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A PROSPECTIVE RANDOMISED EVALUATION OF INTRA-ABDOMINAL PRESSURE WITH CRYSTALLOID AND COLLOID RESUSCITATION IN BURN PATIENTS

General Surgery

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ABSTRACT

Introduction: Intra-abdominal hypertension (IAH) and abdominal compartment syndrome (ACS) can develop in burn patients due to overzealous fluid resuscitation, increased capillary permeability, loss of abdominal wall compliance and interstitial edema. Resuscitation protocol based on crystalloid regimen requires a substantial amount of fluid, therefore may be associated with a high rate of IAH and ACS. Colloid bases resuscitation regiment requires less amount of fluid, therefore, may confer protective effect against the development of IAH & ACS.

Material & methods: Burn patients between 25% to 60% of total body surface area (TBSA) of burn within the age group of 18 to 60 years consenting to participate in this study were included. A total of 60 patients were randomized in two groups, with 30 each to either crystalloid or colloid based fluid regimen. Intra-abdominal pressure, urine output, blood urea nitrogen, serum creatinine, arterial blood gas analysis (PaO2, PCO2, Oxygen saturation, Base deficit), Liver function test in both study were measured at the time of admission and then 4 hourly for next 24 hours. Urinary bladder pressure was measured by the transurethral route using a foley catheter to assess the intra-abdominal pressure. Statistical analysis was done by using multiple hierarchical ANOVA followed by Tukey's test.

Results: The mean age of patients in the crystalloid group was 29.10±8.57, and in the colloid, group was 31.10±11.25. The mean total body surface area of burn (TBSA) in the crystalloid group was 42.90±9.12, and in the colloid group was 41.43±11.16 respectively. The mean amount of fluid used for resuscitation in the crystalloid group was 10485.67±2989.37ml, and the colloid group was 7019.50±1762.31ml. We did not come across any case of IAH or ACS in our study populations. During fluid resuscitation mean IAP at 4 hourly intervals for the next 24 hours were statistically not different in the crystalloid and the colloid group.(p=0.100)

Conclusion: A large amount of fluid given during resuscitation may contribute to IAH or ACS in burn patients. However, it needs to be ascertained whether extensive fluid volume for resuscitation directly causes ACS. Despite the variably reported incidences of IAH & ACS in different literature, we did not come across any cases of IAH or ACS in our study group of the Indian population.

KEYWORDS

Intra-abdominal hypertension, Abdominal compartment syndrome, Crystalloid, Colloid, Fluid resuscitation.

INTRODUCTION

Proper fluid resuscitation of burn patients are of paramount importance. In almost all protocol, the stress has been on refraining from under resuscitation with hardly any guidance on measures to prevent morbidity and mortality that can be caused by over resuscitation.

Intra-abdominal hypertension (IAH) occurs due to raised pressure within the abdominal cavity, where as multiple organ dysfunction along with IAH is known as Abdominal compartment syndrome(ACS). It can develop in burn patients due to infusion of an excessive amount of fluid, loss of abdominal wall compliance, increased capillary permeability, interstitial oedema and intra-abdominal fluid.

Many criticise Parkland formula because of its propensity to overload the patients with an excessive volume of fluid during resuscitation.[1,2] Recently there is an emphasis on a more restricted approach for fluid resuscitation of burn patients.[3,4] as restricting the overzealous fluid in burn patients may prevent the development of IAH and ACS. Resuscitation protocol based on crystalloid regimen requires a substantial amount of fluid, therefore may be associated with a high rate of IAH and ACS.[5] Colloid bases resuscitation regiment requires less amount of fluid, therefore, may confer protective effect against the development of IAH & ACS.[5]Therefore this study was undertaken to study to compare the intra-abdominal pressure with crystalloid and colloid resuscitation in burn patients.

MATERIAL AND METHODS

This prospective randomised trial was conducted in the Department of Surgery, University College of Medical sciences over two years. Burn patients between 25% to 60% of total body surface area (TBSA) of burn within the age group of 18 to 60 years consenting to participate in this study were included. A total of 60 patients were randomized at the time of admission by computer-generated numbers in two groups, with 30 each based on the fluid resuscitation protocol to either crystalloid or colloid based fluid regimen. The crystalloid study group was resuscitated for the initial 24 hours using Parkland formula. The colloid study group was resuscitated using Hetastarch, a synthetic colloid, for an initial 24 hours as per Brooke's formula. Brooke's formula – Ringer lactate 1.5 mg/kg/ %burn +0.5ml /kg/ % colloid(Hetastarch)+ D5W 2000ml.[6]

Intra-abdominal pressure, urine output, blood urea nitrogen, serum creatinine, arterial blood gas analysis (PaO_2, PCO_2, Oxygen saturation, Base deficit), Liver function test in both study were measured at the time of admission and then 4 hourly for next 24 hours. Urinary bladder pressure was measured by the transurethral route using a foley catheter to assess the intra-abdominal pressure. IAP was measured at expiration in the supine position after the bladder was fully emptied and then filled with 50 ml of saline. The foley catheter was marked as zero few millimetres proximal to the Y-junction, which served as the zero reference point when it is at the level of symphysis pubis. The drainage tubing is marked at an increment of 1cm on the tape, starting from the mark on the foley catheter as '0'. Next bladder was drained and then filled with 50 ml of normal saline into the bladder. This saline in bladder acts as passive diaphragm for pressure transmission. After reconnecting the foley catheter to the drainage tubing, the zero reference point was kept at the level of pubis symphysis and the drainage tubing was raised vertically. The distance the sterile saline raised vertically in the tubing was noted as IAP in cm of H_2O. (1 mmHg = 1.36 cm H_2O). Statistical analysis was done by using multiple hierarchical ANOVA followed by Tukey's test.

RESULTS

The mean age of patients in the crystalloid group was 29.10±8.57, and in the colloid, group was 31.10±11.25. The mean total body surface area of burn (TBSA) in the crystalloid group was 42.90±9.12, and in the colloid group was 41.43±11.16 respectively. The mean amount of fluid used for resuscitation in the crystalloid group was 10485.67±2989.37ml, and the colloid group was 7019.50±1762.31ml. (p=0.156) (Table-1) At the time of admission, the mean IAP in the crystalloid group was 8.43±2.26 mmHg and in colloid group 7.97±2.31 mmHg. Intra-abdominal pressure (IAP) was measured at four hourly intervals for the next 24 hours in both groups. Mean IAP in the crystalloid group at 4 hrs was 8.80±2.483, at 8 hrs 8.57±2.582, at 12 hrs 8.60±2.313, at 16 hrs 8.23±2.622 at 20 hrs 8.47±2.113 and 24 hrs 8.63±2.125. Mean IAP in the colloid group at 4 hrs was 8.23±2.359 at 8

hrs 8.57±2.582, at 12 hrs 8.60±2.313, at 16 hrs 8.23±2.622, at 20 hrs 8.47±2.113 and 24 hrs 8.63±2.124. During fluid resuscitation mean IAP at 4 hourly intervals for the next 24 hours were statistically not different in the crystalloid and the colloid group.(p=0.100) (**Table-2)** Urine output was measured at 4 hourly intervals for the next 24 hours in the crystalloid and colloid group. Mean urine output at 4 hourly intervals for the next 24 hours was significantly not different between the colloid and the crystalloid group. (p=0.404)

Blood urea nitrogen (BUN) was measured at 4 hourly intervals for the next 24 hours in the crystalloid and colloid group. Mean BUN at 4 hourly intervals for the next 24 hours in colloid and the crystalloid group was not significantly different. (p<0.192) Mean serum creatinine at 4 hourly intervals for the next 24 hours in crystalloid and colloid group was significantly not different. (p=0.453). Mean PO_2 at 4 hourly intervals for the next 24 hours was not significantly different in both groups. (p<0.293). Mean PCO2 at 4 hourly intervals for the next 24 hours in the crystalloid and colloid group was significantly not different. (p=0.368). Mean oxygen saturation at 4 hourly intervals within 24 hrs were not significantly different in both group. The mean base deficit at 4 hourly intervals within 24 hours was not different significantly. Mean pH, serum bilirubin, SGOT, SGPT and alkaline phosphatase at 4 hourly intervals within 24 hours were not significantly different in the crystalloid and the colloid group

DISCUSSION

In the present study, comparative analysis of crystalloid and colloid resuscitation was undertaken in burn patients with more than 25% TBSA and up to 60% TBSA over two years. At the time of admission, both the group were comparable in age and TBSA. Analysing the results of IAP at the four hourly intervals for next 24 hours in the crystalloid group and the colloid group it was found that neither the mean IAP at different time scale were significantly different between the two groups, nor the mean IAP at the different time scale were suggestive of IAH. Mean urine output, mean blood urea nitrogen, serum creatinine, ABG analysis and mean biochemical parameters of liver function test at 4 hourly intervals for next 24 hours were significantly different between the colloid and the crystalloid group.

O'Mara et.al[7] performed a randomized prospective study evaluating the effect of colloid resuscitation on IAP in patients with 25% or greater TBSA with smoke inhalation or greater than 40% TBSA without inhalational injury. Thirty-one patients were randomized (15 and 16 patients) to either a crystalloid group or a colloid group. For the patients placed in the crystalloid group, the parkland formula was used as a basis for volume infusion. Patients in the colloid group were resuscitated using a combined crystalloid and the colloid regimen. In the colloid group resuscitation was initiated at an hourly rate based on 24 hours goal of 2000 ml of lactated ringers (83ml/hr) and 75ml/kg of fresh frozen plasma. Urinary bladder pressure was measured to assess the IAP. IAH was considered to be present with a urinary bladder pressure of greater than 24 mmHg. The mean age was 46.4 years for crystalloid versus 44.6 years in the colloid group. Mean TBSA in the crystalloid and colloid group was 50.1% and 52.1% respectively. There was an episode of the significant rise of IAP in the crystalloid group, IAP rose from 5.8 mmHg at the time of admission to 72.7 mmHg at a mean of 72.7 hours after admission. In the colloid group, the maximum rise of IAP of 16.4 mmHg was noted at a mean of 68.3 hours. Urine output was normal in both groups. Serum creatinine and BUN were not different in both groups.

ACS was described in burn patients by Greenhalgh and Warden in 1994.[8] They studied 30 paediatric burn victim, who was resuscitated using the crystalloid infusion. Eleven patients developed intra-abdominal pressure greater than 30 mmHg (37% incidence). They also concluded that the development of the IAH was correlated with TBSA and percentage of full-thickness burn. Ivy et al. published a series of only ten patients and out of these seven patients developed IAH.[1] Hershberger et al[9] retrospectively studied 476 patients with burn greater than 30%. Twenty-five patients developed ACS (5.25% incidence) and required decompressive laparotomy within first 24 hrs after-burn.A colloid in the form of 25% albumin was used in 17 out of 25patients (68%) at some point during resuscitation. Mean time to add colloid for fluid resuscitation was 11 hour. They used colloid as rescue therapy in patients with ACS. Oda et al[10] performed abdominal escharotomy for decompression in 8 out of 48 (16.6%) burn patients who developed ACS. All patients were resuscitated by crystalloid infusion. Eight patients developed features of ACS at a mean time of 19.3 hours from a burn injury.

There is a vide variation in the incidence and timing of development of IAH or ACS in burn patients. Greenhalgh and Warden[8] in their study of 30 paediatric patients, showed the 17% incidence of IAH. In the studies conducted by IVY et al[1], Hershberger et al[9] and by Oda et al[10], the incidence of IAH in adult patients were 70%, 5.25% and 16.66%. O'Mara et al[7] showed that developed 72.7 and 68.3 hours after admission in the crystalloid and the colloid group. In the study conducted by Oda et al[10] patients with TBSA 85.6%±10.3 with the mean age of 64.5±18.9 years developed IAH at a mean time of 19.3 hours with crystalloid resuscitation.

In the present study mean age in the crystalloid and colloid group was 29.10±8.05 and 31.10±11.25, and the mean TBSA was 42.90±9.12 and 41.43±11.16 respectively. We did not come across any incidence of IAH or ACS in our patients. However, the amount of fluid required to resuscitate in the colloid group (7019.50±1762.31 ml) was less than the fluid required in the crystalloid group (10485.67±2989.37). Other parameters such as urine output, Kidney function test, ABG and LFT were not different in the crystalloid and the colloid group, and none of these parameters showed any significant derangements.

A large amount of fluid given during resuscitation may contribute to IAH or ACS in burn patients. However, it needs to be ascertained whether extensive fluid volume for resuscitation directly causes ACS. Despite the variably reported incidences of IAH & ACS in different literature, we did not come across any cases of IAH or ACS in our study group of the Indian population. Burn patients who were resuscitated with colloid regimen required less fluid for resuscitation as compared to the crystalloid group. So the addition of colloid does have fluid sparing effect in burn patients.

Table-1: Baseline parameters

Group	Crystalloid	Colloid
No. of patients	30	30
Mean age	29.10±8.057	31.10±11.251
Total body surface area burn (TBSA)	42.90±9.121	41.43±11.16
The total amount of fluid used for resuscitation	10485.67±2989.37	7019±1762.31

Table 2: Comparison of Intra-abdominal pressure(IAP) in crystalloid & colloid group

Time	IAP in Crystalloid group	IAP in Colloid group
At admission (0hrs)	8.43±2.269	7.97±2.312
4 hrs	8.80±2.483	8.23±2.359
8 hrs	8.57±2.582	7.87±1.995
12 hrs	8.60±2.313	7.93±2.149
16 hrs	8.23±2.622	7.30±1.915
20 hrs	8.47±2.113	7.43±1.942
24 hrs	8.63±2.125	7.00±1.930

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