Invasive hemodynamic monitoring at bedside: nursing evaluation and nursing care protocol

MONITORIZAÇÃO HEMODINÂMICA INVASIVA A BEIRA DO LEITO: AVALIAÇÃO E PROTOCOLO DE CUIDADOS DE ENFERMAGEM

MONITORIZACIÓN HEMODINÁMICA INVASIVA A LA CABECERA DEL PACIENTE: EVALUACIÓN Y PROTOCOLO DEL CUIDADO DE ENFERMERIA

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ABSTRACT

This action research type study aimed to establish clinical evaluation parameters essential to the patient subject to hemodynamic monitoring by Pulmonary Artery Catheter (PAC) and to develop a Nursing Care Protocol to critical care patients using catheter with the nurses of an ICU in Santa Catarina State. The population consisted of a non-probabilistic intentional sample of five nurses, and the data were collected through group meetings and questionnaire. The study is presented with descriptive statistics and qualitative analyses of the subjective questions. In conclusion, the clinical evaluation criteria, essential to the patient subjected to hemodynamic monitoring, are constituted by invasive and non-invasive parameters and the protocol grounds making clinical decisions when caring for patient using PAC.

KEY WORDS

Nursing care.
Intensive Care Units.
Monitoring, physiologic.
Nursing assessment.

RESUMO

Pesquisa-ação que objetivou estabelecer os parâmetros de avaliação clínica necessários ao paciente submetido à monitorização hemodinâmica pelo Cateter de Artéria Pulmonar (CAP) e construir um Protocolo de Cuidados de Enfermagem ao paciente grave e de risco em uso do cateter com os enfermeiros da UTI geral de um hospital público de Santa Catarina. A população se constituiu em uma amostra não probabilística intencional de 5 enfermeiros e utilizou para coleta de dados reuniões de grupo e questionário. O estudo é apresentado mediante estatística descritiva e análises qualitativas das questões subjetivas. Conclui-se que os critérios de avaliação clínica necessários ao paciente submetido à monitorização hemodinâmica se constituem em parâmetros invasivos e não invasivos e que o protocolo fundamenta a tomada de decisão clínica para o cuidado do paciente em uso do Cateter de Artéria Pulmonar.

DESCRITORES

Cuidados de enfermagem.
Unidades de Terapia Intensiva.
Monitorização fisiológica.
Avaliação em enfermagem.

RESUMEN

Se trata de una Investigación-acción que tuvo como objetivo establecer los parámetros de evaluación clínica necesarios para el paciente sometido a monitorización hemodinámica por el Catéter de Arteria Pulmonar (CAP) y construir un Protocolo de Cuidados de Enfermería para el paciente grave y de riesgo en el uso del catéter, con los enfermeros de una Unidad de Cuidados Intensivos (UCI) general de un hospital público de Santa Catarina. La población se constituyó en una muestra no probabilística intencional de 5 enfermeros, utilizándose para la recolección de datos reuniones de grupo y un cuestionario. El estudio se presenta por medio de estadística descriptiva y de análisis cualitativo de las preguntas subjetivas. Se concluye que los criterios de evaluación clínica necesarios para el paciente sometido a monitorización hemodinámica se constituyen en parámetros invasivos y no invasivos y que el protocolo fundamenta la toma de decisión clínica para el cuidado del paciente que usa el CAP.

DESCRIPTORES

Atención de enfermería.
Unidades de cuidados intensivos.
Monitoreo fisiológico.
Evaluación en enfermería.

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INTRODUCTION

Nursing has been changing in the course of the past 20 years following the art of critical care. This process has been partly attributed to the organization of specialized units for patient care, technological advances and, overall, a better understanding of physiology by health care professionals, especially the nurses.

One of the early technological advances that guided this progress was the development of the Edwards Swan-Ganz catheter, in the 1960s. In the early 1970s, the addition of a thermistor to the catheter enabled a fast cardiac output evaluation. Several state-of-the-art monitoring systems began to be developed and, as a consequence, more complete hemodynamic evaluations were conducted at patients' bedside[1].

Thus, monitoring through Pulmonary Artery Catheter (PAC) – Swan-Ganz catheter is a constituent part of handling physiologically unstable patients. This comprises the registry of the following pressures: RAP (Right Atrium Pressure), PAP (Pulmonary Artery Pressure), PCP (Pulmonary Capillary Pressure), besides CO (Cardiac Output) and CI (Cardiac Index), among others. Thus, the purpose of hemodynamic monitoring at bedside is to establish a diagnostic, guide and improve treatment. However, it should be taken into account that such invasive parameters are not risk-free and will only bring evident benefits if the data obtained are correct[2-3].

Due to the gravity of the clinical framework and the complexity of the technological apparatus, the nursing care provided to PAC patients represents one of the most challenging and stressing experiences in an Intensive Care Unit (ICU). Furthermore, studies have demonstrated that the hemodynamic evaluation in ICU patients has not been accurate and that the PAC invasive hemodynamic evaluation has influenced the therapeutics management, demanding nurses to be properly trained[2,4].

A study carried out in England, with 184 nurses aimed at identifying the reasons that indicated little or no use of the PACs, found that the lack of professional expertise was the main cause, followed by the risk-benefit ratio regarding its use[3]. Another randomized study evaluating the PAC impact on ICU critical patients found that the catheters should not be used for routine treatments of the ICU patient. They should be used with decompensated cardiac failure patients or with those subjected to surgery, because they have their clinical results improved when the treatment is associated with catheters[2].

Therefore, it is fundamental to develop studies that may contribute to improve the nursing clinical evaluation skills when dealing with PAC patients. Also, the fundaments to guarantee immediate and safe interventions are required. The purpose of the present study was to establish the parameters used by nurses when clinically assessing the patient subjected to PAC hemodynamic monitoring, and also proposing a nursing care protocol for the patient using this catheter.

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METHOD

This is an action-research[5] in which the researcher acts and monitors the study activities, with a qualitative and quantitative approach, carried out in a general ICU of a public hospital in Santa Catarina. This is an intentional, non-probabilistic sample, constituted by five nurses who worked at the hospital ICU where the study was performed. The inclusion criteria were: being a nurse of that unit and agreeing to participate in the study by signing the term of consent.

The study is supported by the Norms and Guidelines that regulate researches with human beings, according to the resolution 1996/96 of the National Health Council. The individuals' right to participate or not was respected and the research was was approved by the Ethics Committee in Research (CONEP) in 2004 under protocol no. 012/2004.

Data collection was performed in October, 2004 through January, 2005, with the application of a structured questionnaire elaborated by the authors, during three (3) group meetings. The questionnaire contained data referring to PAC hemodynamic monitoring purpose, clinical situations that justify its applicability, difficulties of the nurses in relation to PAC hemodynamic monitoring, among others. The group meetings had the purpose of constructing the nursing care protocol for the PAC hemodynamic monitoring patient in conjunction with the nurses, and to evaluate its content and applicability.

The study is limited by the reduced sample that represents it, and thus it cannot be subjected to generalizations if further studies are not performed and discussed. However, it shows important subsides for nursing approaches regarding PAC hemodinamic unstable patients.

This study elaboration relied on three steps: In the first step, there was a special concern about the parameters used by nurses to clinically evaluate the PAC patient subjected to hemodynamic monitoring. For this step, the questionnaire was used. The second step aimed at constructing a protocol with hemodynamic evaluation and nursing care, regarding the PAC patient. It was carried out during the group meetings. The third step aimed at evaluating the protocol content and its contribution to nursing assistance of the PAC patient. In this step, the group meetings were also used.

The data were presented in tables, containing absolute and relative frequencies in the form of testimonies expressed by the participants. The testimonies were discussed with the aid of the bibliography and reflections on the theme by the researches.

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RESULTS AND DISCUSSION

Based on the study objectives, the following general categories were established: *Nurse Clinical Evaluation of the Hemodynamic Monitoring Patient and Collective Process for Protocol Creation.* The study participants were identified as Nurse (Nur.) 1, 2, 3, 4, 5.

Nurse Clinical Evaluation of the Hemodynamic Monitoring Patient

This category is divided into seven subcategories extracted from the questioning performed with the participants: understanding of the hemodynamic monitoring; PAC indications; difficulties that interfere in the PAC hemodynamic evaluation; association of the hemodynamic pressures with the medical diagnosis; morphology of pressure curves and invasive and non-invasive hemodynamic parameters.

Understanding of the hemodynamic monitoring

It is the introduction of a catheter into the pulmonary artery to register the intravascular pressure parameters more safely (Nur. 2).

It is a way to monitor some parameters that aids the diagnosis of the hemodynamic conditions of unstable patients'; It guides the viable therapeutics to be used. It is applied to hemodynamically unstable patients in order to have a differential diagnosis (Nur. 4).

It is seen through the participants' responses that there is a good understanding of what hemodynamic monitoring is, mainly of Nur. 4. According to the literature, the hemody-namic monitoring is an invasive technique used to measure intracardiac, intrapulmonary and intravascular pressures[6]. It is used to evaluate the cardiac function and determine the therapy efficacy[7]. (Incredibly easy nursing) Only through clinical evaluation, without invasive parameters, the prediction of the hemodynamic status in critical patients is roughly 50%, which makes the treatment of the patient with severe hemodynamic unstableness too risky, without a complementary monitoring method[8].

PAC Indications

In the indications of PAC applicability, all the nurses in the study are aware that the septic, cardiogenic, hypovolemic shock and the mechanical complications of myocardial acute infarction are medical diagnosis in which the PAC hemodynamic monitoring is indicated. The participants' responses are believed to be related to their professional experience and all of them are supported by literature. PAC was introduced in the ICU with the objective of helping the diagnosis and treatment of shock[9]. This catheter is used with pathologies requiring information regarding pre-load, post-load, contractility, oxygen consumption and availability[10]. The situations requiring PAC in the first place, among others, are cardiogenic shock, acute myocardial infarction, refractory congestive heart failure, perioperative period in critical patients, septic shock and SARA[8-9].

Difficulties that interfere in the PAC hemodynamic evaluation

The main difficulties that interfere in the hemodynamic evaluation by the nurses are shown in Table 1:

Table 1 – Nurses' difficulties in the hemodynamic evaluation in PAC patients – Florianópolis – 2004

Variable	Description	Absolute frequency	Relative frequency
Difficulties in the hemodynamic evaluation	Pressure Intepretation	5	100%
	Follow-up time	5	100%
	Circuit Assemblage	2	40%
	Material Resources	1	20%
	Occurrences	1	20%
	Others: Performing Cardiac Output	1	20%
	Have complete material in the Unit (kit)	1	20%

The data shows that the pressures interpretation and the required follow-up time to care for the patient are factors that impair most nurses' activities when evaluating the PAC patient, corresponding to 100%. The PAC circuit assemblage installation comes next, with 40%. The correct pressure interpretation through PAC by the nurse is fundamental for both the correct conduction of the hemodynamic care, including anticipation and complication prevention, and for the evaluation of response, regarding nursing care.

The nurse ought to use the PAC information to monitor and help with the diagnosis, refine the evaluation and guide the interventions[7]. For the PAC hemodynamic monitoring to be useful and employed safely, it is necessary for the multiprofessional team to be properly trained[8,11]. The data lead to reflections about the need of incorporating a permanent education process to enable the Evidence-Based Practice, emphasizing the use of research when it comes to clinical decision-making[9]. Regarding the follow-up time, as referred by the participants, a recent study performed with the purpose of identifying and analyzing the specificities of nursing direct assistance hours in a given ICU for proper staff arrangement found healthcare hour concentrations varying from 9 to 13 hours a day per patient[12]. It is worth mentioning that, in the aforementioned study, the PAC monitoring was not considered, which is believed to significantly improve the outcomes.

Association of hemodynamic pressures and medical diagnosis

In the investigation about associations between hemodynamic pressures and respective clinical conditions shown by patients, the average blood pressure (ABP) and the catheter pressure in the left atrium (LAP) were added, along with other hemodynamic parameters. This is due to the fact that the research was carried out at an ICU with several cardiovascular disease patients and high prevalence of surgeries.

Table 2 – Association of the invasive hemodynamic data with medical diagnosis – Florianópolis – 2004

Variable	Description	Absolute Frequency	Relative Frequency
Hemodynamic Parameters	1. Hypovolemic shock (nRAP or ↓ LAP↓ or PCP ↓ ABP ↓, nCO or ↓, SVR↓)	1	20%
	2. Pulmonary Thromboembolism (RAP↑ nLAP or nPCP or ↑ nABP, nCO SVR↑)	1	20%
	3. SARA (RAP↑ or nLAP or nPCP or↑nABP, nCO or ↓, SVR↑)	-	-
	4. Septic Shock (RAP↑or nLAP or PCP↓ or nABP or ↓ nCO or ↓, SVR↑ or↓)	2	40%
	5. Left Ventricular Insufficiency (RAP↑or nLAP or PCP↓or ABP↓ CO↓, SVR↓)	-	-
	6. Right Ventricular Insufficiency (RAP↓ or nLAP or nPCP or ↓ or nABP or↓nCO or ↓, SVR↑)	1	20%

Legend: RAPn or ↓ or ↑ (normal Right Atrium Pressure, diminished or increased); nLAP or ↓ or ↑ (normal Left Atrium Pressure, diminished or increased); nPCP or ↓ or ↑ (normal Pulmonary Capillary Pressure, diminished or increased); nABP or ↓ or ↑ (normal Average Blood Pressure, diminished or increased); nCO or ↓ or ↑ (Normal Cardiac Output, diminished or increased); SVR ↓ or ↑ (Systemic Vascular Resistence, diminished or increased);

In Table 3, the data were grouped according to the association of pressures obtained by CAP, MAP and LAP with medical diagnosis, by verifying how many nurses manage to perform such association. The nurse was supposed to perform an evaluation exercise, associating the hemodynamic parameters shown by the patients with their clinical framework, and thus find evidence of the research in the practical explanations. This association is important because it instigates curiosity and criticism, stimulating the search for scientifical evidences. The more intense spontaneous curiosity is, the more it becomes more epistemological and strict[13].

It is seen in Table 3 that the nurses had difficulties in associating the pressures with the medical diagnosis. Only 02 (40%) managed to identify the septic shock with the pressures obtained, and 01 (20%) identified the hypovolemic shock, pulmonary thromboembolism and right ventricle insufficiency. Neither left ventricule insufficiency nor ARDS (two important indicators for the PAC use) was identified by the nurses. It can also be observed that the items with a higher number of correct responses coincide with the most common clinical situations experienced by the ICU participants of this study.

On the other hand, when the participants were asked whether PAC contributes to the patient hemodynamic evaluation and aids the nursing assistance evaluation, all of them agreed that the catheter is a useful instrument for the clinical patient evaluation and that it aids the treatment and nursing assistance. The fact that the participants were not able to justify their responses may be related to the difficulties that they endure when performing a correct data analysis from the catheter.

Table 3 – Morphology of the Pressure Curves– Florianópolis – 2004

Variable	Description	Absolute Frequency	Relative Frequency
Pressure Curves Morphology	Right atrium	2	40%
	Right Ventricle Curve	5	100%
	PAP Curve (Pulmonary Artery Pressure)	4	80%
	PCP Curve (Pulmonary Capillary Pressure)	2	40%

When the participants were tested about their understanding of the different morphology curves of CAP hemodynamic monitoring, all (100%) the nurses in the study were able to identify the right ventricle curve (RV) on the monitor during the PAC application, and that only one (20%) did not identify the curve corresponding to the pulmonary arterial pressure (PAP).

On the other hand, the curves that represented RAP and PCP were identified by 40% of the study participants. The analysis of these data show that even the correct catheter positioning in the pulmonary capillar, and thus, the LV final diastolic pressure, the objective of PAC (evaluating the LV function) was difficult to be interpreted identified by thee nurses. Hence, it is important to consider that, besides little

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información in the area and the lack of knowledge of pressure curve morphology, the PCP curve may often be confused with the right atrium curve.

As a result, it should be noted that this study is important because it helps nurses to interpret the pressures and curve morphologies, and the patients' clinical framework, not only data of the practical reality that are fragmented and dissociated. The pressure curve morphology determines the right PAC positioning and, therefore, reflects the patients' hemodynamic pressures[1].

Invasive and non-invasive hemodynamic parameters

This study was concerned about the invasive and non-invasive hemodynamic parameters that the study participants believed to be important to evaluate the patients' responses regarding nursing assistance, according to Table 4:

Table 4 – Invasive and non-invasive hemodynamic parameters important to evaluate the patients' responses regarding care – Florianópolis – 2004

Variable	Descrição	Relative frequency	Absolute frequency
Hemodynamic Parameters	PCP	5	100%
	Gasometry	5	100%
	PAP	5	100%
	ABP	5	100%
	RAP	5	100%
	Hemogram	1	20%
	Hemoglobin	1	20%
	Vital Sign	1	20%

These data show the study participants' appropriate understanding of the invasive hemodynamic parameters (PCP, PAP, ABP, RAP and gasometric parameters) pointing out non-invasive parameters such as arterial gasometry, hemogram, hemoglobin, vital signs, in order to evaluate the nursing care that the patients received and their respective diagnosis.

Despite the importance of recognizing the format of pressure curves, they are directly related to the use of an appropriate measurement technique and there are findings showing that nurses may also show deficits, both in measurement techniques and wave format analysis[14].

Collective Process of Protocol Creation

The assistance and healthcare protocols are an attempt to systematize and standardize the nursing practice while a part of the current knowledge and reseach. The impact of the protocols on health practice has been systematically evaluated, and the researchers believe that they are able to be effective in the process of changes in practice, as well as in the improvement of the results with the patients. Thus, these protocols help synthetize information within a concise structure and promote the translation of knowledge into better practice[5-6].

In this category, the participants' opinion was surveyed regarding PAC contribution to improve assistance quality, according to the following data:

Table 5 – Contribution of Nursing Protocol to assist PAC patients – Florianópolis – 2004

Variable	Description	Relative frequency	Absolute frequency
Contribution of protocol to care nursing	Organization	4	80%
	In the patient evaluation processs	4	80%
	Control of the patients' clinical evolution	4	80%
	Assistance Systematization	3	60%
	Nurse Confidence when making decisons	3	60%

Most nurses (80%) believe that a nursing assistance protocol would be useful when it comes to organization. It facilitates the understanding of data obtained by the catheter, for a more precise patient evaluation and evolution control. The items about assistance systematization and nurse confidence when making decisions were also pointed out in 60% of the participants' opinions[15].

In the second step of the study, in conjunction with the nurses, a nursing care protocol with PAC hemodynamic monitoring was built. The protocol was established from a set of problems in patients with hemodynamic alterations according to specific clinical situations. With the identified clinical parameters and the associated scientifical reasoning, there was also guidance related to the phase of nursing care, which are specific and necessary for each clinical situation.

It is important to point out that when the nurses interpret the healthcare protocol, they should consider the type of monitoring being performed, including invasive and non-invasive parameters. The care procedures listed here are

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related to specific aspects of the clinical situation and they should be amplified according to the patients' situation complexity.

1. For patients who show the following situations: RAP↓; LAP↓; ABP↓; CI↓; PCP↓ or normal or nRAP; LAP↓; ABP↓; CI↓; PCP↓ or normal; blood or fuid loss: >750ml with CF: < or > 100 bpm; with normal or diminished AP. Pulse pressure: normal or lowered. Respiratory frequency: > 20 mpm; and urinary volume: <0.5 ml/kg/h. These parameters indicate that the patient is hypovolemic. The nursing care, in turn, should be directed to the detection and prevention of blood and fluid loss; strict physical exam; hydroelectrolitic balance; serial pressure evaluations; and special attention to PCP, which should not be inferior to 12mmHg; PAC calibration and continuous leveling and evaluation of the level of consciousness[1,2,9,15].

2. Patients showing the following situation: nRAP; nLAP; ABP↑; nPCP or ↑; with CF > 100bpm; nCO or ↑ and normal urinary output or ↓ normally have a clinical evaluation of systemic arterial hypertension. In this case, the healthcare procedures are focused on SV evaluation and ABP installation; anti-hypertensive administration and attention to hypertension signs; hydric balance and infusion control; pressure evaluation according to the patients' position; perfusion and peripheral saturation; head position on the bed > or = 30°; PAC calibration and continuous leveling and conscience level evaluation. 3. For patients who show the following situation: RAP↑; nPCP; nPAP; nLAP; nABP; dyspnea; local or diffuse pulmonary stertors; ↑CO; mechanical ventilation dependence; respiratory acidosis; normal or lowered urinary output makes the health team consider a condition of pulmonary hypertension, with attention to the evolution of the acute respiratory distress syndrome (ARDS) The healthcare procedures should be focused on respiratory and cardiovascular evaluation; VS and O_2 saturation; hydric balance; satisfactory oxygen maintainance; prescribed diuretics; head position on the bed > or = 30°; calibration and PAC continuous leveling and consciousness level evaluation; attention to the RAP analysis.

4. Patients who present RAP↑,↓ or n; PCP↑; LAP↑; MAP↓; nABP or ↓; DC↑; IC↑; ventricular arrhythmia; me-chanical ventilation dependence; urinary output↓; decreased perfusion signals; cyanosis of the extremities, cold skin, sudoresis, localized or diffuse pulmonary stertors, normally lead to a clinical nursing evaluation of left ventricular insufficiency. In this case, the healthcare procedures should be focused on: VS and other hemodynamic parameters; oxygenotherapy, effort reduction; hydric balance; ECG monitoring; detection of signals and symptoms of pulmonary congestion; cardiac evaluation; CO evaluation; PAC calibration and continous leveling and consciousness level evaluation; laboratorial, radiological and gasometrical exam evaluation[1-2,9,15].

The **third step** of the study aimed at evaluating the protocol developed, including group meetings with the nurses. They noted that the protocol relied on literature, that is, its main benefits are facilitation towards better health results, given that it promotes the practice of the healthcare professionals; valuable educational resources for healthcare professionals[6], given that it subsidizes decision-making regarding PAC patient care.

CONCLUDING REMARKS

The study demonstrated that the nursing care of PAC patients requires strict scientific bases, associated with invasive or non-invasive parameters. The parameters used by the nurse when evaluating the clinical patient subjected to PAC hemodynamic monitoring should include interpretation of the following pressures: RAP, PAP, PCP, CO and CI. However, the study has demonstrated that the nurses also use non-invasive parameters for the hemodynamic evaluation.

The developed protocol supports decision-making and guides nursing healthcare associated with the main hemodynamic parameters of the PAC patient. It is imperative for further studies to be developed in the hemodynamic monitoring area and that they can contribute to proper decision-making regarding the care for hemodynamically unstable patients.

It is also important to note the need to better prepare nurses to look after patients with this device so as to develop more associative, evidence-based healthcare.

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