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Modified Maintenance Fluid in Pediatric Electrical Burns

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Abstract

Pediatric age group is commonly involved in electrical burn injury. Fluid resuscitation is vital for any burn injury and more so for electrical burn injury to prevent complication. There are no fixed guidelines for fluid therapy in electrical burns especially in pediatrics. In this study we report the effect of maintenance fluid in pediatric electrical burns.

Keyword: Pediatrics; Electrical Burns; Maintenance Fluid.

Introduction

Electrical burns are classified as high voltage (≥1000 V), low voltage (<1000 V). Low voltage injuries rarely cause significant damage beyond a small deep partial thickness burn at contact points. High-voltage injuries are more apt to cause deep tissue destruction. Despite great advances in the treatment modalities of electrical injuries in the recent decades, the magnitude of the problem remains very high both for the victim and the treating surgeon [1]. The peak age distribution is middle-aged and youths, accounting for 76.8%, and childrenup to 16%. Fluid resuscitation forms an important part of management which is even more important in case of paediatric burn injuries [2].

Multiple resuscitation formulas exist for guiding fluid resuscitation with goal of achieving urine output of 1.0ml/kg/hr in children. In Electrical burns with underlying muscle damage additional fluid must be added to maintain urine output and prevent precipitation of myoglobin in renal tubules. In paediatric electrical burns the goal is to maintain urine output of 2.0ml/kg/hr. Standard practice in paediatric burn injury cases is to follow Parkland formula for resuscitation and add 5% dextrose to ringer lactate as maintenance fluid [3]. To prevent electrolyte imbalance especially hyponatremia addition of isotonic saline is required. As there is tendency of hyperkalemia, addition of potassium is not required.

In our study we review threecases of paediatric electrical burns in which modified fluid containing half normal saline with 5% dextrosewas used as maintenance fluid.

Material and Methods

It is anobservational study conducted at Jipmer Tertiary Burns Center (JTBC) in department of Plastic Surgery, Jawaharlal Institute of Postgraduate Medical education and Research (JIPMER), Pondicherry, India during May to June, 2017. Pediatric patients admitted with electrical burns presenting within twenty four hours of injury were included. After hospitalization patients were resuscitated in first 24 hours with Ringer Lactatesolution (volume calculated as per parkland formula - 4ml x % of burn x kg body weightof which 50% of the fluid is given in first 8 hours and rest 50% of the fluid in the next 16 hours).Further, maintenance fluid containing 5% Glucose and 0.45% Normal Saline (@ 4 ml/kg/hour for the first 10kg, 2 ml/kg/hour for 10–20kg and 1 ml/ kg/hour for

greater than 20kg) was added.In next twenty four hours same fluid (ringer lactate and 5% dextrose with 0.45% Normal Saline) was given and titrated to maintain urine output of 2.0ml/kg/ hour. Hourlyurine output and Blood sugar level, Serum Electrolytes (Sodium & Potassium) and renal parameters (blood urea & serum creatinine) were done every six hours for first 48hours to monitor fluid & electrolytes imbalance. Three patients oflow voltage electrical burns suffered while playing at home were included in the study after informed consent taken. Demographic profile was recorded in the study performa. None of the patient developed any complications like hypoglycemia, fluid & electrolyte imbalance.

Table 1: Age, type and percentage of electrical injury and volume of fluid given

S.N.	Age (years)	Type of injury	Percentage of electrical burns	Volume of fluid given (Ringer lactate + 0.45 % Normal Saline + 5%Dextrose)
Patient 1	4	Low voltage	12%	1900
Patient 2	7	Low voltage	9%	2200
Patient 3	11	Low voltage	15%	3600

Table 2: Mean Random blood sugar, serum electrolytes levels and renal parameters done 6 hourly

S.N.	Random blood sugar (mg/dl)	Serum Sodium levels (mEq/l)	Serum Potassium (mEq/l)	Blood urea/Serum Creatinine (mg/dl)
Patient 1	96	138	4.6	15/0.6
Patient 2	102	135	4.1	18/0.5
Patient 3	108	140	4.2	22/0.6

Discussion

Electrical burn thoughaccounts for third most common cause of burn injury after thermal burns and scald burns, the morbidity and mortality from it is much higher than any other burn injury. Age group of 20-40 are associated with high incidences of work related accidental injury whereas pediatric age group are second commonly affected due to accidental touching of naked wire or biting the wire [4-6]. Extremities are the commonly involved sites followed by torso and mouth. Acute electrical burn injury causes cardiac arrthymias, myonecrosis, renal failure, hyperkalemia, acidosis etc. Although high voltage burns are associated with deep muscle necrosis it can be also be seen in low voltage injuries. The more benign looking cutaneous injuries can have significant underlying muscle damage releasing myoglobin and its breakdown causing renal shutdown [6,7]. Adequate and early fluid resuscitation is the primary treatment of any burn injury more so in electrical burns to prevent precipitation of pigments in renal tubule leading to acute renal failure, replacing third space loss, replenishing intravascular volume, maintain adequate organ perfusion andto correct metabolic acidosis [8,9]. Fluid resuscitation in children is a challenging task as it should provide enough fluid to replace the losses and calories and maintain electrolytes balance. Traditionally fluid resuscitation in pediatrics is started when burns exceeding 15% of total body surface area, but in electrical burn no such data is available and fluid resuscitation is started irrespective of percentage of burns in routine practice to avoid complications like renal failure. Fluid resuscitation varies in pediatrics as compared to adults as children have a larger body surface area to weight ratio hence require more fluid then calculated and electric burn itself need high fluid to prevent renal complications [9]. As glycogen reserves in children are poor and can only support 12-24 hours of starvation, calorie requirement increases substantially and needs to be provided to support low calorie and high metabolic state of electrical burn. Electrical burn predisposes to state of hyperkalemia(myonecrosis), hyponatremia due to ADH secretion and fluid shiftand needs to be addressed for better outcomes. Addition of isotonic sodium to Ringer lactate has been described by Neville KA et al [10]. In our study we further modified by adding 0.45% isotonic saline to 5% dextrose besides ringer lactate to continue in the fluid management. Though none of patients developed any complications like hypoglycemia, fluid & electrolyte imbalance but this study has limitations of small sample size, single center study with no comparison done with controls.

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