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Peripheral Blood Stem Cells Harvest from Paediatric Donors for Allogenic Transplantation – Our Apheresis Experience

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INTRODUCTION

- Allogenic hematopoietic stem cell transplant is a widely accepted standardised treatment modality for multitude of haematological malignant and non-malignant diseases;
- Sources of haematopoietic stem cells include - bone marrow, peripheral blood and cord blood ;
- Bone marrow has been used as a prime source to harvest haematopoietic cells in paediatric donors;
- However, since 1990s with a greater advent in haematological pharmaceutical agents to mobilise stem cells into peripheral circulation there has been global escalation in the practice of harvesting mobilised peripheral blood stem cells from autologous/allogenic donors for hematopoietic stem cell transplantation (HSCT);
- Evidences have shown that HLA-matched siblings are regarded as the best prospective donors ;
- Collecting HSCs from allogenic paediatric aged group donors involve meticulous addressal to their physiological, anatomical, psychological and ethical concerns;
- Several technical challenges due to donor characteristics requires attention which include selection of vascular access, assessment of extracorporeal circuit volume, enigma to sedate during procedure, anticoagulant ratio and to counteract side-effects intravenous dose of calcium as maintenance, flow rates, meal and hydration care;
- Presently, institutes with transplant centres have customised regimens in this regard as per their preference and availability of resources;

AIMS & OBJECTIVES

- To report our single centre successful experience of harvesting peripheral blood stem cells from paediatric aged group donors for allogenic haematopoietic stem cell transplantations (HSCTs).

MATERIALS & METHOD

- **Study Design:** Single centred retrospective observational study;
- **Study Setting:** Department of Immunohematology and Blood Transfusion, Indraprastha Apollo Hospital, New Delhi;
- **Study Duration:** January 2019 to September 2024
- **Study Population:** Paediatric Allogenic Donors (Age 0 to 18 years) of either gender enrolled for donating peripheral blood stem cell with due consent from legal guardians/self (if applicable);
- **Ethics approval:** Study was purely observational; no ethical approval was needed;
- **Statistical analysis:** Data was analysed using descriptive statistical tools and frequencies;
- **Equipment:** Spectra Optia apheresis, System 1 P0 4552 (Terumo BCT, Lakewood, CO, USA); using cMNC protocol.

RESULTS

- A total of 98 PBSC harvesting procedures were done for malignant and non-malignant diseases during January 2019 to September 2024 from 95 mobilized allogenic paediatric aged group donors on day-care basis;
- Mean age and weight of the donor noted at the time of apheresis were 8.47 years and 36.89kg respectively;
- Of this 46% were matched sibling and 54% were haploidentical allogenic paediatric donors;
- Femoral HD catheter was used as an access in 74% allogenic donors. HD catheters insertion was done in pediatric ICUs under propofol infusion at the rate of 1-2mg/kg diluted in normal saline was given as a sedative; Preferred size of the catheter was around 5.5 Fr (1-4 years of age), 8.5 Fr (For 5-10 years of age) and 11.5-12 Fr for those >/= 11 years of age.

Table 1: Characteristics of Paediatric Donor

Characteristics of Paediatric Donor	Frequency (%)
Total Donor	95
Age (years)	
<5 years	22 (23.1%)
5-10 years	33 (34.7%)
>10 years	40 (42.1%)
Gender	
Male	23 (25%)
Female	72 (75%)
Weight (kg)	
<10kg	03 (3.1%)
10-20kg	21 (22.1%)
>20kg	71 (74.7%)
Type of Donor	
Matched Sibling Donor (MSD)	45 (46%)
Haploidentical Donor	53 (54%)
Mobilizing Agents	
G-CSF dose (10mcg/kg/day)	95 (100%)
Plerixafor (0.24mg/kg s/c)	95 (100%)

- ACD inlet ratio 1:12 to 1:16; rate of 1.2to1.6 ml/min was used as an anticoagulant - titrated as per donor haematological parameters and inlet requirement ;
- Priming was done in 30% cases (Wt-<25kg) using 200-250 ml of leukocyte-depleted pheno-matched irradiated packed red cells to prevent hemodynamic complications;

Table 2: Characteristics of Cytapheresis

Characteristics of Apheresis	
Total PBSC Harvests	98
Single Day Harvests for 1st Transplant	95
Two Day Harvests for 1st Transplant	01
Single Day Harvests for 2nd Transplant	02
ABO Status	
ABO Compatible Harvest	59 (60.2%)
ABO Incompatible Harvest	
Major ABO Incompatible Harvest	16 (16.3%)
Minor ABO Incompatible Harvest	13 (13.2%)
Bidirectional ABO Incompatible Harvest	07 (07.5%)
Access	
Peripheral	25 (25.5%)
Femoral HD Cath	73 (74.5%)
Red Cell Priming of Cell Separator	
Priming done	
<5years	23 (23.5%)
5-10 years	07 (07.5%)
Priming not done	68 (69.4%)
Pre-CD34 Counts (cells/µL)	
<50	04 (04.1%)
50-100	08 (08.2%)
>100	86 (87.7%)
Mean ACD volume (in mL)	604.6
Mean Total Blood Volume (in Litres)	2.6
Mean Product Volume (in mL)	184.6
Mean Time (in min)	243.6
Mean Yield (in million/kg recipient weight)	27.5
Mean Product CD34 Counts (cells/µL)	4349.1

- Calcium gluconate at the dose of 10mg/kg or as per primary team's order was administered through out apheresis to counteract anticoagulation associated hypocalcaemia; vitals were monitored throughout harvests procedure;
- Challenges - flow issues (femoral (n=20)>peripheral (n=12)) and breaking of interface in donors with SCD trait (n=11) and TDT trait (n=2) were encountered; former tackled with positional correction and multiple times flushing access with normal saline +/- heplock and later by ruling out other causes, reassured legal guardians for multiple alarms and initiated collection into bag upon re-establishment of interface;
- Feeding was encouraged to prevent hypoglycaemia;
- Complications noted include – vomiting (n=8); symptomatic hypocalcemia – Tingling of lip (n=2) – managed with on-going calcium infusion dose escalation as per pediatrics team and tetany (n=1)- Calcium bolus was given as per primary team;
- No serious adverse events were encountered prolonging hospital stay; all procedures were concluded with successful collection of target dose desired at primary physician's end.

CONCLUSION

Our single centre institutional experience corroborates for PBSC harvest from children as allogenic donors is a safer and effective apheresis procedure provided being optimised by an active participation of each clinical stakeholder to overcome physiological, anatomical, psychological, technical and ethical challenges.

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