (SSI). To minimise the risk of surgical site infection, National Institute of Clinical Excellence (NICE) United Kingdom in 2008 [2] published guidance. Its intended as a High Impact Intervention (HII) that covers all three phases: preoperative, intraoperative and postoperative in its seven element based bundle. A key component of SSI bundle is use of antibiotics based on characteristics of procedure and patients. The main aim is to have above minimum inhibitory concentration antibiotic levels in blood and tissue against the organisms likely to infect, for the entire duration of the procedure.

Surgical antibiotic prophylaxis (SAP) are indicated for clean-contaminated, contaminated and clean prosthesis surgery. Inappropriate use of even a single dose of antibiotic given when not indicated may lead to resistance [3, 4] with increased morbidity, mortality [5] and health care costs.
NICE guidance is to choose appropriate antibiotic(s) when it is indicated for surgical procedure and to administer it intravenously within sixty (60) minutes before skin incision, exception being a fluoroquinolone/ vancomycin when it can be given 120 minutes beforehand. It is to be repeated intraoperatively for prolonged surgery (longer than two half lives [6] of antibiotic), use of implant and in case of major blood loss. Interval of redosing depends upon the antibiotic used and is variable. Postoperatively antibiotic is discontinued within 24 hours of surgery, however Scottish Intercollegiate Guidelines Network (SIGN) recommended use of single dose of antibiotic except in special circumstances.

Paediatric surgical patients receive surgical antibiotic prophylaxis similar to the adult population. The Committee on Infectious Diseases of American Academy of Pediatrics and Pediatric Infectious Disease Society recommend use of narrow spectrum antibiotic before incision.
Retrospective study of perioperative antibiotic prophylaxis of pediatric patients in a tertiary care hospital.

Aim is to assess the use of antibiotics (choice for type of surgery, dose, timing, re-dosing and duration of antibiotic) in perioperative time period for surgical prophylaxis of pediatric patients.

METHOD

It is a retrospective study of one year from 1st June 2018- 31st May 2019. Data is collected of paediatric patients (≤18 years) undergoing surgery under general anaesthesia from their perioperative record, and Anaesthesia record chart. For patients who had more than one surgery event during the study period, each event is counted separately. Patients undergoing central line procedures were excluded.
Data is collected on Excel sheet as per Appendix 1.
Patient medical record, Age, weight, type of surgery, antibiotic (choice of type, doses, time , route of administration, repeat dose- for prolonged surgery, major blood loss) Antibiotic use prior to surgery (preoperative), postoperative antibiotic choice, dose, frequency, duration.
Above parameters are checked against the recommended guidelines for compliance. First criteria is right antibiotic for right procedure. If antibiotic choice is inappropriate (as per Hospital guidelines- Appendix 2) then all else fails too.

Further parameters are analysed irrespective of initial criteria outcome (choice of antibiotics). The rest of parameters are checked for compliance with local hospital guidelines and British National Formulary for Children 2016-2017 or American Society of Health-System Pharmacists (ASHP) guidelines (Appendix 3).

RESULTS

Total number of patient surgery events fulfilling criteria are **342**, two excluded due to incomplete data from record. The mean age 5.2 years with standard deviation of 3.5 years. The range is from 4 months, 16 days to 18 years. The mean weight is 18.4 kg with a standard deviation of 10.5 kg. The weight ranges from 6.4 to 65 kg.

In 225 cases antibiotic was given, the most frequently used antibiotic is Cefuroxime 41.8% (94/225). The other antibiotics used are: Cephazolin (31.6%), Coamoxiclav (19.6%), Ceftriaxone (4%), and all others 3.1% (Ciprofloxacin, Metronidazole, Meropenem and Piptaz). All antibiotics are given intravenously. Of the cases in which antibiotics are given, 63.5% (143/225) had antibiotic choice not in accordance with hospital policy. However it is observed that it is appropriate given the organism coverage.

Of the cases (225) in which antibiotic is administered, there are only **23%** of cases where antibiotic dose was given correctly (even if initial choice was incorrect). A 25% variability[7] on recommended dose of antibiotic on weight basis as recommended by British National Formulary for children 2016-2017 depicts **72.7%** cases as underdosed, and only 4.3% overdosed.

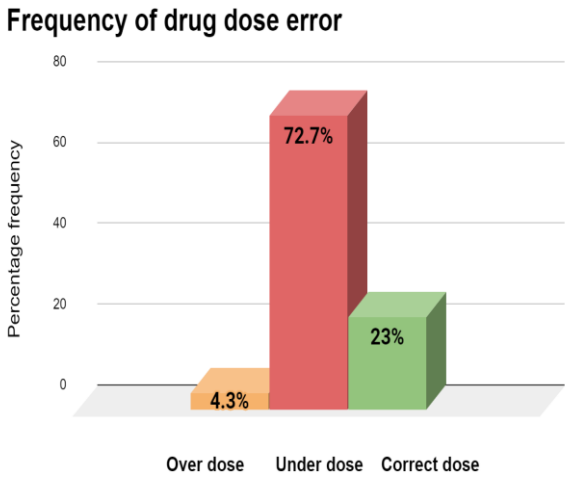
There was only one case (<0.5%) in which repeat antibiotic was indicated due to prolonged surgery but was not administered. In rest of the cases it was appropriately repeated when indicated or not repeated as not indicated.

Post operative discharge to home antibiotic medication was given in **24%** of cases. Surgical subspecialty breakdown shows all examination under anaesthesia of eye (EUA) did not get any discharge antibiotics, whereas other eye procedures 60% had discharge antibiotics.

Co-amoxiclav being the most common (42%) antibiotic for home discharge, with average 5.5 days (most frequently prescribed for 5 days).

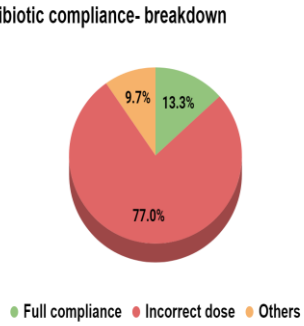
Overall full compliance (in terms of choice of antibiotic and dose) is **13.3%**. Most frequent non-compliance is that of dose calculation, either under- dose or over- dose.

Graph 1:



Reference value from BNF children 2016-2017/ ASHP

Graph 2



DISCUSSION & RECOMMENDATIONS

In hospital acquired infections outside ICU environment surgical site infections make up a total of 20 % of the bulk[1]. Nelson and his colleagues deduced after Cochrane reviewed that this risk can be decreased by the use of appropriate antibiotic prophylaxis[8,9]. However, recent studies including meta analysis show a small decrease in efficacy of antibiotic prophylaxis in colorectal surgery[10]. Therefore, it is now imperative that all components of antibiotic prophylaxis are carried out precisely. Surgical antibiotic prophylaxis has several elements: Indication, choice of antibiotic, dose, timing, route, redosing and postoperative duration & frequency. Any omission of these elements lead not only to suboptimal drug therapy and risk of infection to the patient but may also contribute to drug resistance in the population (Antimicrobial resistance AMR)[11]

Timing of antibiotics: Burke in 1961 established the importance of timing in relation to surgical procedure[12,13]. The delay is associated with twice the SSI rate compared to timely administration[13]. Since then it is further endorsed by NICE that the appropriate antibiotic needs to be administered at the induction of anesthesia 60 min prior to skin incision for clean, clean contaminated and contaminated surgical procedures alike. Top up with repeat dosage is recommended if there has been considerable blood loss, the surgical procedure is prolonged or there is major prosthetic surgery done[2.]. Our current practice of 'time out' as part of WHO surgical safety checklist, ensuring that antibiotics are given before incision. 'Time out' is undertaken just before the surgical incision by the surgical, anesthesia and nursing team to confirm amongst other things administration of surgical antibiotic prophylaxis. It immensely helps in achieving the aim of antibiotic administration between thirty to sixty minutes of incision time but not more than one hour (or 2 hours if using vancomycin and fluoroquinolones). It is a very useful tool to help implement the High Impact Bundle for the prevention of surgical site infection to all the surgical procedures undertaken in the tertiary care centre.

Dose of antibiotics: Adequate dose of antibiotic is to be administered to achieve serum and tissue concentration and repeated in case the procedure is longer than two half lives of antibiotic. Dose itself is based on weight and weight should be recent to ensure under/over dose. In our study dosing is the most common error, which is also reflected by the CDC report in 2014 which showed upto 30% of antibiotics are improperly prescribed in acute hospitals[14].

Indication & Choice: The need for antibiotic prophylaxis is based on the type of wound (clean, clean- contaminated, contaminated). The choice of antibiotic for a procedure is

based on organism, organism sensitivity and narrow spectrum antibiotic. Hence, there is a need for local guidelines for each region depending upon their local flora and sensitivity. In our study Cefuroxime and Cephazolin were most commonly used, which is in line with organism sensitivity however not in line with updated guidelines. Combination antibiotics were used when advised by infectious diseases or anaerobic cover was required.

Post operative duration: It is recommended to discontinue post operative antibiotic prophylaxis within 24 hours for most procedures. The optimal time for cardiac surgery and foreign body replacement is not known but is extended to 48 hours. In a survey Zikria Saleem et al, reported that in Punjab 97.4% post operative cases have >24 hours of antibiotic prophylaxis[15]. The overuse of antibiotics may harm the patient as shown by Branch-Elliman et al the increased incidence of acute kidney injury and Clostridioides difficile infection with prolonged post operative antibiotic prophylaxis[16].

In our study an overall full compliance rate of 13.3% shows a huge room for improvement. These findings are similar to another survey locally by Zakir Khan et al indicating poor compliance to recommendations with only 9.5% receiving SAP as per recommendation[17]. Another survey of three tertiary care childrens' hospitals in Italy also showed 8% compliance[18].

As a first step local Hospital guidelines are available which includes a comprehensive surgery wise indication and antibiotic preference. Findings of this study were shared with stakeholders' and local infection control committee that led to review and inclusion of commonly performed procedures such as eye surgery and pediatric doses (based on weight) in guidance to ensure uniformity of practice. In its revised version of guidelines, other related questions such as dose of antibiotic at time of re-dosing, dose calculation for low/high body mass index (BMI) patients were also addressed.

As an additional support measure to health care practitioners, it is made available on intranet and on the computer desktop of each operating theatre, to further improve its awareness and utility. A Study by Giordano in Italy showed an improvement in practice following awareness initiatives[19].

British National Formulary Children 2016-17 is used as a reference source, although it is british publication, over the years other countries too have adopted it. Its regular updates also ensure that current recommendations are included.

Over the last twenty years, optimal use of antibiotics under a structured program of Antibiotic Stewardship especially after its endorsement by Joint Commission Accreditation (JCIA) transformed the practices. The seven elements of Antibiotic Stewardship were reported to be in place in 85% of United States (US) acute hospitals in 2018 versus 41% in 2014[20]

In recent years there is a local initiative to establish ASP, which would help in streamline the antibiotic prescribing practices[21,22].

Despite above measures which address awareness, educational and facilitation of process, prescribing has a cultural context to be addressed[20]. The practices that develop amongst different specialities within the same hospital has culture and contextual factors[23]. Therefore, one needs to look into these factors for our own environment to completely understand the complexity of problems and potential solutions.

Appendix 2

Type of Surgery	**Preferred agent**	**Alternative agents in patients with beta lactam allergy**
Colorectal	Cefazolin + Metronidazole Ceftriaxone + Metronidazole	Clindamycin + Fluoroquinolones or aminoglycosides Metronidazole + Fluoroquinolones or Aminoglycosides
Head & Neck • Clean • Clean with placement of prosthesis • Clean-contaminated cancer surgery	None Cefazolin, cefuroxime Cefazolin + Metronidazole Cefuroxime + Metronidazole	None Clindamycin Clindamycin
Neurosurgery Elective craniotomy and cerebrospinal fluid-shunting procedures	Cefazolin	Clindamycin, Vancomycin
Breast	Cefazolin	Vancomycin, Clindamycin
Endocrine (Thyroidectomy, adrenalectomy)	Prophylaxis NOT recommended	
Hysterectomy (vaginal or abdominal)	Cefazolin	Clindamycin or Vancomycin + Aminoglycoside or fluoroquinolone

Table 2 - Doses and re-dosing intervals for antimicrobials

Antimicrobial	**Dose**	**Re-dosing interval (hour)**	**Comments**
Cefazolin	2 grams > 120 kg = 3 grams	4	
Clindamycin	900 mg	6	
Vancomycin	< 80 kg = 1 gram 80 – 99 kg = 1.25 grams 100 -120 kg = 1.5 grams >120 kg = 2 grams	NA	Requires prolonged infusion time, should be given within 120 minutes prior to surgical incision
Ampicillin-sulbactam	3 grams	2	
Aztreonam	2 grams	4	
Ceftriaxone	2 grams	NA	
Cefuroxime	1.5 grams	4	
Ciprofloxacin	400 mg	8	Requires prolonged infusion time, should be given within 120 minutes prior to surgical incision
Ertapenem	1 gram	NA	
Gentamicin	5 mg/kg (single dose) If CrCl<20, 2mg/kg (single dose) or consult pharmacy	NA	
Levofloxacin	500 mg	NA	Requires prolonged infusion time, should be given within 120 minutes prior to surgical incision
Metronidazole	500 mg	12	

Post-surgery prophylaxis

Most of the procedures do not require post-operative antimicrobial prophylaxis. If needed, the duration should be limited to less than 24 hours, regardless of the presence of indwelling catheters or drains.

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Appendix 3: Recommended antibiotic dose for surgical prophylaxis

Antibiotic	Dose(mg/kg)			Dosing interval (hour)
	Hospital Pharmacy Handbook	**BNF children 2016-2017**	**ASHP [1] 2019**	
Co-amoxiclav		30		
Cefuroxime		50	50	4
Ceftriaxone	30	50-80	50-75	na
Cefazolin	20		30	4
Ciprofloxacin	5-10		10	na
Metronidazole	15	30	15	na
Pip-taz	50/6.25; 100/12.5	90	100	2

1 American Society of Health-System Pharmacists (ASHP), the Infectious Diseases Society of America (IDSA), the Surgical Infection Society (SIS), and the Society for Healthcare Epidemiology of America (SHEA)

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