Physiotherapy in the prevention of pneumonia associated with invasive mechanical ventilation: experience report

Fisioterapia na prevenção de pneumonia associada à ventilação mecânica invasiva: relato de experiência

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RESUMO

Pergunta de Pesquisa. Qual a experiência da atuação fisioterapêutica na prevenção de pneumonia associada à Ventilação Mecânica Invasiva (VMI)? Objetivo. Descrever o processo de desenvolvimento da pneumonia associada à ventilação invasiva (PAV); descrever os tipos de terapia de suporte respiratório mecânico e os riscos advindos dessa terapia, associado á incidência da infecção pulmonar no paciente submetido ao suporte ventilatório; e pontuar os principais recursos que tem sido utilizado na fisioterapia respiratória para tratamento, e para melhorar a qualidade de vida nos pacientes acometidos. Hipótese. A hipótese desde estudo é que a atuação da fisioterapia, quando utilizadas precocemente, auxiliam de forma significativa na qualidade a prevenção da PAV, diminui danos associados à ventilação mecânica e tempo de internação na Unidade de Terapia Intensiva – UTI. Tipo de estudo. Relato de Experiência. Local. O estudo foi realizado no Hospital Boa Viagem - CEMUB, na Unidade de Terapia Intensiva - UTI, Leito 05. Amostra. Equipe de fisioterapia com atuação em paciente internado em unidade de terapia intensiva do dia submetida ao suporte de ventilação mecânica por mais de 48 horas. Método estatístico. Análise descritiva, de relato de experiência, associada com revisão das publicações recentes a respeito do tema proposto, realizando confrontamento de autores e exposição de um caso realizando as considerações específicas. Análise estatística: Utilizar-se á estatística descritiva. Procedimento: Foi realizado um relato da experiência da atuação do profissional fisioterapeuta que prestou assistência a um paciente portadora de Pancreatite aguda, Pós Operatório Imediato (POI), colangiopancreatografia retrôgrada endoscópica (CPRE), obstrução de vias biliares,
Research question. What is the importance of Physiotherapy in preventing pneumonia associated with Invasive Mechanical Ventilation (IMV)? Purpose. Identify the process of pneumonia associated with invasive ventilation, expose the pathological process of pneumonia; describe the types of mechanical respiratory support therapy and the risks arising from this therapy, associated with the incidence of pulmonary infection in the patient undergoing ventilatory support; and point out the main resources that have been used in respiratory physiotherapy for treatment, and to improve the quality of life in affected patients. Hypothesis. The hypothesis since this study is that the techniques used by respiratory physiotherapy when used early help significantly in the quality of the treatment, reduce damages associated with mechanical ventilation and length of stay in the Intensive Care Unit - ICU.. Type of study. Prospective, field, explanatory, descriptive, observational longitudinal, using the quantitative method. Location. The study was carried out at Hospital Boa Viagem - CEMUB, in the Intensive Care Unit - ICU, Bed 05. Sample. Male patient admitted to the intensive care unit of the day submitted to mechanical ventilation support for more than 48 hours. Inclusion criteria: Male, aged 57 years, submitted to mechanical assistance for more than 48 hours. Exclusion criteria: Individuals who are not on mechanical ventilation. Variables. Primary: Pneumonia associated with mechanical ventilation - VAP. Secondary: Gender, Age, diagnosis, associated pathology, duration of mechanical ventilation. Statistical method. The study was based on a review of remote and recent publications on the proposed theme, confronting authors and exposing a case with specific considerations. Statistical analysis: Descriptive statistics will be used. Procedure: A report was made of the experience of the physiotherapist who assisted a patient with acute pancreatitis, immediate postoperative period (POI), endoscopic retrograde cholangiopancreatography (ERCP), bile duct obstruction, sepsis, Implicit Relational Assessment Procedure (IRAP), systemic arterial hypertension (SAH). Data were collected through medical record analysis, organized with enumerated scripts, containing: anamnesis, monitoring of vital signs - SSVV, Diagnostic Hypothesis - HD, Vasoactive Drugs - DVA, sedations, Antibiotic Therapy, Water Balance - BH, Radiology, laboratory exams and arterial blood gas analysis. Data contained in the two physiotherapy evolutions, the hospital's own model: breathing pattern, chest extensibility, pulmonary auscultation, quantity and aspect of the accumulation of secretions in the airways and artificial airways, mechanical ventilation:
ventilatory mode, inspiratory time, respiratory rate, fraction inspired oxygen, sensitivity, maximum inspiratory pressure, positive pressure at the end of expiration and tidal volume. Number of endotracheal tubes and date of intubation, respiratory physiotherapy techniques used. Study Period: collection of information carried out from February 2020 to May 2020. Bibliographic references from 2001 to 2020.

**Keywords:** Pneumonia, Invasive ventilation, Therapy with ventilatory support, Intensive care unit, Physiotherapy.

### 1 INTRODUCTION

Pulmonary complications in patients undergoing mechanical ventilation (MV) are highlighted as a significant cause of morbidity and mortality. The frequency with which this has happened and clinical impact of these complications are worrisome factors in large hospital centers, whose most frequent related infections in ICUs are pneumonia associated with mechanical ventilation (VAP), also including respiratory tract insufficiency (ITR), bronchospasms, atelectasis, and hypoxemia, thus prolonging the time in ventilatory care, which results in an increase in days of hospital stay. \(^1,^2\)

Pneumonia is acute respiratory infection of the lower airways, which usually compromises the pulmonary parenchyma, alveolos, bronchiolos and pulmonary interstitium. \(^3\) It has been constituting great public health care leading the Brazilian Society of Pneumonia and Tisiology (2007) to classify it in two ways, the first as hospital-acquired pneumonia (PAH), which occurs 48 hours after hospital admission, occurring in wards, and there is no need for orotracheal intubation. Its classification takes place from admission to its emergence. And the second is ventilator-associated pneumonia (VAP), occurs with 48 - 72 hours after endotracheal intubation and the patient is instituted to IMV.

The practices of physical therapists can significantly reduce the incidence of complications associated with health interventions, such as infections that are associated with the orotracheal tube used for mechanical ventilation. Therefore, physical therapists should systematically plan and organize interventions and stimulate practices based on scientific knowledge, in order to promote qualifications of physical therapy care, aiming to prevent or reduce the risks of such complications, as they contribute to increased morbidity, length of stay in the hospital bed, late recovery, high hospital costs and mortality of patients in intensive care units \(^4\).
In these cases, knowledge of the care to be provided to patients intubated with orotracheal tube is essential for the prevention of ventilator-associated pneumonia (VAP), since this condition is facilitated by bacterial colonization caused by aspiration of contaminated secretions. Other complications that can be generated by the orotracheal tube are laryngeal and tracheal lesions caused by friction and ulceration due to excessive inflation and premature accidental extubation, which can be caused by patient agitation, anxiety depression, leading to reintubation and, therefore, prolonged exposure to orotracheal intubation (5).

VAP is a process characterized by pulmonary parenchyma infection that occurs due to a recurrent complication in patients undergoing this ventilatory assistance. The mortality rate in patients with hospital pneumonia in ICU’s acquires worrisome data, as shown in studies, affecting about 32% in patients not submitted to mechanical ventilators and 46% in patients under MV (6,7,8).

Advanced age, comorbidities, impaired renal and hepatic functions, lower levels of consciousness, use of polypharmacy, inadequate administration of medications, invasive procedures and long hospitalizations are risk factors associated with the occurrence of adverse events, defined as an incident that causes damage or injury to the patient attributed to care. These events compromise the quality of care and can lead to death, disability, loss of confidence and dissatisfaction with the service, being important factors to be considered in VAP (9).

Several factors may promote pulmonary complications in patients. Anesthesia can lead to reduced functional residual capacity, hypoxemia, and central respiratory impairment, while surgical manipulation can restrict ventilation, damage respiratory muscles, and cause atelectasis. When combined with pre-existing airway diseases and postoperative pain, the risk of pneumonia, respiratory failure and death is increased. The main goal of mechanical ventilation is to improve arterial oxygenation. This improvement is achieved through endotracheal intubation to ensure the supply of oxygen to the airways and through an increase in airway pressure. Satisfactory oxygenation is easily achieved in most patients with airway obstruction. The main challenge increases in patients with alveolar filling disorders. The ventilator is associated with a number of complications, which increase morbidity and mortality that include: mucus clogging, for example (atelectasis, occlusion of the endotracheal tube), VAP and nosocomial infection, barotrauma, for example (pneumothorax, subcutaneous emphysema) and hypotension (10).
The maintenance time of IMV, through tracheal intubation or tracheostomy, the period of contact with the equipment and maintenance, inadequate care, is what provides the complications resulting from the use of ventilatory support therapy and infections. The use of ventilatory support such as IMV and noninvasive mechanical ventilation (NIV) is considered a major advance in the treatment of respiratory failure, but if ventilatory support is not used safely, it can sanction MV-related injuries, ventilatory supports in the ICU, resulting in increased expenses to the health system.\(^{(5,7,8)}\)

Patients have different characteristics that hinder the clearance of pulmonary secretion, such as inadequate humidification, high oxygen fractions, use of sedatives or analgesics, basal lung disease, and the presence of an artificial airway that mechanically suspends the elimination of secretion near the trachea. Secretion retention results in episodes of hypoxemia, atelectasis, and VAP. Bronchial hygiene is believed to improve respiratory system compliance by increasing dynamic compliance and static compliance. There are many techniques used as interventions to liquefi, mobilize and clean airway secretions for patients with excessive secretions and cough. These techniques include thoracic percussion, chest vibration, postural drainage techniques, and the use of devices used independently or in combination to help mobilize secretions. In addition, the use of bronchodilators prior to the implementation of these techniques can facilitate airway clearance and improve ventilation\(^{(11)}\).

Pneumofunctional physiotherapy has been growing considerably in the fields of performance mainly in relation to ICUs, with multiprofessional actions resulting in lower morbidity rates, the physiotherapist, as a member of the team, provides better respiratory and functional conditions to the patient, and may contribute to the length of stay in the ICU.\(^{(12)}\)

An adequate treatment of prevention and combating VAP requires the formation of care protocols that cover the entire health team, regarding hygienic care, adequate clinical follow-up and physical therapy as soon as possible. The measures used for effective physical therapy should be based on assisting in the condition of MV, preparation and adjustment of the device, monitoring of clinical conditions, bronchial aspiration and hygiene, and action on early and adequate weaning.\(^{(10,11)}\)

Considering the importance of detailing and further deepening studies on the best therapeutic treatment, the following problem becomes relevant: What is the importance of Physiotherapy in the prevention of pneumonia associated with Invasive Mechanical Ventilation (IMV)?
1.1 HYPOTHESIS

The hypothesis since study is that physical therapy assistance, when used early, helps significantly in the prevention of VAP.

1.2 GOAL

Describe experience report of the physiotherapy team and the main resources used for prevention and treatment in patients affected by VAP.

2 METHODOLOGICAL PROCEDURE

1.2.1 Type of study

Experience report, observational and descriptive.

1.2.2 Local

The study was carried out at Hospital Boa Viagem - CEMUB, with address at Rua Ana Camelo da Silva, 315, Bairro de Boa Viagem, in the municipality of Recife, State of Pernambuco, ZIP Code 51.111-040

1.2.3 Sample

Performance of the physiotherapist in a patient hospitalized in intensive care unit of the day submitted to mechanical ventilation support for more than 48 hours.


Search Source: search in books, articles and periodicals. Electronic search on the CAPES and Bireme portal, in the following databases: PUBMED (Publications Medicine), LILACS (LatinAmerican and Caribbean Literature inHealth Sciences), SCIELO (ScientificElectronic Library), Scirus (Scirus-Scientific Information), BDDT (digital library of dissertations and theses), Redalyc (Network of Scientific Journals of Latin America and the Caribbean). For the references, the Vancouver standards were used.

1.2.4 Variables

A standardized data collection form was used to collect the primary and secondary variables.

1.2.4.1 Primary variable

Ventilator-associated pneumonia - VAP.
1.2.4.2 Secondary variables

Genera, Age, diagnosis, associated pathology, time of mechanical ventilation.

1.2.5 Confidentiality protection measures

The confidentiality of the research subjects was maintained, at no time or by any means will there be the possibility of public disclosure of the results that allows identifying the data of the subject of the research.

3.2 EXPERIENCE REPORT

Epidemiological identification of the research subject

The physiotherapy team assisted a 57-year-old male patient who was admitted to the sector on July 3, 2020.

Identification of the location where the research subject is located

The team operates at Hospital Boa Viagem - CEMUB, with address at Rua Ana Camelo da Silva, 315, Bairro de Boa Viagem, in the municipality of Recife, State of Pernambuco, ZIP Code 51.111-040

Description of the clinical history of the research subject

According to the physiotherapy team's report and the patient's historical record, he was in the Hospital de Caruaru, with no initial date of hospitalization for the hemodialysis clinic, in RE - CNO2 (3lpm) - (Spontaneous Breathing - Nasal Oxygen Catheter), when he evolved with productive cough, fever, prostration and hypoxemia. He was transferred to the São Sebastião Hospital on 01/07, followed by observation of the clinical picture, evolving with AI (Acute Respiratory Failure), and it was necessary to perform IOT (orotracheal intubation), tube number 8.0, on 03/07 at 5:00.

The team reported that the patient was transferred to the Alfa Hospital (HRBV - Hospital Referência Boa Viagem) on 03/07 at 14:38, arriving in Severe EG, with TOT (orotracheal tube), AVM (mechanical ventilatory assistance). It arrives stable in use of VAD, seeded, well adapted to AVM, in PCV mode (Ventilatory Controlled Pressure). Without edemas in extremities, hypocorated, presents febrile episodes. SSVV: HR: 70 PA: 128x88 SpO2: 97% (SSVV: vital signs / HR: heart rate / BP: Blood pressure / SpO2: saturation of oxygen in the blood). Level of consciousness: RASS = -4 with sedation (propofol: 30ml/h + Fentanyl: 10ml/h + Midazolam: 10ml/h) using VAD

The medical team requested that CULTURES be made: HEMOC 07/07: Sthaphylo Coagulase Negative - Sensitive Linezolid And Teic HEMOS 07/07: Enterocococcus MR with growth time 2 days – sensitive gentamicin, linezolid and streptomycin, resistant to Vanco. + Micrococcus: catheter tip: negative after 11 hours. And administration of ANTIBIOTICS: TAZOCIN (DI: 03/07 - DT: 12/07) DEXAMETASONE: (DI: 03/07 - DT: 12/07) - 10/07 - wheeled antibiotic (Meronem + Vancomycin) - patient presenting catheter secretion, febrile peaks, punctured new dialysis catheter day 14/07 19/07 – meronem + amicacin + metronidazole (TD: 21/07).

**Observation and description of evolution**

**Day 04/07** - 2 hemoconcentrates of Red Blood Blood Were Transfused. Tests were performed: **Urea**- 160, Creatinine- 9.1, Potassium- 4.9, Sodium- 137, Hemoglobin: 5.9, Gasometri Arterial: PH: 7.26; PCO2: 31.5; PO2: 83.8; BIC: 14; LACT: <1; SO2: 97.2; W/W: 399.3, X-ray: with bilateral infiltrate, ECG = No alterations, sinus rhythm, Pulmonary auscultation: MV(+) in HtA with Diffuse Snoring, Water balance= -356ML and Secretion in large hematic quantity. Level of consciousness: RASS = -5 *with sedation (propofol: 30ml/h + Fentanyl: 10ml/h + Midazolam: 10ml/h).

Daily awakening was performed, but the patient did not wake up until the end of the shift, returns sedation on the night shift by asynchrony on the ventilator, and adjustments to the parameters were necessary, leaving higher. It starts fentanyl sedation 5ml/h and precededex 10ml/h using VAD (norepinephrine: 5ml/h) – performing weaning. Diet by SNE (nasoenteral probe). Hemodialysis- total loss 2.4L antibiotic: tazocin and dhimhasone. Patient presenting febrile peaks, along with nephrologist performed catheter change for dialysis, because it has no insertion date.

The physical therapy approach was: THB (bronchial hygiene therapy), RRT (nasal and oral) - (TrS- secretion removal therapy) pulmonary homogenization maneuver, Cuff pressure adjustment - 30cmH2O, Decubitus elevation, Parameter adjustment according to arterial blood gas analysis, Therapeutic bed positioning, passive kinesiotherapy, passive stretching, tibiotarsus pumping (Mountain Biking) and Joint mobilization(Ventilatory mode: PVC - Parameters: PInsp: 13cmH2O PEEP: 8 cmH2O FIO2: 30% VM: 7.64 VC: 278).
DAY 06/07 - Patient in improvement of the condition, follows with schedule of performing 1 more hemoconcentrate of red blood cells, performing hemodialysis, using VAD: (norepinephrine: 2.0ml/h sedation: (fentanyl: 5ml/h), performs daily awakening, pulmonary auscultation: MV(+) in AHT with diffuse snoring, water balance = 1,860ml, secretion in large amount hematic level of consciousness: RASS: -4. The physical therapy approach was: THB (bronchial hygiene therapy), RRT (nasal and oral) - (RRT- secretion removal therapy), pulmonary homogenization maneuver, Cuff pressure adjustment - 30cmH2O, Decubitus elevation - 45c, Adjustment of parameters according to arterial blood gas, weaning of AVM, Therapeutic positioning in bed, passive kinesiotherapy, passive stretching, tibiotarsus pumping (Mountain Biking) and Joint mobilization.

DAY 07/07 – without the use of VAD sedation: (fentanyl: 5ML/H), performs daily dispererration, pulmonary auscultation: MV(+) in AHT with diffuse snoring, water balance= 1,222ML, secretion in large hematic amount, level of consciousness: GLASGOW com scale (ECG): 10, without edema. Patient remains hemodynamically stable, conscious, interacts with therapist, being performed on RET (spontaneous breathing test), successfully extubation was performed, but extubation failure evolves due to loss of touches on hypopharynx floor and tongue drawdown, with new intubation required, sedation initiation (dormanid: 4ml/h and fentanyl: 4ml/h)

DAY 15/07 - without the use of VAD sedation:(precedex: 5ml/h) – performed dismantling, pulmonary auscultation: MV(+) in AHT with snoring water balance= + 899ml secretion in moderate amount of consciousness: ECG: 9 without edema, patient remains hemodynamically stable, waits for NC to evolve extubation.

DAY 17/07 - without the use of VAD and without the use of sedation, pulmonary auscultation: MV(+) in AHT with snoring, water balance= + 752ml, secretion in moderate quantity, level of consciousness: ECG: 9, without edema, patient follows hemodynamically stable, obeys commands, hypersecretory, performed TER, successfully, being performed extubation, (CNO2 93LPM), remains stable, with difficulty coughing, presents dysphonia – vocal cord dysfunction after IOT. The physical therapy approach after extubation was: RRT (nasal and oral) - (RRT- secretion removal therapy), Elevation of decubitus - 45c, Weaning from O2, forced expiration technique (TeF), Inspiratory muscle training (IMT), Therapeutic positioning in bed, active-assisted kinesiotherapy, passive stretching, pumping tibiotarsus (mountain biking), joint mobilization and Sedstation in the armchair.
DAY 23/07 - without the use of VAD and without the use of sedation, pulmonary auscultation: MV(+) in HtA with snoring, water balance= + 684 ml, secretion in moderate quantity, level of consciousness: ECG: 14. Patient vigil, disoriented, obeys the commands, alternating with psychomotor agitation, hemodynamically stable, secretory, requires aspiration frequently in VAS (upper airway), using oral atropine to dry oropharynx secretion.

DAY 28/07 - no use of VAD and no use of sedation, pulmonary auscultation: MV(+) in AHT without adventitious noises, secretion in a small amount, presents swallowing, level of consciousness: ECG: 15. Patient is discharged from the ICU, to ward, follows in RE/AA, without respiratory complaints, conscious and oriented, collaborative, diet orally, with good acceptance, discreetly dysphonic.

4 DISCUSSION

Ventilatory-associated pneumonia (VAP) is associated with increased duration of mechanical ventilation (MV), intensive care unit (ICU) and hospitalization, and increased hospital mortality rates. Patients with acquired brain injury (UTI), coma, with postsurgical problems are commonly admitted to the ICU, often aspirate at the time of injury or during intubation and, therefore, are particularly at risk for VAP.

Respiratory physiotherapy and early mobilization are suggested strategies to prevent and treat VAP. In a study with ICU specialists, 83% used respiratory physiotherapy to prevent VAP(17), and patients with VAP demonstrated to receive significantly more respiratory physiotherapy than those without VAP. These studies report the importance of oral hygiene to decrease oral colonization by pathogens, prevent and control infections, provide comfort and improve the integrity of the oral mucosa.

The main objectives of respiratory physiotherapy include promoting effective alveolar ventilation and adequate oxygenation, elimination of airway secretions, maintenance of chest wall mobility, and increased tolerance and mobility to exercise. Some important aspects are considered in the literature, which associated with respiratory physiotherapy may decrease cases of ventilatory-associated pneumonia (VAP), such as hygiene of the hands of professionals, bed inclination, oral health of the patient, methods of prevention of thrombosis, among others.

One study investigated whether respiratory diseases in physical therapy play a role in preventing VAP (18). In the study, 46 patients traumatized on MV by 24 found a significant reduction in the incidence of VAP, duration of MV, length of icu stay or
mortality associated with the addition of two times a day respiratory physiotherapy for routine nursing care, as well as related the importance of bed inclination to reduce respiratory problems. Therefore, the authors recognized that an accurate diagnosis of VAP is crucial, and advocated the importance of further studies using standard clinical criteria to diagnose VAP and implementation of a standardized respiratory physiotherapy regimen throughout the ICU stay.

In an additional study of 60 adults receiving MV for 48 hours hospitalized in a medical, surgical and trauma set in the ICU, these authors performed the addition of two times a day respiratory physiotherapy to routine nursing care, independently associated with a reduction in VAP, diagnosed by clinical criteria. In this study, there were significant differences in the duration of MV, length of ICU stay or mortality, and also highlighted the importance of procedures related to the reduction of deep vein thrombosis (DVT)\(^{(19)}\). In a study of 180 patients receiving MV for more than 48 h, it found a significant difference in the incidence of VAP, length of ICU stay or mortality receiving standardized physiotherapy\(^{(20)}\).

One study found that a regular regimen of respiratory physiotherapy, positioning and sucking repeated six times a day, when provided in addition to routine medical/nursing care, significantly reduced the incidence of VAP, MV time or ICU/hospitalization for adults. This same study highlights the importance of continuing education for the multidisciplinary health team\(^{(21)}\).

While Templeton and Palazzo study included in some patients, standardized physiotherapeutic interventions twice a day significantly reduced the incidence of VAP. Extra inpatient health support was also a crucial element for improving cases.

**Final considerations**

The interventions reported in the present study demonstrated the importance of physiotherapy in reducing pneumonia associated with mechanical ventilation, which impacts the number of deaths from this invasive procedure. The importance of working together with the multidisciplinary team in efforts to assist in this process was evidenced. ICU patients are likely to have broncho aspiration of secretions, especially those who form exposed to airway manipulation methods with invasive methods. A bed elevation of 30 to 40 if there is no contraindication, is a measure that prevents bronchoaspiration, decreasing cases of atelectasis and improving ventilatory volume. Another important
point evidenced is the hygiene of the oral mucosa, to reduce pathogenic microorganisms that can cause respiratory diseases.

Other methods of VAP prophylaxis were cuff pressure monitoring, daily suspension of "daily awakening" sedation, and weaning protocols. Another important aspect is the use of medications for the prevention of deep vein thrombosis (DVT), because it obstructs pulmonary arterial blood flow, which is extremely important for patients in the ICU context.

Based on the study, it was possible to realize the importance of training and continuing education with the multidisciplinary team to improve the theoretical and practical aspects. In the present study, the multidisciplinary team focused on the period prior to hospital discharge, elaborating available means to continue treatment at home, performing a search for the home care team, together with support from primary care, thus promoting care more integrated ly in the region.
REFERENCES


