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Analysis of voluntary cough flow peak of patients in an emergency hospital

Análise de pico de fluxo de tosse voluntária de pacientes em um hospital de urgências

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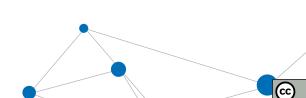[2]Goiânia Emergency Hospital. Goiânia, Goiás, Brazil. ORCID: 0000-0002-2648-9380. sandroesandra@terra.com.br
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RESUMO | INTRODUÇÃO: A tosse, voluntária ou reflexa, é um dos principais mecanismos de depuração para proteção das vias aéreas. O pico de fluxo de tosse (PFT) é um método de avaliação específica, mas que vem demonstrando utilidade para avaliar riscos de complicação pulmonares bem como sua gravidade. Variável muito semelhante ao pico de fluxo expiratório cuja principal diferença consiste no fechamento da glote durante a manobra de tosse. Então avaliar a tosse é importante para identificar pacientes com alterações no pico de fluxo de tosse, e consequente risco de complicações pulmonares. **OBJETIVO:** Analisar o PFT voluntário e parâmetros clínicos e epidemiológicos em uma população internada nas enfermarias de um hospital de urgências. **MÉTODOS:** Estudo transversal com pacientes internados nas enfermarias de um Hospital Público de Goiânia. Foram coletados dados epidemiológicos e clínicos. O PFT foi mensurado pelo peak flow meter e a avaliação de dor através da Escala de Dor Visual Numérica associada à Escala de Dor de Faces. **RESULTADOS:** A amostra foi composta em sua maioria por homens 288 (81,36). A média de idade da população estudada foi de 45,91 anos (±20,14). Sessenta e um por cento dos pacientes (219) apresentaram tosse eficaz, e 43 (12,15%) tosse ineficaz, revelou associação com idade, sexo e diagnóstico. **CONCLUSÃO:** Os pacientes que mais apresentaram alterações na força de tosse foram os idosos, sexo feminino e vítimas acometidas por desordens neurológicas e toracoabdominais.

PALAVRAS-CHAVE: Tosse. Pico do fluxo expiratório. Fluxo expiratório forçado.

ABSTRACT | INTRODUCTION. Cough, whether voluntary or reflex, is one of the major clearance mechanisms for airway protection. Peak cough flow is a recent and specific evaluation method, but it has been useful for evaluating pulmonary complications as well as their severity. Variable very similar to the peak of expiratory flow whose main difference consists in the closure of the glottis during the maneuver of cough. Therefore, assessing cough is important to identify patients with changes in peak cough flow, and the consequent risk of pulmonary complications. **OBJECTIVE:** To analyze the peak flow of voluntary cough and its association with clinical and epidemiological parameters in a population hospitalized in the wards of an emergency hospital. **METHODS:** A cross-sectional study with 354 patients admitted to the wards of a Public Hospital of Goiânia. Epidemiological and clinical data were collected. Optic cough flow was measured by the peak flow meter and the pain assessment using the Numerical Visual Pain Scale associated with the Face Pain Scale. **RESULTS:** The sample consisted mostly of 288 (81,36) men. The mean age of the study population was 45,91 years (± 20,14). 61, 86% (219) of the patients had effective cough, and 43 (12,15%) had an ineffective cough. **CONCLUSION:** Patients who presented the greatest changes in coughing strength were the elderly, females and victims of neurological and thoracoabdominal disorders.

KEYWORDS: Cough. Peak expiratory flow rate. Forced expiratory flow rates.

Introduction

Cough, voluntary or reflex, is one of the major depuration mechanisms for airway protection. During the coughing movement there is an increase in intrapulmonary pressure that is achieved from a deep inspiration, in the sequence, closure of the glottis occurs and the contraction of the expiratory musculature that provides high flows in the phase of expiration of the cough and this high flow transfers kinetic energy from the air to the secretion or to the foreign body, removing them from the bronchial wall and transporting them to the pharynx or mouth where they can be eliminated. For this mechanism to occur satisfactorily, it is necessary to have whole neuromuscular activity and effective coordination[1-2].

The Peak Cough Flow (PCF) is the maximum expiratory flow measured during a coughing movement and can be performed by means of the peak flow apparatus, which has good applicability because it is easy to handle[3-4]. Its magnitude is related to the capacity of airway secretion removal, being the most reproducible form of cough strength evaluation[5]. PCF is a variable very similar to peak expiratory flow, the main difference consists in the closure of the glottis during the cough movement. The greater the velocity of airflow at the time of coughing, the greater its effectiveness.[1]

The PCF is an evaluation method which has shown usefulness to analyze the risks of pulmonary complications as well as their severity. Also used as a predictor of success in the extubation or decannulation processes of several patients, especially neuromuscular[6]. In consideration of cough as the main mechanism of pulmonary defense is one of the pulmonary complications that the hospitalized patient can present the purpose of this study was to evaluate the peak flow of voluntary cough and clinical and epidemiological parameters of a population hospitalized in the wards of a hospital emergency room.

Materials and methods

It is a cross-sectional study approved by the Research Ethics Committee of the Emergency Hospital of Goiânia (CAAE 52043915.2.0000.0033). This research had as its target population patients admitted to the wards of a State Hospital of Goiás. Patients who were hospitalized in the medical, surgical, neurology, maxillo facial surgery, orthopedics and traumatology sectors participated in the study. Data collection took place from March to July 2016.

To calculate the sample, the population who was hospitalized in the year 2015 in the previously mentioned units, in a similar period to that of the proposed collection, was used as reference base. Thus, based on information from the Medical and Statistical Archives Service, a total of 4519 patients were surveyed. The maximum error considered for sampling (or estimation) of the survey is 5% using a 95% confidence level. According to the formula below, the sample required for the collection of data from the research was 354 patients.

Patients aged 20 years or older, cognitive level sufficient to understand the purpose of the study and to carry out the proposed evaluations were included in the study. It was excluded from the study patients using artificial airway (orotracheal tube and tracheostomized tubes), patients in the recent postoperative period of abdominal surgeries, voluntary manifestation of the desire not to participate in the study, indigene population and prisoners population. All participants signed a Free and Clarified Consent Term (FECT). As the study involved the elderly, the Statute of the Elderly, and Resolution 466/2012 of the NHC (National Health Concil) were considered and respected.

The cough evaluation was performed using the PCF measured by the peak expiratory flow meter, Peak Flow Meter, its measurement range varies between

60 and 900 L / min, registered in the National Agency of Sanitary Surveillance number 10.332.170.038. The device is made of plastic material, self-draining up to 134 ° C, with internal stainless steel bar, manually calibrated by a one-way silicone valve that minimizes risks of cross-infections.

The test was first explained to the patient and a check was made to validate the good understanding. The participant was asked in the sitting position to perform three movements of voluntary cough as fast and strong as possible, from the total lung capacity, it was considered the highest result for registration in a research questionnaire. A disposable nozzle was used for each participant. The cough variable was created from the value obtained from the measurement of peak cough flow and was classified as "ineffective" when PCF was less than 160L / min, "weak with risk" when PCF was measured between 160 and 269 L / min and "effective" when PCF was greater than 270 L / min[1.6].

To evaluate the pain, the Numerical Visual Pain Scale (NVPS) was used, associated with the Face Pain Scale with six faces. This scale consists of a ruler divided into eleven equal parts, numbered successively from zero to ten. The volunteer referred to the equivalence between pain intensity and a numerical classification, with zero corresponding to the classification "no pain" and ten "maximum pain". The scale of faces was applied to that participant who could not indicate by the numerical scale. He pointed out the intensity of his pain according to the mime represented in each face drawn on the scale presented, and the expression of happiness corresponded to the classification "without pain" and the expression of maximum sadness corresponded to the classification "maximum pain". The pain was classified as absent, mild, moderate and severe according to NVPS.

Epidemiological and clinical information and the prescription of analgesics were collected from a simple interview by the application of a questionnaire of their own and by the analysis of the patients electronic medical records

The data were entered in the EPIINFO program 3.3.2, with double input to analyze the inconsistencies. The data treatment was performed from the STATA / SE 12.0 program. Statistical analysis includes the characterization of subjects using simple frequency of the studied variables. Pearson's Chi-square association tests, and Fisher's exact test for categorical variables. The level of statistical significance was set at $p < 0.05$.

Results

Profile of participants

A total of 354 participants were included in the sample, predominantly male 288 (81.3%). The mean age of participants was 45.91 ± 20.1 years. One hundred and seventy-four (49.1%) patients were victims of a traffic accident and in relation to the profession, 104 (29.3%) of the participants worked in repair and maintenance services. There was a statistically significant difference when associating cough with sex and age with $p < 0.001$ for both, Table 1.

Table 1. Characteristic of the sample. Goiânia, Goiás, 2016

Variables	Sample Distribution N (%)
Sex	
Female	66 (18,64)
Male	288 (81,36)
Idade	
20-59	277 (78,25)
≥ 60	77 (21,25)
Comorbidities	
None	251 (76,52)
HAS	56 (17,07)
DM	11 (3,35)
Reason for hospitalization	
Car Accident	174 (49,15)
Referrals	62 (17,51)
Fall of own height	35 (9,89)
Accident at Work	27 (7,63)
Fall of Height	25 (7,06)
Physical aggression	17 (4,80)
Others	14 (3,95)
Diagnosis	
Fractures	234 (66,10)
Injuries to Soft Parts	36 (10,17)
Injuries to thoracoabdominal	23 (6,50)
Neurological Injuries	21 (5,93)
SCI	9 (2,54)
Others	14 (3,40)

DM: *Diabetes Mellitus*, AH: Arterial Hypertension, SCI: Spinal Cord Injury

Clinical Data

The majority of the sample, consisting of 251 (76.5%) people, stated that they did not have any comorbidities, and among those with comorbidities the most was Systemic Arterial Hypertension (SAH) 56 (17.0%), followed by Diabetes Mellitus (DM) with 11 (3.1%). When associating SAH and DM with the variable cough presented p> 0.05. Regarding smoking, 145 (40.9%) of the sample refused, 58 (16.3%) reported being smokers, 52 (14.6%) were former smokers and 99 (27.9%) did not report smoking.

The most common clinical diagnosis was fractures, which occurred in 234 (66.1%) individuals involving fractures of the upper limbs, lower limbs and pelvic fracture; the second most common diagnosis were soft tissue injuries 36 (10.1%), followed by thoracoabdominal lesions 23 (6.5%), neurological lesions with 21 (5.9%), spinal cord trauma 9 (2.5%) and 14 (3.4%) had other diagnoses. There was no statistically significant difference when cough was associated with the diagnosis of fractures, spinal cord trauma and others, Table 2.

Table 2. Classification of cough according to demographic and clinical variables. Goiânia, Goiás, 2016

Variables	Cough			Value p
	Ineffective n(%)	Weak n(%)	Effective n(%)	
Sex				<0, 001
Female	26 (37,88)	27 (39,39)	13 (22,73)	
Male	18 (6,25)	66 (22,92)	204 (70,83)	
Age				<0, 001
20-59	17 (6,14)	64 (23,10)	196 (70,76)	
≥ 60	26 (33,77)	28 (36,36)	23 (29,87)	
Comorbidities				
HAS	12 (21,43)	15 (26,79)	29 (51,79)	0,019
DM	1 (9,09)	1 (9,09)	9 (81,82)	0,436*
Diagnostics				
Fractures				0, 315
No	19 (15,83)	30 (25,00)	71 (59,17)	
Yes	24 (10,26)	62 (26,50)	148 (63,25)	
Injury of soft parts				0, 786*
No	40 (12,58)	83 (26,10)	195 (61,32)	
Yes	3 (8,33)	9 (25,00)	24 (66,67)	
Thoracoabdominal injuries				<0,001*
No	33 (9,97)	90 (27,19)	208 (62,84)	
Yes	10 (43,48)	2 (8,70)	11 (47,83)	
Neurological Injuries				0, 001
No	36 (10,81)	84 (25,23)	213 (63,96)	
Yes	7 (33,33)	8 (38,10)	6 (28,57)	
Pain				0, 073
Absent	22 (17,32)	33 (25,98)	72 (56,69)	
Present	21 (9,25)	59 (25,99)	147 (64,76)	

Pearson's Chi-square test and Fisher's exact test.

The mean peak cough flow found in the sample was 330.3 L / min (min: 60 L / min and maximum: 760 L / min). Among the individuals evaluated, 43 (12.1%) had an ineffective cough, 92 (25.9%) had a weak cough with risk, which predisposed the individual to pulmonary complications, and 219 (61.8%) of the sample presented an effective cough.

According to the intensity of pain, 127 (35.8%) reported being pain free at the time of the evaluation, while 227 (64.1%) felt pain. Of these, 76 (21.4%) reported mild pain, 106 (29.9%) moderate pain and 45 (12.7%) severe pain. Although frequent, pain did not present a significant statistical difference with the cough variable, Table 2.

Regarding the use of analgesics, of the 354 patients evaluated, only one (0.2%) were not using any analgesic, 67 (18.9%) were using a single analgesic and 286 (80.7%) were in use of more than one analgesic. The most used analgesics were common ones 339 (95.7%), followed by opioid analgesics 277 (78.2%), and finally 58 (16.3%) they used analgesics from the non-steroidal anti-inflammatory group. Since some patients received more than one analgesic, the total prescribed was 674 analgesics.

Discussion

The profile of the population found in the research corroborates with national data showing that the male population of productive age, between 18 and 40 years old, is more commonly involved in traffic accidents. The traffic accident is a worldwide serious problem and according to an estimate by the World Health Organization, approximately 1.2 million people die each year from road traffic accidents, which is therefore considered the second cause of death in individuals aged between 5 and 29 years, and the third cause of death among people aged 30 to 44 years[7].

The predominance of males can be explained by the difference in risk exposure, recklessness in traffic and lifestyle. In a study carried out in an Emergency Hospital of Teresina, Piauí, 86.1% of the patients were men and only 13.8% were women

(8). In another study carried out in an urgency and emergency hospital in Belém, Pará, the authors identified that young men with low schooling and low income are the most involved in accidents that cause fracture in the lower limbs, a similar result to this study in which the prevalent population was male and the most frequent diagnosis was fractures in the lower limbs[9].

Regarding the presence of comorbidities, the result of this study was similar to a multicenter study performed in 19 hospitals in Spain, with 605 patients, in which 75.7% of the patients did not present prior comorbidities[10]. Despite the high rates of chronic non-communicable diseases present in the Brazilian population[11], this finding can be explained by the age range of the population in this study that has not yet developed these diseases.

When evaluating the Peak Cough Flow, the highest values were found in the adult male population. The fact may be related to the profile of patients treated in the hospital unit in question, who are mostly men, young, previously healthy, victims of traffic accidents and with the most frequent diagnoses of fractures in anatomical areas that are not directly involved in the coughing mechanism.[12]

Associating the peak cough flow with age showed a significant p <0.001. The elderly population presented a high percentage of ineffective cough, which corroborates with data found in a study performed with active and sedentary elders in which the authors verified the relation of the increase of the age with the reduction of the inspiratory and expiratory muscular force, and that the style of more active life can positively influence the higher respiratory muscle strength and higher PCF values[5]. Other studies also observed a gradual decline in PCF values with increasing age[13-14].

In the present study patients with thoracoabdominal lesions had a significant association with the cough variable with p <0.001, of the patients diagnosed with these lesions 43.4% were classified as having an ineffective cough. Different results were found in a study that, when evaluating the coughing strength of patients with abdominal injuries, concluded that individuals who developed postoperative pulmonary

complications did not present a decrease in PCF[15]. In a study of dysphagic patients with pulmonary complications, it was found that mean values of peak cough flow were significantly lower than those without pulmonary complications[16]. The significance found in our research may be perhaps attributed to the complexity of the lesions, which were mostly concomitant thoracic and abdominal.

The findings verified in a study with patients who suffered a cerebrovascular accident pointed out that the coughing capacity was diminished in this population[17]. Another study with patients with Parkinson's disease revealed that these patients had altered cough function[18]. In the present research it was opportune to verify similar results among the patients with neurological disorders that had significant association with the cough. In the sample, 71.43% presented changes in coughing force, a fact that can be justified by respiratory compromise, normally developed by patients with neurological alterations, in detriment to muscle weakness and postural dysfunction of the trunk.

In consideration of pain intensity and analgesic adequacy, a study was carried out in an emergency department in the city of São Paulo, in which they evaluated the use of analgesics in injuries due to transport accidents and found that, in spite of serious injuries, 37% of cases, analgesics were the only ones prescribed[19]. Similar results were found in the present study where a large number of simple analgesics were prescribed, but not used in isolation for the most part. The oligoanalgesia, the subprescription of potent analgesics and high percentage of patients.

Conclusion

The mechanism of cough production in the hospitalization process may be altered. When analyzing the PCF, effective cough was found in 219 (61.8%) participants of the research. Coughing presented worse results in elderly patients, female patients and victims of neurological and thoracoabdominal disorders.

Author contributions

Dias LS participated in the design, design, collection of research data and statistical analysis of data, interpretation of results and writing of the scientific article. Moreira SMBP and Vieira LL participated in the conception, design, statistical analysis of the research data, interpretation of the results and writing of the scientific article.

Competing interests

No financial, legal or political competing interests with third parties (government, commercial, private foundation, etc.) were disclosed for any aspect of the submitted work (including but not limited to grants, data monitoring board, study design, manuscript preparation, statistical analysis, etc.).

References

1. Freitas FS, Parreira VF, Ibiapina CC. Aplicação clínica do pico de fluxo da tosse: uma revisão de literatura. Fisioter Mov. 2010;23(3):495-502. doi: 10.1590/S0103-51502010000300016

2. BRASIL. II Diretrizes brasileiras no manejo da tosse crônica. J Bras Pneumol. 2006;32(supl 6):s403-46. doi: 10.1590/S1806-37132006001000002

3. Salam A, Tilluckdharry L, Amoateng-Adjepong Y, Manthous CA. Neurologic status, cough, 18. secretions and extubation outcomes. Intensive Care Med. 2004;30(7):1334-9. doi: 10.1007/s00134-004-2231-7

4. McConnell AK., Copestake AJ. Maximum static respiratory pressure in healthy elderly men and 4. women: issues of reproducibility and interpretation. Respiration. 1999;66(3):251-8. doi: 10.1159/000029386

5. Freitas FS, Ibiapina CC, Alvim CG, Britto RR, Parreira VF. Relação entre força de tosse e nível funcional em um grupo de idosos. Rev Bras Fisioter. 2010;14(6):470-6. doi: 10.1590/S1413-35552010000600004

6. Faria ICB, Dalmonch RM. Respiratory function and the mechanism of cough in Duchenne. Rev.Bras Promoção da Saúde. 2009;22(2):113-9. doi: 10.5020/355

7. Cavalcante FG, Morita PA, Haddad SR. Sequelas invisíveis dos acidentes de trânsito: o transtorno de estresse pós-traumático como problema de saúde pública. Cien Saude Colet. 2009;14(5):1763-72. doi: 10.1590/S1413-81232009000500017

8. Moura JC, Rangel BLR, Creoncio SCE, Pernambuco JRB. Perfil clínico-epidemiológico de traumatismo cranioencefálico do Hospital de Urgências e Traumas no município de Petrolina, estado de Pernambuco. Arq Bras Neurocir. 2011;30(3):99-104.

9. Motoki THC, Carvalho KC, Vendramin FS. Perfil de pacientes vítimas de trauma em membro inferior atendidos pela equipe de cirurgia reparadora do Hospital Metropolitano de Urgência e Emergência. Rev Bras Cir Plást. 2013;28(2):276-81. doi: 10.1590/S1983-51752013000200018

10. Gershengorn HB, Kahn JM, Wunsch H. Temporal trends in the use of nutrition in critically ill patients. CHEST. 2014;145(3):508-517. doi: 10.1378/chest.13-1597

11. Ministério da Saúde. Informações epidemiológicas e morbidade. [Internet]. [acesso em dez. 2016]. Disponível em: http://datasus.saude.gov.br/informacoes-de-saude/tabnet/epidemiologicas-e-morbidade

12. Scheeren CFC, Gonçalves JJS. Comparative evaluation of ventilatory function through pre and postoperative peak expiratory flow in patients submitted to elective upper abdominal surgery. Rev Col Bras Cir. 2016;43(3):165-70. doi: 10.1590/0100-69912016003007

13. Berardsmore CS, Wimpress SP, Thomson AH, Patel HR, Gooknough P, Simpson H. Maximum voluntary cough: an indication of airway function. Bull Eur Physiopathol Respir. 1987;23(5):465-72.

14. Cook NR, Evans DA, Schen P, Spizer FE, Vedal S, Branch LG et al. Peak expiratory flow rate in an elderly population. Am J Epidemiol. 1989;130(1):66-78.

15. Colucci D, Fiore J, Risso T, Paisani DM, Vieira M, Pereira R et al. Os pacientes que desenvolvem complicações pulmonares após cirurgias abdominais altas apresentam tosse menos eficaz. Rev Bras Fisioter. 2008;12(Resumo):100.

16. Bianchi C, Cantarella G, Khirani S, Biardi P. Cough Peak Flow as a Predictor of Pulmonary Morbidity in Patients with Dysphagia. Am J Phys Med Rehabil. 2012;91(9):783-8. doi: 10.1097/PHM.0b013e3182556701

17. Meireles ALF, Meireles LCF, Queiroz JCES, Tassitano RM, Soares FO, Oliveira AS. Eficácia da eletroestimulação muscular expiratória na tosse de pacientes após acidente vascular encefálico.Fisioter e Pesqui. 2012;19(4):314-9. doi: 10.1590/S1809-29502012000400004

18. Hegland KW, Okun MS, Troche MS. Sequential Voluntary Cough and   Aspiration or Aspiration Risk in Parkinson's Disease. Lung. 2014;192(4):601-608. doi: 10.1007/s00408-014-9584-7

19. Meneghetti CHZ, Figueiredo VE, Guedes CAV, Batistela ACT. Evaluation of Respiratory Muscle Strength in stroke patients. Rev Neurocienc. 2011;19(1):56- 60.

20. Calil AM, Pimenta CAMP. Importância da avaliação e padronização analgésica em serviços de emergência*. Acta Paul Enferm. 2010;23(1):53-9.

21. Barreto RF, Gomes CZL, Silva RM, Signorelli AAF, Oliveira LF, Cavellani CL et al. Avaliação de dor e do perfil epidemiológico, de pacientes atendidos no pronto-socorro de um hospital universitário. Rev Dor. 2012;13(3):213-9. doi: 10.1590/S1806-00132012000300004