Transfusion and Apheresis Science 51 (2014) 209–214

Contents lists available at ScienceDirect

Transfusion and Apheresis Science

journal homepage: www.elsevier.com/locate/transci

Efficacy and safety of plasma exchange: ann 11-year single-center experience of 2730 procedures in 317 patients

Joan Cid *, Gloria Carbassé, Bienvenida Andreu, Antonio Baltanás, Ana Garcia-Carulla, Miguel Lozano

Apheresis Unit, Department of Hemotherapy and Hemostasis, CDB, IDIBAPS, Hospital Clínic, University of Barcelona, Barcelona, Spain

ARTICLE INFO

Article history:
Received 8 April 2014
Received in revised form 14 July 2014
Accepted 25 August 2014

Keywords:
Plasma exchange
Efficacy
Safety

ABSTRACT

We reviewed retrospectively 317 patients who received 2730 plasma exchange (PE) procedures. According to guidelines published by the American Society for Apheresis (ASFA) in 2013, there were 220 (69%), 55 (17%), 32 (9%), and 7 (4%) patients who were treated with PE for a disease or condition considered as category I, II, III, and IV, respectively. Overall, 73%, 72%, and 69% of the patients showed an improvement of the underlying disease or condition at the end of the PE, and at 3 months and at 6 months after finishing the PE, respectively. We observed adverse effects in 90 (3%) PEs.

1. Introduction

According to the last edition of the guidelines published by the American Society for Apheresis (ASFA) in 2013, plasma exchange (PE) is a "therapeutic procedure in which blood of the patient is passed through a medical device which separates out plasma from other components of blood, the plasma is removed and replaced with a replacement solution such as colloid solution (e.g., albumin and/or plasma) or combination of crystalloid/colloid solution" [1].

The knowledge of the exact mechanism of action of PE is limited [2]. In some disorders, the mechanism of action of PE appears to solely represent the removal of pathological substances. Examples of these substances include antibodies (auto- [3] and allo-antibodies [4]), immune complexes, cryoglobulins, myeloma light chains [5], and endotoxins [6]. In most autoimmune disorders, the mechanism of action of PE is less clear in part due to a lack of correlation between presumed pathological antibody titers and disease severity. Beyond the removal of pathological substances, the therapeutic effect of PE may be more complex and include changes in immune cell numbers, function and phenotype, suggesting alterations in the immune system [2].

In order to guide physicians concerning which disorders are most likely to benefit from PE, the ASFA has created a set of evidence-based guidelines for the use of PE in certain clinical situations, which are divided into four categories (I–IV) [1].

The objective of our study was to review retrospectively our 11-year experience with PE in our 600-bed university hospital to describe the main demographic and clinical characteristics of treated patients, the distribution of patients who were treated according to the categories of the 2013 ASFA guidelines, as well as the safety and the efficacy of the PE procedures performed at our tertiary care center.

2. Materials and methods

We retrospectively reviewed all consecutive patients treated in the apheresis unit of our hospital since January 1, 2000 to December 31, 2010. We did not exclude any patients from the study. All patients signed an informed consent before starting the PE procedures.

A therapeutic cycle (TC) was defined as the total number of PEs performed daily or on alternate days because of the underlying disease or condition. When PEs were stopped

* Corresponding author. Tel.: +34 932275448; fax: +34 932279889.
E-mail address: jcid@clinic.ub.es (J. Cid).

http://dx.doi.org/10.1016/j.transci.2014.08.018
1473-0502/

and started again more than 1 month after stopping, it was considered a new TC. Procedures were conducted by trained nurses supervised by a physician specialist in Hematology and Hemotherapy according to the Spanish regulations.

We extracted all data presented in this study from the consultation form that we performed for each patient [7]. We filled in a consultation form before starting each TC where we collected all demographic data of the patient, as well as clinical and analytical data of each PE procedure. We also collected adverse events (AE) that occurred during the TC. Patients were medically evaluated before starting PE procedures with careful review of current medications, such as angiotensin-converting enzyme inhibitors [8,9] and beta-blockers [10]. In addition, a trained nurse evaluated if peripheral venous access was adequate to perform the PE treatment. When present, an arteriovenous fistula was used, and it was considered a peripheral venous access. When it was necessary, an indwelling catheter (Softcell catheter 12.5 F, Bard, Access Systems, Inc., Salt Lake City, UT) was placed by trained personnel in the Angioradiology Unit under ultrasound and X-Ray control.

PE was carried out daily or on alternate days by continuous-flow centrifugation (Cobe® Spectra and Spectra Optia®, Terumo BCT, Leuven, Belgium), including weekends. Total blood volume (BV), according to Nadler et al. [11], and plasma volume (PV), according to the formula $PV = BV \times (1 - \text{Hematocrit})$, were calculated using an Excel spreadsheet. We exchanged 1.0–1.5 calculated plasma volumes per session.

Fluid replacement consisted of 5% albumin solution (Albutein® 5%, Grifols, Barcelona, Spain) for all patients, except those suffering from thrombotic thrombocytopenic purpura (TTP). Quarantined fresh frozen plasma (FFP) was used for patients suffering from TTP, and methylene blue-inactivated FFP was used in some of the other cases, when coagulopathy induced by PE with albumin was considered inacceptable for patient's conditions, e.g. PE within 24 hours of a kidney biopsy. Quarantined FFP (FFP which is retested and found negative for infectious disease markers 4–6 months after collection) was used for patients suffering from TTP because of data from observational studies suggesting faster achievement of remission with this type of FFP in comparison with methylene blue-inactivated FFP [12,13].

Anticoagulation with citrate (ACD-A, Grifols) was used at our center at a citrate infusion rate of 0.4–0.6 mL of ACD-A/min/L of total blood volume when 5% albumin was used as a replacement solution and 0.6–1.0 mL of ACD-A/min/L of total blood volume when fresh frozen plasma was the replacement solution. Routinely, we also infused intravenously calcium chloride (Ca) plus magnesium sulfate (Mg) solution throughout the PE at a rate of 1 mol of Ca and Mg per 10 mol of citrated blood (0.5 mg of ion Ca per 1 mL of citrate), prepared in 100 mL 0.9% saline solution bags [14].

Every two PE procedures, when albumin was used as replacement solution, we administered a dose of 200 mg/kg intravenous immunoglobulins (IVIG; Flebogamma, Grifols) in order to prevent the hypogammaglobulinemia associated with PE that might facilitate infections and to prevent the rebound phenomenon (e.g., biofeedback stimulation of increased immunoglobulin synthesis) [15].

Table 1
Indications for performing plasma exchange.

Disease	Patients n (%)	Therapeutic cycles n (%)
Renal	186 (59)	235 (62)
Hematology	53 (17)	60 (16)
Neurology	33 (10)	33 (9)
Autoimmune	25 (8)	27 (7)
Hepatology	12 (4)	12 (3)
Cardiology	8 (2)	11 (3)
All	317 (100)	378 (100)

We performed laboratory assays from patient's blood sampled immediately before starting and immediately after finishing each PE procedure. We performed a complete blood count (CBC) on an autoanalyzer (Advia 2120, Siemens AG, Madrid, Spain). We performed prothrombin time and fibrinogen measurements on an autoanalyzer (Sta® R Evolution, Roche Diagnostics, Barcelona, Spain). We obtained acid/base equilibrium parameters with an autoanalyzer (Rapid Lab 860, Siemens AG). We measured biochemistry parameters (total calcium, magnesium, sodium, and potassium) with an autoanalyzer (Advia 2400, Siemens AG).

The clinical outcome of the patients undergoing PE was assessed at the end of the PE treatment, and at 3 months and at 6 months after finishing the PE and categorized as improvement, no change or worse. This global assessment was made after checking medical records of the patients, according to the evaluation of the treating physician.

2.1. Statistical analyses

We used the paired t-test to compare the values of the quantitative variables before and after performing PE. We used the unpaired t-test to compare the absolute change of Ca and Mg according to the use of prophylactic administration of Ca–Mg solution. We used the chi-squared test to compare the frequency of PE procedures with AEs with or without the infusion of Ca–Mg solution. In all cases, we considered a statistically significant result when the p value was less than 0.05. We carried out the statistical analysis with a software (SPSS Software, release 19.0, IBM Corporation, Armonk, NY).

3. Results

Our series comprises 317 patients, 182 (57%) men and 135 (43%) women with a median age of 49 years (range: 16–87). The 317 patients underwent 378 TCs. There were 43 patients who underwent more than one TC: 29 patients underwent two TCs, 10 patients underwent three TCs, and four patients underwent four TCs.

Table 1 shows the most frequent indications for performing PE. In the group of renal diseases, there were 85 (46%) patients with acute antibody-mediated rejection (AMR) after ABO-compatible kidney transplantation. In the group of hematologic diseases, there were 23 (43%) patients with myeloma cast nephropathy, and 14 (26%) patients with TTP. In the group of neurologic diseases, there were 10 (30%)