



Ineffective breathing pattern in cardiac postoperative patients: Diagnostic accuracy study^{☆,☆☆}



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ABSTRACT

Purpose: The aim of this study was to analyze the accuracy of the defining characteristics of ineffective breathing pattern (IBP) in postoperative cardiac patients.

Methods: A diagnostic accuracy study was performed with 98 patients. Measures of sensitivity, specificity, predictive values, likelihood ratios, diagnostic odds ratio, and area under the ROC curve were calculated.

Results: IBP was present in 23.5% of the patients. Alterations in depth of breathing (sensitivity 96%, negative likelihood ratio 0.11%) and pursed-lip breathing (sensitivity 99%, negative likelihood ratio 0.07%) were the most sensitive defining characteristics for IBP, while altered chest excursion (specificity 97%, positive likelihood ratio 11.41%) and prolonged expiration phase (specificity 99%, positive likelihood ratio 42.39%) were the most specific.

Conclusion: Some clinical indicators were more related to the presence or absence of IBP than others. Knowledge of such measures can help nurses to assess patients more accurately.

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1. Introduction

The identification of human responses to health problems or events from the life cycle, also known as nursing diagnoses, is the basis for nurses' decisions (Herdman & Kamitsuru, 2014). To define appropriate interventions and monitor the effects of these, it is necessary to establish an accurate representation of the phenomenon of interest. Thus, it is known that the identification of the real health state of the patient contributes to a more efficient care plan (Sousa et al., 2013).

Postoperative respiratory events are expected for almost all cardiac surgical patients. This kind of dysfunction is usually well tolerated when the patient has an adequate pulmonary reserve, but for patients with a history of respiratory disease, postoperative pneumonia, or

cardiogenic pulmonary edema, the respiratory function can be impaired severely. Postoperative respiratory events are caused by multiple factors including: general anesthesia, use of central respiratory depressants, sternotomy, use of drainage tubes, cardiopulmonary bypass, blood-derivative transfusion, diaphragm dysfunction, chronic obstructive pulmonary disease, and obesity (Stephens, Shah, & Whitman, 2013).

Postoperative respiratory problems can be early detected based on consistent defining characteristics. Some of these problems represent nursing diagnoses like ineffective breathing pattern (IBP), for which specific actions should be taken. IBP was introduced in the NANDA-I taxonomy in 1980, and passed through three revisions, being the last one dated in 2010. IBP describes a condition in which the inspiration and/or the expiration do not provide adequate ventilation (Herdman & Kamitsuru, 2014), and it has been investigated in a number of studies (Beltrao, Silva, Araujo, & Oliveira Lopes, 2011; Pascoal et al., 2014; Zeitoun, Barros, Michel, & Bettencourt, 2007). However, there is a lack of studies focusing on the defining characteristics of IBP in cardiac surgery adult patients.

The diagnostic reasoning involves several cognitive tasks that result in the establishment of a diagnostic hypothesis. Usually, a single clinical datum is not sufficient to establish a diagnosis with certainty (Lopes, Silva, & Araujo, 2012). Thus, the knowledge about the accuracy of

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Table 1
Operational definitions for the defining characteristics of ineffective breathing pattern.

Defining characteristics	Operational definitions
Alterations in depth of breathing	Increased or decreased thoracic expansion or abnormal retraction of the rib cage during breathing cycles. Alterations in depth of breathing can be evaluated by inspection of the thoracic expansibility and by diaphragmatic expansibility measurements.
Altered chest excursion	Asymmetry of the movements of the thoracic cage. Altered chest excursion can be evaluated by inspecting the chest movements with breathing for symmetry.
Bradypnea	Number of breathes (inhales and exhales) per unit of time that is lower than 12 breaths per minute. Bradypnea can be evaluated by inspection.
Dyspnea	Labored or difficult breathing. Dyspnea can be evaluated by patients' report of "shortness of breath" or that they "can't get enough air".
Increased anterior–posterior diameter	Anteroposterior diameter that is greater than the latero-lateral diameter. Increased anterior–posterior diameter can be evaluated by measuring the chest diameters and by verifying a relationship between anteroposterior and transverse diameter greater than 1:2.
Orthopnea	Appearance of worsening of dyspnea while in horizontal position. Orthopnea can be evaluated by inspection or asking about the position adopted by the patient.
Prolonged expiration phase	A ratio between the inspiratory and expiratory time that is greater than 1:2. Prolonged expiration phase can be evaluated by inspection.
Pursed-lip breathing	A respiratory pattern characterized by breathing in through the nose and out by means of pursed lips. Pursed-lip breathing can be evaluated by inspection and require the examiner to ask if the patient was taught to breathe using pursed-lips breathing.
Tachypnea	Number of breathes (inhales and exhales) per unit of time that exceeds 20 breaths per minute. Tachypnea can be evaluated by inspection.
Use of accessory muscles to breathe	Contraction of the trapezius, sternocleidomastoid, internal intercostal, scalene, pectoralis major, or abdominal muscles during with breathing. Use of accessory muscles to breathe can be evaluated by inspection.

defining characteristics is important, as it increases the nurses' ability to discriminate between patients with and without a specific nursing diagnosis. This study aimed to analyze the accuracy of the defining characteristics of IBP in cardiac surgery adult patients.

2. Materials and methods

2.1. Design and setting

An accuracy study was carried out in the heart surgery ICU of a 349-bed referral hospital in a large city located in north-eastern Brazil. This unit is exclusive for adult patients in the post-operative period and most patients remain in the unit for 48 hours or more after surgery. At this hospital, the documentation of nursing diagnoses is paper-based and consists in a checklist of potential nursing diagnoses.

To ensure a more precise identification of IBP, the list of nursing diagnoses inferred by the nurses in this ICU was not used. The method used to identify IBP in this study was based in conceptual and operational definitions, as described further in the [Data collection](#) section.

2.2. Sample

Consecutive sampling was adopted in this study. Sample size was calculated using the formula for single test accuracy studies ([Zhou, Obuchowski, & McClish, 2002](#)) with a confidence level of 95% desired width of one half of 95%, confidence interval of 10%, and a conjectured sensitivity of 85%, leading to a total of 98 patients. Patients aged 18 years and older, who were in the period between 24 and 48 hours following cardiac surgery, and who had a level of consciousness that would enable data collection were included.

For safety reasons, exclusion criteria for this study included mechanical ventilation, heart transplantation, and end-stage comorbidities. Ethical approval for the study was granted by the appropriate local research ethics committee and all participants signed an informed consent form.

2.3. Data collection

Data collection was carried out by two nurse researchers who individually assessed the patients and reviewed their medical records for complementary information, when necessary. A third researcher was responsible for observing and supervising the data collection, and for making the diagnostic inferences. This third researcher was chosen

as an expert for having a high level experience with respiratory diagnoses from the NANDA-I taxonomy gained during 10 years participation in a research project on nursing diagnoses, interventions and outcomes, and for authoring several publications focusing on respiratory nursing diagnoses.

A data collection instrument was created for use in this study and comprised three sections: respiratory symptoms and measures of pulmonary function, a guide for the respiratory assessment of the patients, and a list of operational definitions for each defining characteristic of IBP, as listed in the NANDA-I taxonomy 2012–2014 (the current version at the time data collection was carried out). Presently, the NANDA-I taxonomy 2015–2017 is the current version. However, there are no differences regarding the 2012–2014 and 2015–2017 versions of the NANDA-I taxonomy in regard to the defining characteristics of IBP. Operational definitions were extracted from the literature ([Seidel et al., 2011](#); [Swartz, 2010](#)) and can be seen in [Table 1](#).

The respiratory assessment did not include a spirometry test, because the clinical condition of the patients was not compatible with it. Thus, the following defining characteristics that are suggested by NANDA-I for the assessment of IBP were not assessed in this study: decreased expiratory pressure, decreased inspiratory pressure, decreased minute ventilation, and decreased vital capacity. The defining characteristic "nasal flaring" that is also present in the NANDA-I taxonomy was not assessed for being seen mostly in infants and younger children ([Seidel et al., 2011](#)). The defining characteristic "use of three-point position" was not assessed because, at this hospital unit, the patients are recommended to be laid down on bed during the entire postoperative period, except during procedures and physical therapy.

2.4. Data analysis

All analyses were performed using the R software version 3.0.2 ([R Core Team, 2014](#)). After the inferential process, measures of statistical accuracy were calculated for each defining characteristic. In this study, sensitivity (Se) can be understood as the probability of correctly identifying the presence of a defining characteristic in patients with IBP. Specificity (Sp) represents the opposite, i.e. the probability of correctly identifying the absence of a defining characteristic in patients without IBP. The positive predictive value (PV+) represents the probability of having IBP in patients with a defining characteristic, while the negative predictive value (PV−) represents the probability of the

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