Nursing care of patients on corticosteroid pulse therapy
Assistência de enfermagem ao paciente em pulsoterapia com corticosteróide

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ABSTRACT
Introduction: Intravenous pulse therapy with corticosteroid involves administration of high doses (starting from 1 g/day), given on three or more consecutive days. Because of possible adverse effects, it is recommended that patients stay at hospital during administration of pulse therapy. Monitoring of vital signs can early identify these adverse effects and allow efficient intervention assuring patient’s safety. Uniform nursing care is necessary considering the responsibility of the nursing team regarding drug administration and follow-up of patients. Objective: To identify the most important nursing care issues to inpatients undergoing corticosteroid pulse therapy. Methods: Bibliographic search in databases, books, articles in endocrinology, pharmacy and nursing journals; discussions with experts in neurology, transplant and pharmacy. Results: Side effects during corticosteroid pulse therapy may occur as soon as infusion starts. An instrument was designed to monitor such effects and systematize nursing care. Conclusions: Systematized nursing care during corticosteroid pulse therapy leads to early identification of possible complications and intervention to minimize them.

Keywords: Patient care/nursing; Pulse therapy, drug/nursing; Adrenal cortex hormones/therapeutic use

INTRODUCTION
Some concepts of corticosteroid pulse therapy are presented in the literature. It involves the use of “suprapharmacological” doses of corticosteroids, generally between 0.5 and 2 g. The usual dose is 1 g, administered intravenously for three or more days, or in alternate days. The mean therapy cycle ranges from three to seven days and the mean infusion time is between two and eight hours. The most used corticosteroid derivatives are: prednisolone, dexamethasone, and methylprednisolone(1-3).

Because of its potent anti-inflammatory and immunosuppressive effect, the therapy with high doses of corticosteroids is indicated in the treatment of several immunological diseases, such as systemic lupus...
erythematosus, rejection of solid organ transplantation, multiple sclerosis, among others\(^{(1-3)}\).

The following side effects may occur during infusion of this substance: metabolic disorders and suppression of the hypothalamic-pituitary-adrenal axis, with indication of hospitalization and consequent need of monitoring side effects and providing early intervention. The action of nursing staff can minimize the complications related to this treatment in the short and long run\(^{(4-5)}\).

For quality and safe performance it is necessary – especially the nursing staff – to have specific knowledge about pharmacodynamics and side effects of corticosteroids during pulse therapy. The nursing staff is in charge of administering these drugs. This demands nurses to act based on scientific principles, which are essential requirements for an evidence-based practice\(^{(6)}\).

**Pharmacokinetics and pharmacodynamics of corticosteroids**

The clinical effects of corticosteroids depend on their pharmacokinetics (absorption rate up to excretion) and pharmacodynamics (concentration necessary to produce a maximum effect, establishment duration and intensity of corticosteroid effects)\(^{(7-8)}\).

The half-life varies between 30 and 270 minutes. Corticosteroids are metabolized in the liver and 95% of them are excreted by the kidneys. Their main effects are anti-inflammatory/immunosuppressive, metabolic and toxic. The anti-inflammatory effects include changes in circulation/migration of leucocytes and specific changes in the cell functions; metabolic and toxic effects are usually unwanted. Duration, dose and frequency of administration depend on the clinical status and on the intended risks or benefits\(^{(8)}\), as shown in Chart 1\(^{(1,9-10)}\).

**Immediate and long-term adverse reactions**

Adverse reactions with corticosteroid pulse therapy are mostly related with suppression of the hypothalamic-pituitary-adrenal axis; however, they depend on the dose, duration, mode of use and presentation used.

To minimize the side effects related to this treatment, it is desirable that the drug be rapidly eliminated and has a short half-life. The longer the half-life, more potent and longer the action in the body will be\(^{(4)}\).

**Main adverse reactions during corticosteroid pulse therapy**

Some studies showed that adverse reactions occur during corticosteroid pulse therapy, such as skin rash, transient sleep disorder, mood swing\(^{(11)}\), sinus bradycardia, hyperglycemia, high blood pressure\(^{(12)}\), all of them mostly transient\(^{(13)}\). Despite the number of adverse reactions cited, we will highlight below those more often mentioned in the literature and the ones that may occur since the beginning of pulse therapy, thus requiring closer monitoring of the patient by the nursing staff.

**Cardiovascular disorders**

A literature review shows that cardiovascular disorders may occur during corticosteroid pulse therapy. Some factors, such as age, heart failure, smoking, diabetes mellitus, high blood pressure, female gender, left ventricular hypertrophy, myocardial infarction, lung diseases and hyperthyroidism, may increase the risk of patients presenting cardiovascular changes during pulse therapy with corticosteroids. Most of these abnormalities are seen in the first 24 hours after starting infusion. There are reports of these disorders leading to death\(^{(4,6,14)}\).

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**Chart 1. Corticosteroid features**\(^{(5,9-10)}\)

<table>
<thead>
<tr>
<th>Fast action</th>
<th>Relative potency</th>
<th>Pharmacokinetics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dose (mg)</td>
<td>Anti-inflammatory activity(^{1})</td>
<td>Ability to retain sodium (Mineralocorticoid activity)(^{1})</td>
</tr>
<tr>
<td>Cortisone</td>
<td>25</td>
<td>0.8</td>
</tr>
<tr>
<td>Hydrocortisone</td>
<td>20</td>
<td>1</td>
</tr>
<tr>
<td>Methylprednisolone</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Prednisolone</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Prednisone</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Betamethasone</td>
<td>0.8</td>
<td>20-30</td>
</tr>
<tr>
<td>Dexamethasone</td>
<td>0.8</td>
<td>20-30</td>
</tr>
</tbody>
</table>

\(^{1}\) anti-inflammatory, immunosuppressive effects, metabolic alterations; \(^{2}\) the mineralocorticoid activity is associated to sodium retention and potassium depletion, and likely increase in blood pressure; \(^{3}\) the effects of sodium retention and potassium depletion (leading to fluid retention), and hypokalemia, depend on the patient’s predisposing factors and dosage given; min. = minutes.
The main cardiovascular abnormalities are arrhythmias, bradycardia and high blood pressure\(^4,12,14\). The arrhythmia most commonly seen in clinical practice is atrial fibrillation, which may lead to important consequences, such as hemodynamic abnormalities and stroke. The prevalence increases with age, 4% in individuals aged over 60 years and 9% in those over 80 years\(^4\).

Some mechanisms were proposed to justify the occurrence of arrhythmias during corticosteroid pulse therapy. First, high doses of corticosteroid cause abnormalities in electrolyte exchange through cell membrane inducing arrhythmia; there is mainly an efflux of potassium through the membrane and this would influence in arrhythmogenesis. Secondly, high doses of corticosteroids have mineralocorticoid activity, that is, retention of sodium and intracellular fluids, causing high blood pressure and congestive heart failure, thus reflecting a risk for atrial fibrillation. Other mechanisms were proposed, such as peripheral vasodilation and anaphylactic reaction, but they have not been clarified in the scientific literature\(^4,6,14-16\).

The occurrence of bradycardia during corticosteroid pulse therapy is explained by high doses of corticosteroids that induce abnormalities in electrolyte exchange through cell membrane\(^1,7,13\).

Arterial hypertension induced by corticosteroid therapy is more prevalent in patients on high doses of steroids and they can frequently occur in individuals with family history of arterial hypertension\(^17\).

The mechanisms involving the development of arterial hypertension during corticotherapy include increased systemic vascular resistance, increased extracellular volume due to sodium retention caused by corticosteroid and reduced cardiac contractility\(^6,8\).

**Blood glucose abnormalities**

Corticosteroid therapy is associated with increased risk of hyperglycemia in patients with no previous diagnosis of *diabetes mellitus*, as well as with worsening and difficult control in those who suffer from this disease. The action of corticosteroids leads to increased gluconeogenesis (production of glucose in the liver from amino acids), decreased use of peripheral glucose (with increased metabolism of proteins and lipids, because they become an option to obtain energy), increased insulin resistance and reduced secretion of pancreatic insulin. These abnormalities lead to a clinical picture ranging from hyperglycemic status to development of long-term *diabetes mellitus*\(^17-19\).

The incidence of hyperglycemia rises if patients present risk factors associated to development of *diabetes mellitus*, such as age \(\geq 45\) years, body mass index (BMI) \(\geq 25\) kg/m\(^2\), family history of *diabetes mellitus*, sedentary lifestyle, ethnicity, insulin resistance, history of gestational *diabetes mellitus*, hypertension, elevated HDL and triglyceride levels, polycystic ovary, and association of drugs that lead to blood glucose abnormalities, such as corticosteroids\(^4,18\).

**OBJECTIVE**

To identify the main nursing care activities during corticosteroid administration at a hospital unit.

**METHODS**

A bibliographic search was carried out in databases (Medline, Cochrane, Bireme) and books considering the period 1980 to 2006. The search terms were pulse therapy, nurse, nursing care, corticoids and corticosteroids, both in English and Portuguese.

In data collected by bibliographic search, only two articles specifically addressed nursing care to patients undergoing corticosteroid pulse therapy\(^4,18\). This indicated the need of further studies about this topic in order to emphasize nursing care and add value to the healthcare delivered to patients on this therapy.

The division of nursing care into before, during and after corticosteroid infusion aims to didactically separate the duration of treatment which patients will undergo; in each stage care to be provided is justified according to adverse reactions and/or side effects presented by patients.

**RESULTS**

For planning nursing care, it is essential that nurses know the main aspects related to pharmacodynamics, metabolism, potency and side effects of drugs, in addition to other types of care which must be customized and focused on real and/or potential situations patients may be involved.

There are studies recommending monitoring of vital signs since the first day of corticosteroid pulse therapy, six hours before, during and after the administration, at varied frequency, until completing 24 hours. Measurement of blood glucose, serum sodium and potassium, and electrocardiogram (ECG) must be carried out before and four hours after administration on every day of corticosteroid pulse therapy\(^6\).

Another study suggests the measurement of blood pressure one hour before pulse therapy and every hour after starting infusion for 11 hours, in order to early identify the adverse cardiovascular reactions to pulse therapy and minimize the potential complications\(^4,5\).
It is also suggested that pulse therapy be administered for a period longer than 45 minutes and that the patient be monitored for at least 24 hours after starting infusion, mainly in patients with associated cardiovascular diseases(20).

Considering that “the state-of-the-art in healthcare demands professional’s alignment to patient’s needs, training for efficient and safe resolution at the lowest possible cost”(21), a nursing care plan was prepared based on the articles found about nursing care and possible side effects caused by corticosteroids, in addition to the clinical experience of the authors of the present article.

The “periods” of this care plan were divided into before, during and after drug intravenous infusion and added to the care during oral administration of the drug.

**Nursing care before corticosteroid infusion**

- To check blood pressure, heart rate, respiratory rate, capillary glucose and weight before corticosteroid infusion(4,13-14,17). Justification: these measures serve as parameter to compare with further measurements.
- To give instructions to patients and companions before corticosteroid infusion in regard to: treatment prescribed by physicians (drug, dose, frequency, side effects), care about the peripheral venous access (prevention of phlebitis and bloodstream infection), monitoring that will be carried out (weight, diuresis, blood glucose, vital signs). Justification: patient’s compliance to treatment depends on several factors, including appropriate information that patients understand. The Joint Commission recommends, as a patient’s safety standard, to encourage him/her to get actively involved in the care process, in addition to effectiveness of communication between the nursing staff and the patient, for the safety in the process of drug administration(22).
- To implement special care for intravenous drug infusion, prevention of phlebitis and bloodstream infection, maintenance of proper venous access used exclusively for corticosteroid administration. Justification: the infusion of high doses of corticosteroids is related to higher risk of phlebitis and bloodstream infection due to decreased inflammatory reaction, immunosuppression, inhibition of protein synthesis, fluid retention, skin fragility, abnormal coagulation cascade, subcutaneous tissue atrophy, in addition to other adverse effects related especially to the skin, such as skin eruptions, skin rash and urticaria, which may promote the entry of microorganisms into the bloodstream(9,23-25).
- To set the infusion to start between 8 to 11 A.M. Justification: because of the circadian cycle (higher production of corticosteroids in the morning)(25).
- To investigate previous treatment with corticosteroid and possible reactions. Justification: nursing care involves planning of care based on evidence and customized to each patient(21). Therefore, the nurse’s knowledge about past treatments, signs and symptoms, as well as previous reactions during corticosteroid pulse therapy is crucial to treatment planning.
- Care while preparing and administering the drug: check the drug stability with the hospital pharmacist and administer by infusion pump. Justification: the clinical pharmacy can help planning treatment by providing information about stability and solution for drug re-dilution, thus collaborating with the team so that the infusion duration of pulse therapy varies within the drug stability limit. The infusion pump is recommended due to the possibility of exactly planning volume and time, and for allowing safe adjustments to infusion rate.

**Nursing care during corticosteroid infusion**

- To evaluate and record the behavior pattern and level of consciousness once during shift. Justification: insomnia and other neuropsychological disorders are described in the majority of patients(23-24). Patients with cardiomyopathy may present syncope, blurred vision, and palpitations before atrial fibrillation(5). Additionally, the following side effects are described during this therapy: headache, paresthesia, seizure, psychosis, vertigo, irritability, depression and euphoria(7,9,23,25).
- To assess the vital parameters (BP, HR, RR), capillary blood glucose: 15 minutes (twice), 30 minutes (three times) and every hour until completing six hours after beginning of infusion (the last control must match the end of infusion). Justification: the frequency suggested is based on pharmacokinetics of drugs used in the corticosteroid pulse therapy and on side effects. If the patient presents any of the side effects (especially hypertension peak, hyperglycemia, arrhythmia, tachycardia, headache, nausea and vomiting), correctly adjust the frequency of vital signs assessment(1,4,15).
- To monitor and notify the medical team regarding the occurrence of the main side effects: hypertension peak, hyperglycemia, arrhythmia, tachycardia, headache, nausea and vomiting. Justification: due to mineralocorticoid activity and change in the Na+/K+ pump, there is a change in sodium levels leading to water and sodium retention and potassium and
chloride loss. The hydroelectrolytic abnormalities may have cardiovascular and systemic effects, such as increased blood pressure. Additionally, enhanced lipid mobilization, redistribution of fat deposits and increased secretion of hydrochloric acid may also be involved in the occurrence of nausea. Associated with these events, the hormone abnormalities, excess of androgens, inhibition of the hypothalamic-pituitary-adrenal axis and intolerance to carbohydrates with increase of gluconeogenesis are related to hyperglycemia. Short and long-term complications have varied severity depending on the intensity of occurrence and waiting time for resolution of these side effects. Cases of atrial fibrillation after methylprednisolone pulse therapy are rare, but must be considered; therefore, in addition to the suggested controls, in patients with high cardiovascular risk undergoing pulse therapy there is an indication of continuous monitoring with ECG, according to some studies.

- To check capillary blood glucose before and after the end of infusion. Justification: a study of 146 patients showed that, in non-diabetic patients, there is an increase in blood glucose levels higher than 50% in the first pulse, followed by a slow and spontaneous return to glucose values in the following pulse therapies. In diabetic patients, however, there is additional hyperglycemia, with increased potassium levels suggesting a rapid efflux of potassium from cells as a direct drug effect (methylprednisolone). This effect also contributes to higher cardiac risks. As previously described, blood glucose associated with corticosteroid pulse therapy leads to established diabetes mellitus in the long run.

- Assessment of renal function: to control and record urine voiding (frequency, volume, appearance); to evaluate episodes of dysuria; to measure body weight every day during pulse therapy. Justification: mineralocorticoid activity and the change in the Na+/K+ pump may cause changes in the sodium levels leading to water and sodium retention and loss of potassium and chloride. Additionally, there is a risk of immunosuppression, skin and mucous membrane abnormality and glycosuria, which can cause urinary tract infection (UTI).

- To assess the skin-mucous integrity and record the abnormalities. Justification: they occur as a consequence of collagen destruction in the blood vessel tissues leading to leakage of blood from the small vessels to the skin tissues; hematomas and skin lesions may occur. Moreover, the risk of thrombophlebitis and thromboembolism is increased during corticosteroid pulse therapy due to inhibition of the complement system and changes in the coagulation cascade.

- To evaluate stools frequency, color and consistency and to evaluate the presence of intestinal hemorrhage or melena. Justification: gastrointestinal, coagulation and blood vessel abnormalities may cause upper or lower gastrointestinal bleeding which can be detected in the bowel discharge. Dietary adequacy (fluid and fiber intake) should also be evaluated taking into account the patient’s past medical history.

### Nursing care after corticosteroid infusion

- To monitor the occurrence of the main side effects and follow up laboratory test results.

- Oral corticosteroids usually follow intravenous therapy and it is recommended to advise the patient to monitor the occurrence of main side effects, such as abnormal sleep and behavioral patterns, visual abnormalities, gastrointestinal disorders (nausea and vomiting), signs and symptoms of infections and investigate the possible sites (skin, nails, mucous membranes), signs and symptoms of hypoglycemia or hyperglycemia (adopting orientations prescribed by the medical team); presence of hematomas/hematuria/gingival bleeding, edema in the lower and upper limbs. Justifications: hydroelectrolytic disorders may occur during pulse therapy and during continuous treatment with oral corticosteroids. Follow-up laboratory tests and strict and thorough clinical assessment by the nursing team, especially by registered nurses, are crucial for monitoring and action regarding prevention and treatment of complications caused by corticosteroid pulse therapy, either during pulse therapy or during maintenance treatment.

- If patients continue on oral corticosteroids, they and their family must be instructed about the administration schedule. It is suggested that the highest dose be administered in the morning due to cortisol circadian cycle.

### DISCUSSION

Bibliographic search provides a review of potential short and long-term complications of corticosteroid therapy. Control of such complications is recommended by means of patient monitoring, measurement of vital signs and blood glucose levels during intravenous corticosteroid pulse therapy, although no consensus has been achieved about frequency at which it must be carried out.

Considering that the nursing team must provide full assistance to patients with early identification...
and intervention in cases of potential care complications, it is suggested to have standardized care based on the pharmacological aspects of corticosteroids, nurse clinical assessment and individual care plan according to the patient’s past history (diagnosis and comorbidities), previous pulse therapy and potential reactions presented during corticosteroid intravenous infusion.

In addition, discussion of each case with the medical team and other members of the multiple professional teams are essential conditions for successful therapy and customized management of patient care according to their signs and symptoms.

CONCLUSIONS

It is recommend to monitor vital signs and side effects because they represent, according to specialists, the essential requirements for good practice in patients undergoing corticosteroid pulse therapy. Therefore, healthcare services must promote patient’s safety by providing technological resources that meet these needs, such as the development of human resources and appropriate materials.

Additionally, the inclusion of family members in the educational process meets the international patient’s safety requirements and shows the nurse’s concern about patient care during and after the hospitalization.

REFERENCES