



RESEARCH ARTICLE

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## EARLY MOBILIZATION VERSUS POSITIVE PRESSURE IN THE POSTOPERATIVE PERIOD OF ELECTIVE ABDOMINAL SURGERY: A RANDOMIZED CLINICAL TRIAL

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### ABSTRACT

Abdominal surgery causes pathophysiological transformations that can be characterized by recurrent episodes of post-surgical complications ranging from pulmonary complications to complications inherent to surgical incision. Pulmonary complications are the main causes of postoperative morbidity and mortality and can be minimized and/or avoided through physiotherapy. This study aims to verify whether there is superiority between early mobilizations versus positive pressure continues in the airways on clinical variables and pulmonary function in postoperative patients of elective abdominal surgery. The study is a subproject, quantitative, analytical, exploratory of the randomized clinical trial type. The study sample consists of 20 volunteer individuals who were subdivided into two groups, the patients were evaluated for maximum inspiratory strength, maximum expiratory and peripheral muscle strength, then underwent ambulation or positive pressure, and when discharged the patient was reevaluated. Early mobilization was superior to positive pressure since maximum inspiratory pressure had significant statistical differences only for in the ambulation group ( $p=0.007$ ), maximum expiratory pressure and peripheral muscle strength no static differences were found ( $p = 0.910$  and  $p = 0.853$ , respectively).

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## INTRODUCTION

Abdominal surgery, also called Laparotomy, consists of the surgical procedure of opening the abdominal cavity and may be exploratory or elective (NETO; SILVA, 2016). Exploratory laparotomy aims to investigate abdominal disease of unknown cause without previous study, different from elective abdominal surgery, which is performed an appropriate preoperative and a antecedent study of the patient (TEZA; KEMPISKI, 2011). The surgical procedure in the abdominal cavity causes pathophysiological transformations, which start from anesthesia that will decrease nerve conduction of the diaphragm's phrenic nerve to the postoperative period due to immobilism and pain in the surgical incision, thus favoring the onset of pulmonary complications. The incision of abdominal surgery may be high (superior to umbilical scar) or low (below the umbilical scar), the closer the incision is of the diaphragm the more pulmonary complications the patient may present (BOONE; ZANDONADI; KOPPE, 2018).

Post-surgical complications range from lung complications that is described as a lung abnormality that produces disease or identifiable dysfunction, affecting patient recovery, such as atelectasis, pneumonia, pneumothorax, pleural edema, pleural effusion and respiratory failure, as well as complications inherent to surgical incision such as infection, hemorrhage and venothrombotic events (FILARDO; FARESEN; FERNANDES; 2002). Postoperative pulmonary complications are the main causes of morbidity and mortality, with the length of hospital stay, medication use and increased hospital cost. Pulmonary complications usually present in the first 48 hours after the surgical procedure (BODEN, 2018). Initially it was believed that pain would have the greatest responsibility for this change in ventilatory mechanics restricting pulmonary expansion, but studies show that surgical manipulation of the viscera is that it causes an inhibition of the diaphragm that decreases and alters their movements causing a decrease in lung volumes and capacities and sputum of the individual (BOONE; ZANDONADI; KOPPE, 2018). Physiotherapy aims

to accelerate the recovery process of this patient as well as minimize and/or prevent these pulmonary complications from arising. Currently early mobilization (ambulation) is widely used as a technique in the postoperative period of surgeries due to activation of the diaphragm muscles as well as conventional oxygen therapy to reverse respiratory distress through oxygen supplementation (BODEN, 2018).

However conventional oxygen therapy cannot reverse the decrease in lung volumes caused by surgery, unlike CPAP, a resource that provides continued positive airway pressure that has shown to reverse reduced lung volumes anesthesia and surgery (LOCKESTONE, 2019). Although it is techniques commonly applied in respiratory physiotherapy there is a gap in the efficacy of certain postoperative physiotherapeutic interventions in patients undergoing abdominal surgeries, this is due to the lack of evidence to prove the effectiveness of some techniques used in this area. Thus, this work aims to compare and prove the benefits of two techniques that are often used in the hospital environment as prevention and treatment of respiratory complications in the postoperative period of abdominal surgeries. An active and low-cost technique, ambulation and another that uses a positive airway mechanical pressure device, CPAP.

## MATERIAS AND METODOS

This is a study with a cross-sectional, analytical-descriptive design of experimental, comparative, controlled type randomized clinical trial, used quantitative data analysis.

The work is a subproject of the original project: Respiratory interventions versus assisted ambulation in the postoperative period of thoraco-abdominal surgeries: a randomized clinical trial, having approval number of the opinion: 3,368,508 and caae: 14419319.0.0000.5578. This study was conducted in the outpatient unit of a private hospital where it serves private patients and the SUS - Unified Health System. It took 10 patients in each group to obtain a statistical power of 80% in detecting a difference of 10% between the outcomes of each group, with alpha of 5%, considering an estimated standard deviation of 0.5. The sample was probabilistic analyzed through the winpepi version 4.0 program, where its primary characteristic is to be able to be subjected to statistical treatment, which allows to compensate for sample errors and other aspects relevant to the representativeness and significance of the sample (MARCONI; LAKATOS, 2002). For the accomplishment of this study, the volunteer participants met the following criteria: age equal to or greater than 18 years, attended via the Unified Health System (SUS), conscious and lucid, with the ability to understand and perform the tests and maneuvers, which presented above 23 points in the Mini Mental Examination Scale, with capacity for conduct suggested in the protocol and candidates for nonlaparoscopic elective abdominal surgery.

Exclusion criteria were considered patients with chronic diseases, particularly cardiovascular, pulmonary, hepatic, kidney, endocrine, neurological aspects that prevent the performance of the intervention protocol, hemodynamic instability (Heart rate  $>60$  or  $<130$  / Systolic blood pressure  $>120$  or  $<140$  mmHg / Diastolic blood pressure  $>80$  or  $<90$  mmHg), elevated pain (Visual Analog Scale  $>7$ ). After the signing of the Free and Informed Consent Form and approval of the Ethics and Research Committee (CEP), information

regarding age, gender, clinical history and diagnosis of patients was obtained from the medical records. Information about the type and duration of the surgeries was obtained from the surgical records of each patient. First, a data questionnaire on patient characteristics was applied, verifying whether he already has any impairment or if he presents symptoms of respiratory system dysfunction. Blood pressure, oxygen saturation, heart rate, respiratory rate, temperature were measured at the beginning of the care: soon after, the pneumofunctional evaluation, evaluation of the musculoskeletal system and peripheral vascular evaluation were performed.

Then the EVA scale was applied to evaluate pain intensity, the Sedentary Lifestyle scale that aims to measure the relationship between weight and height and the MEEN, which aims to evaluate symptoms of dementia in individuals. The parameters for obtaining peripheral muscle strength were obtained through the Dynamometer (INSTRUTHERM DIGITAL MODEL) and respiratory muscle strength data were obtained through the manuvacuometer apparatus (MVD300-GLOBALMMED) that assesses strength respiratory muscle by measuring maximum Inspiratory Pressure (Pimax) and Maximum Expiratory Pressure (Pemax). All tests were performed in seedstation with the airway occluded by a nasal clip and with the maximum voluntary effort of the patient. To measure Pimax, the patient was asked for maximum inspiration until total lung capacity (TPC) followed by a forced expiration up to functional residual capacity (CRF). For the evaluation of The MaxB, forced expiration was requested until functional residual capacity followed by a maximum inspiration up to total lung capacity (TPC). Each must be performed three times with intervals of one minute, the highest value obtained will be considered the maximum capacity value of each muscle group. It was performed randomization through sweepstakes through brown and sealed envelopes in which it was decided which intervention the patient would perform: GD group of early mobilization or GCPAP group of positive pressure.

In the Early Mobilization group (DG) the interventions were performed through an ambulation protocol in which the patient took a walk with a minimum distance of 200 meters, whenever this distance was reached and the BORG - Modified was below 5 points, the patient was encouraged to walk for another 100 meters, this determination was repeated until the patient reached his maximum walking capacity. In the Positive Pressure group (GCPAP) the patient used the Resmed R5 CPAP using a nasal oro mask for 20 minutes, with ramp activation in 5 minutes with initial pressure of 8 cmH<sub>2</sub>O and peak pressure at 12 cmH<sub>2</sub>O. Patient positioned in seedstation in bed 12 hours after surgery. All outcome markers analyzed at admission form repeated at the time of hospital discharge of patients. The data collected in the field were tabulated and received descriptive treatment (frequency, mean and dispersion measurement) and analytical treatment with the help of the Statistical Package for the Social Sciences - SPSS 22.0 software (tests: paired t-student and independent; Pearson Chi-Square, nonparametric Mann Whitney U, all under reliability of 95%). The tables were and graphs plotted by Microsoft excel software.

## RESULTS

The sample consisted of 20 individuals divided equally between CPAP group and Ambulation Group presented close

mean age, BMI, height and weight for both groups, as can be seen in Table 1. For this reason, there was no statistically significant difference for these variables ( $p = 0.948$ ;  $p = 0.107$ ;  $p = 0.519$ ;  $p = 0.393$ , respectively). Regarding gender distribution, although only the CPAP group has males 3 (30.0%) this distribution has no statistically significant relationship ( $p = 0.105$ ). With regard to clinical variables, previous lung disease, diabetes mellitus and heart diseases are constant for the groups. And even if there are slightly different distributions for systemic arterial hypertension and smoking case between groups, there is no statistically significant difference ( $p = 0.5$  for both).

**Table 1. Clinical and sociodemographic profile of the sample. Vitória da Conquista**

Variables	Mean $\pm$ dp <sup>1</sup>		p <sup>*1</sup>
	Group CPAP	Group Ambulation	
Age, years	36,80 $\pm$ 11,83	39,00 $\pm$ 13,06	0,948
BMI	29,01 $\pm$ 4,45	26,68 $\pm$ 2,24	0,107
Height, m	1,63 $\pm$ 0,06	1,64 $\pm$ 0,08	0,519
Weight, Kg	76,40 $\pm$ 8,07	72,40 $\pm$ 10,58	0,393
Variables	Group CPAP	Group Ambulation	p <sup>*2</sup>
Sex, n (%)			
Female	7 (70,0)	10 (100,0)	0,105
Male	3 (30,0)	—	
Lug Disease prior, n (%)			
No	10 (100,0)	10 (100,0)	const <sup>3</sup>
SAH, n (%)			
No	9 (90,0)	8 (80,0)	0,5
Yes	1 (10,0)	2 (20,0)	
DM, n (%)			
No	10 (100,0)	10 (100,0)	const <sup>3</sup>
Cardiopath, n (%)			
No	10 (100,0)	10 (100,0)	const <sup>3</sup>
Smoker, n (%)			
No	9 (90,0)	10 (100,0)	0,5
Yes	1 (10,0)	—	

<sup>1</sup>Sample standard deviation; <sup>\*1</sup> Independent t-Student test; <sup>\*2</sup>Pearson chisquare test; <sup>3</sup> Constant variable; Source: Search data.

The surgical variables, outlined in Table 2, allow us to infer that although the CPAP group has 7 (70%) cases of hysterectomy against 3 (30%) cases of the Ambulation group. Furthermore, appendectomy in the CPAP group has a prevalence of 3 (30.0%), against 7 (70.0%), this difference was not significantly verified between the groups ( $p = 0.089$ ). Another surgical variable analyzed was the type of anesthesia during surgery, presenting constant distribution 10 (100%) of the spinal cord raque type for both groups.

**Table 2. Surgical characteristics of the sample. Vitória da Conquista - BA, 2019**

Variables	n (%)		p <sup>*</sup>
	Group CPAP	Group Ambulation	
Hype of surgery			
Hysterectomy	7 (70,0)	3 (30,0)	0,089
Appendectomy	3 (30,0)	7 (70,0)	
Hype of anesthesia			
Medullary Raque	10 (100,0)	10 (100,0)	const. <sup>1</sup>
General	—	—	

<sup>\*</sup>Pearson's quisquare test; <sup>1</sup> Constant variable. Source: Search data.

With the results expressed in Table 3, it was possible to observe that the means obtained from Pi max are lower for the analyzed groups and that the one in which there is the greatest difference between the predicted value and obtained from Pi max is CPAP, however, these differences were not verify statistically ( $p = 0.392$  CPAP group and  $p = 0.326$  Ambulation group). The analysis of Pe max, also contained in table 3, shows that the values obtained from Pe Max of the CPAP

group ( $38.80 \pm 22.71$ ) and the Ambulation group ( $39.67 \pm 16.15$ ) are well below the predicted value ( $107.59 \pm 24.65$  and  $92.83 \pm 8.88$ , respectively) and analogously to the behavior d Pi max, this comparison showed no statistically significant difference for both groups ( $p = 0.483$  and  $p = 0.559$ , respectively). Regarding dynamometry, for both groups the values are very close to the predicted, but only the CPAP group presents the statistically verified variation significantly ( $p = 0.007$ ).

**Table 3. Comparison between obtained and predicted. Vitória da Conquista - BA, 2019**

Variables	Mean $\pm$ dp <sup>1</sup>	
	Group CPAP	Group Ambulation
Pi máx. obtained	38,80 $\pm$ 22,51	45,84 $\pm$ 13,12
Pi máx. predicted	96,80 $\pm$ 64,95	56,31 $\pm$ 6,01
p <sup>*</sup>	0,392	0,326
Pe máx. obtained	38,80 $\pm$ 22,71	39,67 $\pm$ 16,15
Pe máx. predicted	107,59 $\pm$ 24,65	92,83 $\pm$ 8,88
p <sup>*</sup>	0,483	0,559
Dinamometria obtained	27,76 $\pm$ 10,71	22,28 $\pm$ 4,72
Dinamometria predicted	27,90 $\pm$ 8,29	23,20 $\pm$ 3,26
p <sup>*</sup>	0,007	0,807

<sup>1</sup> Sample standard deviation; <sup>\*1</sup> Paired t-student test; Source: Search data.

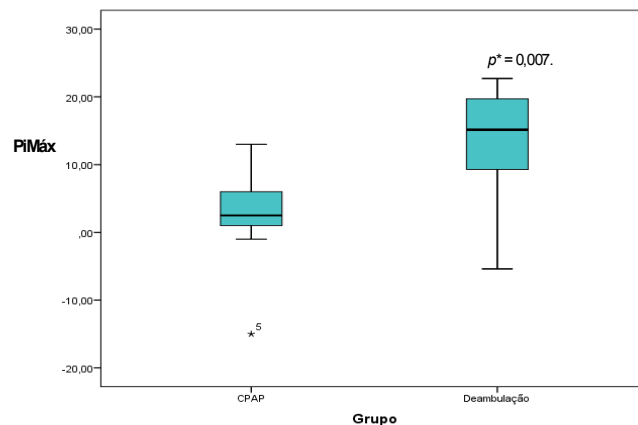
The reassessment of the expired variables showed a better result for the ambulation group, and was statistically verified significantly only for the max Pi of the Ambulation group, as shown in table 4. And although dynamometry presents a better result for the CPAP group, the variation has a significant correlation only for the Ambulation group.

**Table 4. Evaluation and reassessment. Vitória da Conquista - BA, 2019**

Variables	$\pm$ dp <sup>1</sup>	
	Group CPAP	Group Ambulation
Pi máx. pre	36,10 $\pm$ 19,11	32,68 $\pm$ 12,41
Pi máx. post	38,80 $\pm$ 22,51	45,84 $\pm$ 13,12
p <sup>*</sup>	0,297	0,009
Pe máx. pre	34,80 $\pm$ 21,96	28,70 $\pm$ 11,16
Pe máx. post	38,80 $\pm$ 22,71	39,67 $\pm$ 16,15
p <sup>*</sup>	0,100	0,670
Dinamometria pre	25,99 $\pm$ 10,27	20,66 $\pm$ 5,54
Dinamometria post	27,76 $\pm$ 10,71	22,28 $\pm$ 4,72
p <sup>*</sup>	0,198	$\leq$ 0,001

<sup>1</sup>Sample standard deviation; <sup>\*1</sup> Paired t-student test; Source: Search data.

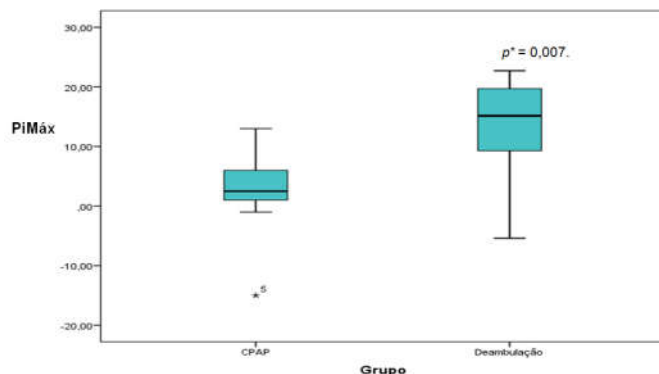
Variations of Pimáx for both groups can be observed in graph 1. It is noteworthy that there was a higher mean difference for the ambulation group ( $13.16 \pm 8.64$ ) than for the CPAP group ( $2.70 \pm 7.71$ ), and that this difference was significantly verified ( $p=0.007$ ).



<sup>\*</sup>Teste U de Mann Whitney; Fonte: Dados da pesquisa.

**Graph 1. Evolution of postoperative Pimáx. Vitória da Conquista - BA, 2019**

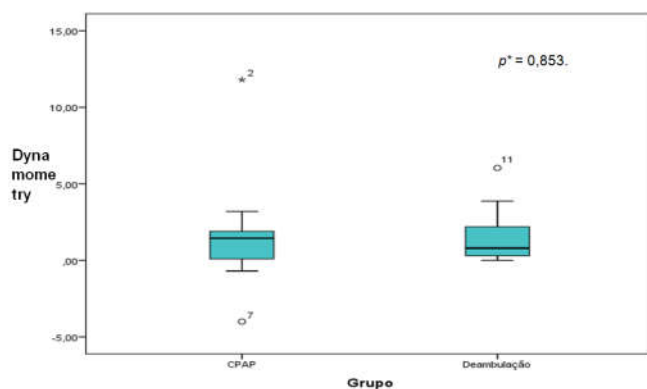
The analysis of the reevaluation for PeMáx, expressed in graph 2, showed that although the ambulation group presented a higher mean difference ( $6.99 \pm 22.29$ ) than the CPAP group ( $2.70 \pm 14.57$ ), this difference cannot be confirmed significantly ( $p = 0.910$ ).



\*Teste U de Mann Whitney; Fonte: Dados da pesquisa.

**Graph 1. Evolution of postoperative Pimáx. Vitória da Conquista – BA, 2019**

With the aid of graph 3, it is possible to conclude that there was a higher mean difference in dynamometry for the CPAP group ( $1.77 \pm 4.02$ ) than for the ambulation group ( $1.62 \pm 1.93$ ) and that due to this difference being very close is not significantly verified ( $p = 0.853$ ).



\*Teste U de Mann Whitney; Fonte: Dados da pesquisa.

**Graph 3. Evolution of postoperative dynamometry. Vitória da Conquista – BA, 2019**

## DISCUSSION

The results presented in this study showed that early mobilization was higher in the gain of PImax and PEmax than the application of the CPAP device in the postoperative period of elective abdominal surgery, and that there was no significant difference in peripheral muscle strength gain. According to Peixoto-Souza et al. 2012 diaphragmatic dysfunction is presented to a higher or lesser degree in abdominal surgeries, this is due to reasons inherent to the surgical procedure such as anesthesia, manipulation of the viscera intraoperative, postoperative pain and loss of abdominal muscle integrity, among others, justifying physiotherapeutic intervention in these patients. Incisional pain in the postoperative period can generate a superficial inspiration and decrease the efficacy of cough, thus increase the risks of atelectasis and pneumonia in the postoperative period. Thus, physiotherapy becomes necessary for the

prevention/recovery of this patient through respiratory physiotherapy techniques and early mobilization providing the maintenance of respiratory functional capacity, reducing the risks of pulmonary complications, as well as a return of activities of daily living, as early as possible, to patients who are subject to prolonged immobilization (PARTSCH et al., 2004). No studies were found that comparatively evaluated early mobilization techniques versus positive pressure in the postoperative period of elective abdominal surgery, so this study is of great relevance because it brings comparative data of the two techniques and proves that early mobilization, an active and inexpensive technique became more effective in the outcome of inspiratory and expiratory muscle strength gain than CPAP, a mechanism of high cost and requires a slightly more complex management. According to Cabral et al 2016 early mobilization, is an active therapy, which brings physical and psychological benefits, reducing the length of hospitalization and reducing the risks of pulmonary complications. Early ambulation accelerates recovery time and leads the patient to be discharged as early as possible, being considered a therapy that optimizes functional recovery and returning the individual early to their daily activities.

The present study corroborates the study conducted by Feliciano et al 2012 that evaluated the efficacy of an early mobilization protocol during the time of stay in the intensive care unit (ICU) and verified a significant gain in inspiratory muscle strength and peripheral muscle strength only in the mobilization group. The evaluation was performed using the MRC score and manuvacuometry. We can affirm that early and systematized applied to early postoperative mobilization is feasible and safe, since it provides improvement in respiratory capacity through lower loss of muscle fibers, both from the inspiratory muscles and peripheral muscles, the first due to surgical manipulation and the second due to immobilism. According to Peixoto-Souza et al 2012 the application of CPAP through a continuous positive pressure in the airways, generates some beneficial effects, such as increased average airway pressure, recruitment of poorly ventilated alveoli, au-ment of lung volumes and stabilisation of the upper airways. However, this study showed that the use of CPAP in the postoperative period in elective abdominal surgical had no significant gain in the Pimax and Pemax item in relation to the early mobilization technique.

This study will corroborate the study by Brigatto et al 2014 in which Bipap was used, a positive pressure mechanism at two postoperative levels of bariatric surgery through the combined positive effects of PEEP and inspiratory support pressure, allowing the recruitment of alveolar collapse zones, increasing pulmonary ventilation and improving gas exchange, besides generating an increase in thoracic expandability. However, it was not able to restore pulmonary function in the postoperative period of bariatric surgery, and its effectiveness was highlighted only in the restoration of mobility. Despite the small influence of positive pressure on pulmonary function and peripheral muscle strength in the volunteers studied, it is important to point out that the applied technique did not provide any adverse effects, such as increased pain and blood pressure or generated postoperative complications, such as fistulas, abdominal distension, or surgical anastomosis dehiscence. Thus, it can be considered that the application of positive pressure was safe in the postoperative period of elective abdominal surgery in cases where they are not able to perform early ambulation. The time of daily application of



CPAP and the reduced size of patients integrated into the trial were considered as a limitation of this study.

## Conclusion

It was found that the superiority of physiotherapeutic care through early mobilization was higher in ventilatory musculoskeletal variables and peripheral dynamite to the isolated use of CPAP in patients undergoing elective abdominal surgeries. I suggest that further studies be carried out in order to verify the effect of the techniques used in an integrated manner.

## REFERENCES

- Boden, Ianthe, Sullivan, Kate, Hackett, Claire, Winzer, Brooke, Lane, Rebecca, McKinnon, Melissa, Robertson, Iain 2018. ICEAGE (Incidence of Complications following Emergency Abdominal surgery: Get Exercising). *World Journal Of Emergency Surgery*, [s.l.], v. 13, n. 1, p.1-17, 3 jul. 2018. Springer Nature.
- Boone, Ana Claudia Barbosa, Koppe, Larissa da Silva, Zandonadi, Lana Pagotto, Melotti, Dalger Eugênio (2018). *Avaliação da força muscular respiratória de pacientes no pré e pós-operatório de cirurgias abdominais*. 2018. Trabalho de conclusão de curso – Escola Superior de Ciências da Santa Casa de Misericórdia de Vitória - EMESCAM, Vitoria, 2018.
- Brigatto, Patrícia, Carbinatto, Jéssica C., Costa, Carolina M., Montebelo, Maria I. L., Rasera-Júnior, Irineu, & Pazzianotto-Forti, Eli M.. (2014). Aplicação de pressão positiva nas vias aéreas na restauração da função pulmonar e da mobilidade torácica no pós-operatório de cirurgia bariátrica: um ensaio clínico randomizado. *Brazilian Journal of Physical Therapy*, 18(6), 553-562. Epub January 09, 2015.
- Cabral, Camila de Souza, Carvalho, Camila Nunes, Burgos3, Camila Pain de Oliveira, Guedes, Lorena Barreto Arruda, Nascimento, Milena Travessa Salles (20016). Efeitos da mobilização precoce em pacientes com diagnóstico trombose venosa profunda (tvp) revisão de literatura. Escola Bahiana de Medicina e Saúde Pública
- Feliciano Valéria, Albuquerque, Cláudio Gonçalves, Andrade, Flávio Maciel Dias, Dantas, Camila Moura, Lopez, Amanda, Ramos, Francimar Ferrari, Silva, Priscila Figueiredo dos Santos, França, Eduardo Ériko Tenório (2012). A influência da mobilização precoce no tempo de internamento na Unidade de Terapia Intensiva (2012). *Rev Assofrair*.
- Filardo, Flávia de Almeida, Faresin, Sonia Maria, & Fernandes, Ana Luisa Godoy. 2002. Validade de um índice prognóstico para ocorrência de complicações pulmonares no pós-operatório de cirurgia abdominal alta. *Revista da Associação Médica Brasileira*, 48(3), 209-216.
- Lockstone, Jane, Parry, Selina M., Denehy, Linda, Robertson, Iain K., Story, David, Parkes, Scott, Boden, Ianthe (2019). Physiotherapist administered, non-invasive ventilation to reduce postoperative pulmonary complications in high-risk patients following elective upper abdominal surgery; a before-and-after cohort implementation study. Chartered Society of Physiotherapy published by IsevierLtd., Australia, p.1-10, 2019.
- Marconi, Marina de Andrade, Lakatos, Eva Maria. *Técnicas de Pesquisa/São Paulo: Atlas Ed.*, 2002. 282p.
- Neto, Andresa Alzira de Souza, Silva, Isabel Cristina 2016. Fisioterapia respiratória na reversão de atelectasia no pós operatório de Laparotomia. *Anais VIII SIMPAC – v.8, n.1, Viçosa – MG. p. 439-444*, 2016.
- Partsch Hugo, Kaulich M, Mayer W. 2004. Immediate mobilisation in acute vein thrombosis reduces post-thrombotic syndrome. *Int Angiol.*; 23:206-12. 2005; 18:148-5.
- Peixoto-Souza, Fabiana Sobral, Gallo-Silva, Bruna, Echevarria, Luciana Bernardo, Silva, Marcio Antonio Antunes, Pessoti, Elisane, & Pazzianotto-Forti, Eli Maria. (2012). Fisioterapia respiratória associada à pressão positiva nas vias aéreas na evolução pós-operatória da cirurgia bariátrica. *Fisioterapia e Pesquisa*, 19(3), 204-209.
- Teza, Daniela Carolina Barizon, Kempinski, Emília Carvalho 2011. *Comparação entre duas técnicas fisioterapêuticas (Respiron® e EPAP) em pós-operatório de cirurgias abdominais*, Maringá – Paraná, 2011.

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