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Relationship between preoperative pulmonary risk assessment and postoperative pulmonary complications in patients undergoing cranial surgery in the presence of chronic disease

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Abstract

Postoperative complications are becoming more and more important than the risk given in preoperative pulmonary evaluation due to the increase in patients requiring surgical intervention. Patients undergoing craniotomy are routinely evaluated preoperatively, but the role of these evaluations in predicting outcomes has not been adequately studied. We aimed to investigate the effect of preoperative pulmonary risk assessment and the type of operation performed on postoperative complications and mortality concerning the presence of chronic disease in patients undergoing cranial surgery in the light of the literature. Preoperative pulmonary consultation data and postoperative pulmonary consultations, if any, of cranial surgery patients who were operated on in the neurosurgery clinic of a tertiary hospital were retrospectively analyzed. 85 (43.8%) of the surgical patients were male and 109 (56.2%) were female, and the average age of 194 people was 74 (35-90). 83 (42.7%) of the patients had at least one chronic disease. Considering the preoperative pulmonary risks, 72 (37.1%) patients were given medium risk. Statistically, the mortality rate was higher in those with ICU beds. Atelectasis in 10 (5.15%) patients, pneumonia in 7 (3.608%) patients, embolism in 3 (1.5%) patients, respiratory failure in 3 (1.5%) and bronchospasm in 2 (1%) patients, respectively. Postoperative pulmonary complications developed in 25 (12.9%) patients. Prediction of respiratory complications with effective preoperative pulmonary evaluation is important in terms of decreasing morbidity and mortality and decreasing the length of hospital stay. Since most of the complications are seen in patients given high risk in the preoperative period, close follow-up of high-risk patients in the postoperative period is important.

Keywords: Postoperative complications, pulmonary risk, cranial surgery, chronic disease, geriatric

Introduction

Pulmonary complications that develop in a short and long time in patients who undergo non-pulmonary surgical intervention lead to significant morbidity and mortality and increase the duration of hospital stay [1]. PPCs cause higher mortality, a longer stay in both hospital and ICU, a dramatic increase in medical cost and socioeconomic burden [2].

Today, studies are reporting that postoperative morbidity and mortality can be reduced and hospital costs can be reduced with a careful preoperative pulmonary evaluation in patients undergoing surgery in pulmonology practice [3,4].

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Postoperative pulmonary complications (PPC) are the complications that cause the most mortality and morbidity in the postoperative period [5]. The incidence, clinical effect, and risk factors of individual PPCs are not fully known. To maximize the effectiveness of new interventions, detailed knowledge of mild to severe PPCs is needed to identify modifiable risk factors [6,7]. In these patients, preoperative spirometry and chest radiography may not be routinely requested to determine the risk of postoperative pulmonary complications, but chronic obstructive These tests may be useful in patients with a history of lung disease or asthma [8].

Postoperative complications are becoming more and more important according to the risk given in preoperative pulmonary evaluation due to the increase in patients requiring surgery. All these data reveal the importance of developing strategies for patients scheduled for surgery to increase quality and minimize complications. Patients undergoing cranial surgery are evaluated routinely before surgery. However, the role of these evaluations in predicting outcomes has not been sufficiently studied. We aimed to investigate the effect of preoperative pulmonary risk

assessment and the type of operation performed on postoperative complications and mortality concerning the presence of chronic disease in patients undergoing cranial surgery in the light of the literature.

Materials and Methods

194 cranial surgery patients were included in the study from 870 patients who were operated on in the Neurosurgery Clinic of Afyonkarahisar Health Sciences University, Faculty of Medicine, between 2014-2019. Preoperative pulmonary consultation data and postoperative pulmonary consultations of cranial surgery patients were analyzed retrospectively. Age, gender, existing diseases, preoperative pulmonary risk class, operation type and duration, type of anesthesia (all patients were operated on under general anesthesia), perioperative, and postoperative complications were recorded.

This study had been carried out with the decision dated 2020/395 (2011-KAEK2) by Afyonkarahisar Health Sciences University Clinical Research Ethical Board.

Statistical analysis

SPSS Windows 20 program was used for statistical analysis. Descriptive statistical methods (mean, standard deviation, median, frequency, ratio, minimum, maximum) were used to evaluate the study data. Compliance of quantitative data to normal distribution was tested with Kolmogorov-Smirnov, Shapiro - Wilk test, and graphical evaluations. Student-t-test was used to compare the quantitative data of the two groups with the normal distribution, and the Mann-Whitney U test was used to compare the two data groups with the abnormal distribution. Pearson's Chi-Square test and Fisher's Exact test were used to comparing qualitative data. Significance was set at $p < 0.05$.

Table 1. Demographic characteristics of the patients

	Chronic diseases have	Chronic diseases have'nt	Total	P
	n=83 %42.8	n=111 %57.2	n=194	
Age	74(46-89)	74(35-90)	74(35-90)	
Gender				
Woman	36(%43.4)	49(%44.1)	85(%43.8)	
Male	47(%56.6)	62(%55.9)	109(%56.2)	
Cigaret	38(%48.8)	45(%54.2)	73(%37.6)	
AveragHospitalization Days	15(1-100)	15(1-145)	15(1-145)	
Saturation	94(75-99)	94(84-99)	94(75-99)	
Pulse / Minute	80(60-172)	80(47-170)	80(47-172)	

Results

Of the 194 patients included in the study, 85 (43.8%) were male and 109 (56.2%) were female, and the average age was 74 (35-90). 73 (37.6%) of the patients were active smokers. During the examination, the saturation values of the patients who were evaluated preoperatively for pulmonary examination were 94 (75-99) and the heart rate values were measured as 80 (47-172) / minute (Table 1).

83 (42.7%) of the patients had at least one chronic disease. The most common chronic diseases are essential hypertension (HT) and coronary artery disease (CAD) in 36 (43.4%) patients, chronic respiratory diseases (asthma and chronic obstructive pulmonary disease, etc.) in 25 (30.2%) patients, respectively. Diabetes mellitus (DM) was present in 25 (30.2%) patients. When the operated patients were compared, no statistically significant difference was observed in terms of the total presence of chronic diseases.

When the patients who had a chronic disease in the preoperative period and died in the postoperative period, a statistically significant difference was observed in terms of death rates in the presence of malignancy alone (Table 2) ($P < 0.001$).

Considering the types of cranial surgery applied to the patients, the intracranial mass operation was performed most frequently in 83 (42.7%) patients, while Arnold Chiari malformation surgery was performed with at least 1 (0.5%) patient. In terms of postoperative mortality rates, it was statistically insignificant in terms of postoperative complications and mortality rates after surgical interventions ($P = 0.135$, $P = 0.185$, respectively) (Table 3).

Table 2. Chronic disease rates by gender

	Chronic Diseases Have n=83	
	n	%
Hypertension And Coronary Artery Disease	36	43.4
Diabetes	25	30.2
Congestive heart failure	17	20.5
Chronic obstructive pulmonary disease	14	16.9
Asthma	11	13.3

Table 3. The count of cranial surgeries applied to geriatric patient groups

	Chronic Diseases Have N=83		Chronic Diseases Have'nt N=111		Total n=194		P
	n	%	n	%	n	%	
Intracranial tumor	32	38.6	51	45.9	83	42.8	0.732
Intracranial hemorrhage	34	41	39	35.1	73	37.6	
Shunt(cyst etc)	8	9.6	13	11.7	21	10.8	
Hydrocephalus	8	9.6	8	7.2	16	8.2	
Chiari malformation	1	1.2	0	0	1	0.5	
Malignancy	10	12					
Neurological Disease	8	9.6					
Benign prostatic hypertrophy	5	6					
Thyroid dysfunction	3	3.6					
Osteoporosis	3	3.6					
Chronic renal failure	1	1.2					
Total	83	100					

In the preoperative period, 162 (98.7%) patients were asked to have posteroanterior chest (PA) x-ray and 100 (51.5%) patients had normal findings in 65 (33.5%) patients and 7 (3.6%) had an appearance consistent with a solitary pulmonary nodule or malignancy.

In physical examination, 8 (4.12%) patients had rhoncus and 9 (4.63%) patients had ral. In 3 (1.54%) patients, nasal oxygen saturation was followed due to long-term oxygen therapy use due to chronic respiratory failure.

Considering the preoperative pulmonary risks, 72 (37.1%) patients were given medium risk, while 58 (29.9%) patients were given severe risk. When the risks given to the patients were evaluated, it was observed that the increase in the risk given to the patient was not significant as the age increased according to the risks given to the patients (P = 0.114).

While 128 (66%) of the patients applied to the polyclinic, 66 (34%) of them were made as an emergency service application. Among the emergency service applications, 8 (12.12%) people applied for a traffic accident. When patients who were admitted for emergency surgery and those who underwent elective surgery were compared, there was no statistically significant difference in mortality rates (P = 0.053).

In the postoperative period, 147 (75.8%) of the patients were followed up and treated in the neurosurgery service, while 47 (24.2%) were followed up and treated in the intensive care (ICU). (P <0.001) 46 of the patients receiving treatment. Various postoperative complications were caused by death. Statistically, the mortality rate was higher in patients with ICU beds. (P <0.001) Only 7 (3.6%) of these deaths died due to postoperative pulmonary complications, and there was a significant statistical difference between hospitalization or hospitalization in deaths due to postoperative pulmonary complications. not followed. (P: 0.057).

Table 4. Preoperative risk and postoperative complications according to geriatric patient groups

	Chronic Diseases Have N=83		Chronic Diseases Have'nt N=111		Total n=194		P
	n	%	n	%	n	%	
Preop Given Risk							
Light	3	3.6	7	6.3	10	5.2	0.331
Light-Medium	6	7.2	14	12.6	20	10.3	
Middle	28	33.7	44	39.6	72	37.1	
Medium-Heavy	18	21.7	16	14.4	34	17.5	
Heavy	28	33.7	30	27	58	29.9	
Hospital Application Status							
Normal	57	68.7	71	64	128	66	0.206
Emergency	26	31.3	40	36	66	34	
Section Lying							
Service	63	75.9	84	75.7	147	75.8	0.554
Intensive Care	20	24.1	27	24.3	47	24.2	
Postoperative Respiratory Complication	15	18.1	10	9	25	12.8	0.05
Discharge Type							
With Healing	39	47	63	56.8	102	52.6	0.283
As A	24	28.9	22	19.8	46	23.7	
Death	20	24.1	26	23.4	46	23.7	

Atelectasis in 10 (5.15%) patients, pneumonia in 7 (3.608%) patients, embolism in 3 (1.5%), respiratory failure in 3 (0.87%) and bronchospasm in 2 (1%) patients, respectively. Postoperative pulmonary complications developed in a total of 25 (12.9%) patients. Of the patients who had an embolism, 2 (1%) passed away. As the duration of hospitalization increased, a positive correlation was observed in mortality. (P = 0.02) Also, there was a positive correlation between the increase in the number of hospitalization days and having an embolism (p = 0.040) (Table 4).

Discussion

Chest diseases consultation is performed for two purposes: preoperative evaluation and due to any pathology. The preoperative pulmonary evaluation aims to determine possible serious respiratory dysfunction that may occur after anesthesia and surgery before the operation [9,10]. Estimation of postoperative pulmonary complications (PPCs) allows for individually administered preventive measures and even early treatment if a PPC eventually begins to develop [11]. The parameters that should be evaluated in the preoperative pulmonary anamnesis phase; Age, smoking and drug history, occupational exposure, immobilization, comorbidities, and pulmonary embolism are risk factors. Also, sleep-apnea symptoms and the presence of recently passed respiratory tract infections should be questioned. With a detailed evaluation, findings of undefined lung disease can be obtained and can help determine the basal state before surgery [12]. In a past study conducted by Balcı A. et al in terms of preoperative evaluations in spinal surgery patients and the preoperative risks given to patients in our hospital. They divided the preoperative risks into 5 (mild, mild-moderate, moderate, moderate-severe, severe). The most common risk scale given to patients in the preoperative period was the medium-risk group with a value of 50.3% [13]. In our study, the most common risk value given to patients who were evaluated preoperatively was 37.1%, while this was a severe risk with 29.9%. In our study, while the preoperative risk was given to the patients, it was mostly carried out by considering the clinical conditions and anamnesis of the patients, which is similar to the risk ratios in previous studies.

Preoperative chest radiography is useful, especially in the presence of new or unexplained symptoms and signs, when sudden worsening of the symptoms and signs of the underlying disease is detected or if thoracic surgery is to be performed [14]. In our study, Posteroanterior (PA) chest x-ray of nearly all patients was evaluated in the preoperative period, and no obstacle was found for the operation. Besides, when our study was evaluated, the PFT test was excluded from the evaluation, since the pulmonary function test (PFT) was not requested from most of the patients in the preoperative period. However, in many studies conducted in recent years, it has been concluded that PFT disorder is not a good indicator of complications, and a good clinical evaluation is much more important [15,16]. In our study, patients were given the risk of operation with clinical findings and anamnesis.

The frequency of postoperative pulmonary complications (PPC) varies between 6-79% in the case of series due to various publications and different surgical interventions [17-19]. This wide range is that the patients in the studies were exposed to different surgical procedures and the postoperative pulmonary risks in the studies were different. However, in terms of specific surgeries, examples of preoperative pulmonary evaluations and postoperative pulmonary complication rates in cranial surgery patients forming the basis of our study are few in the literature. For example, in a study conducted on 931 patients who underwent cranial surgery, postoperative pulmonary complications (PPC) was observed in 14.3% of the patients [20]. However, different studies are showing that the probability of developing PPC following elective cranial surgery is 11.2-24.6% [21,22]. In our study, this rate was found to be 12.9% when PPCs after cranial surgery were examined, and it is consistent with similar literature information. This is how the PPCs are defined here: In most studies, PPC is defined as atelectasis, pneumonia, pulmonary edema, exacerbation of the underlying chronic lung disease, or respiratory failure in patients after surgery [23,24]. Neurosurgery operations are accepted as high risk for the formation of PPC [25]. A plausible explanation for this increased risk is the reduction in lung volumes and arterial blood gas tension secondary to the operation, with changes in breathing patterns occurring after craniotomy [26].

Early reports of respiratory complications in patients undergoing neurosurgical procedures include respiratory depression, reintubation, bronchospasm, laryngospasm, and upper airway obstruction occurring in 2.8% of patients [27]. In a study conducted by Hooda B. et al., 3.1% atelectasis occurred in 2.1%, tracheobronchitis in 2.1%, ARDS in 1.4%, and pneumothorax in 0.7% in terms of PPC [28].

Sogame's prospectively studied 236 cranial surgery patients and 58 patients (24.6%) (tracheobronchitis, pneumonia, bronchospasm, and atelectasis) PPC formation and 23 (10%) deaths were reported [29]. When we evaluated the PPCs in our study, 10 of 29 patients had atelectasis, 8 had pneumonia, 5 had tracheobronchitis, 3 had a pulmonary embolism, and 2 had respiratory failure. In our study, it can be shown that all patients who needed long-term mechanical ventilation as a possible reason for the absence of bronchospasm, receiving regular bronchodilator nebulization therapy as an institutional protocol in the intensive care unit. Besides, considering the complications of bronchospasm in patients in the preoperative period, the prediction of nebular and intravenous steroid therapy according to the risk prediction is descriptive to assume that no bronchospasm events occur in patients, but in the light of the retrospective nature of the study, it is largely speculative. Therefore, we suspect that the bronchospasm status was underreported for our study.

Prolonged hospital stays in the postoperative period is an important burden in terms of pulmonary dysfunction, morbidity, mortality, and increased cost of care [30]. As a matter of fact, in our study, the duration of ICU and hospital stay of the patients with PPC was significantly longer. It is independently associated with PPCs. These findings are in line with other studies conducted on neurosurgical patients [29,31].

Conclusion

As a result, postoperative respiratory complications are one of the causes of morbidity, mortality, and intensive care hospitalization in cases undergoing surgical operations. Therefore, it is important to evaluate patients in the preoperative period, and to predict respiratory complications, to reduce morbidity and mortality, and to decrease postoperative hospital stay. Since most of

the complications are seen in patients given high risk in the preoperative period, close follow-up of high-risk patients in the postoperative period is important.

Conflict of interests
The authors declare that they have no competing interests.

Financial Disclosure
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Ethical approval
This study had been carried out with the decision dated 2020/395 (2011-KAEK2) by Afyonkarahisar Health Sciences University Clinical Research Ethical Board.

References

1. Delisser HM, Grippi MA. Ch 40 Perioperative respiratory considerations in the surgical patient. Fishman's Pulmonary Diseases and Disorders,third ed. Fishman AP., Elias JA., Fishman JA., Grippi MA., Kaiser LR., Senior RM. (ed) McGraw-Hill1998;Sf: 619-629.
2. Boden I, Skinner EH, Browning L, et al. Preoperative physiotherapy for the prevention of respiratory complications after upper abdominal surgery: pragmatic, double blinded, multicentre randomised controlled trial. BMJ 2018;360:j5916.10. Okada S, Shimada J, Kato D, et al. Long-term prognostic impact of severe postoperative complications after lung cancer surgery. Ann Surg Oncol 2019;26:230–7
3. Manku K, Bacchetti P, Leung J. Prognostic significance of postoperative in-hospital complications in elderly patients. I. Long Term Survival. Anesth Analg. 2003;96:583-9
4. Harari D, Hopper A, Dhesi J et al. Proactive care of older people undergoing surgery('POPS'): designing, embedding, evaluating and funding a comprehensive geriatric assessment service for older elective surgical patients. Age and Ageing. 2007;36:190- 6
5. Lawrence VA, Dhanda R, Hilsenbeck SG et al. Risk of pulmonary complications after elective abdominal surgery. Chest. 1996;110:744-50.
6. Vetter TR, Ivankova NV, Goeddel LA, et al Perioperative Surgical Home Group. An analysis of methodologies that can be used to validate if a perioperative surgical home improves the patient-centeredness, evidence-based practice, quality, safety, and value of patient care. Anesthesiology. 2013;119:1261–74.
7. Anderson AD, McNaught CE, MacFie J, et al. Randomized clinical trial of multimodal optimization and standard perioperative surgical care. Br J Surg. 2003;90:1497–504.
8. Smetana GW, Conde MV. Preoperative pulmonary update. Clin Geriatr Med 2008;24:607-24.
9. Zamani A. Selçuk üniversitesi araştırma hastanesi'nde göğüs hastalıkları konsültasyonu yapılan olguların değerlendirilmesi. Tüberküloz Ve Toraks Dergisi 1996;44:139-44
10. Woerlee GM. Common perioperative problems and the anasesthetist: Kluwer academic Publishers 1988;179.
11. Nijbroek SG, Schultz MJ, Hemmes SNT. Prediction of postoperative pulmonary complications. Curr Opin Anaesthesiol. 2019;32:443-51.
12. Erdinç E. Preoperatif Pulmoner Değerlendirme. TTDO Mesleki Gelişim Kursu. 2007:24-7.
13. Balci A, Rakip U, Cengiz A. Preoperative pulmonary evaluation and evaluation of postoperative pulmonary complications in geriatric patients undergoing spinal surgery. Journal of Health, Medicine and Nursing. 2020;78:27-35
14. Anonymous. A rational approach to radiodiagnostic investiga¬tions. World Health Organ Tech Rep Ser. 1983;689:1-49.
15. Smetana GW. Preoperative pulmonary evaluation. N Engl J M 1999;340:937-44.
16. Doyle RL. Assessing and modifying the risk of postoperative pulmonary complications. Chest 1999;115(Suppl 5):77-81.
17. Goldman L, Caldera DL, Nussbaum SR, et al. Multifactorial index of cardiac risk in noncardiac surgical procedures. N Engl J Med. 1977;297:845-50.
18. Rock AK, Opalak CF, Workman KG, et al. Safety Outcomes Following Spine and Cranial Neurosurgery: Evidence From the National Surgical Quality Improvement Program. J Neurosurg Anesthesiol. 2018;30:328-36.
19. Edwards AE, Seymour DG, McCarthy JM, et al. A 5-year survival study of general surgical patients aged 65 years and over. Anaesthesia 1996;51:3-10.
20. Bharati SJ, Pandia MP, Rath GP, et al. Respiratory complications in the early post-operative period following elective craniotomies. J Neuroanaesth Crit Care. 2015;2:114–20.
21. Manninen PH, Raman SK, Boyle K, et al. Early postoperative complications following neurosurgical procedures. Can J Anaesth. 1999;46:7–14.
22. Sogame LC, Vidotto MC, Jardim JR, et al. Incidence and risk factors for postoperative pulmonary complications in elective intracranial surgery. J Neurosurg. 2008;109:222–7.
23. Hall JC, Tarala RA, Hall JL, et al. A multivariate analysis of the risk of pulmonary complications after laparotomy. Chest. 1991;99:923–7.
24. Smetana GW, Lawrence VA, Cornell JE American College of Physicians. Preoperative pulmonary risk stratification for noncardiothoracic surgery: Systematic review for the American College of Physicians. Ann Intern Med. 2006;144:581–95.
25. Qaseem A, Snow V, Fitterman N, et al. Risk assessment for and strategies to reduce perioperative pulmonary complications for patients undergoing noncardiothoracic surgery: A guideline from the American college of physicians. Ann Intern Med. 2006;144:575–80.
26. Franceschini J, Sogame LC, Gazzotti MR, et al. Pulmonary function and thoraco-abdominal configuration after elective craniotomy. Neurosurg Q. 2008;18:22–7.
27. Manninen PH, Raman SK, Boyle K, et al. Early postoperative complications following neurosurgical procedures. Can J Anaesth. 1999;46:7–14.
28. Hooda B, Chouhan RS, Rath GP, et al. Incidence and predictors of postoperative pulmonary complications in patients undergoing craniotomy and excision of posterior fossa tumor. J Anaesthesiol Clin Pharmacol. 2019;35:254-60.
29. Sogame LC, Vidotto MC, Jardim JR, et al. Incidence and risk factors for postoperative pulmonary complications in elective intracranial surgery. J Neurosurg. 2008;109:222–7.
30. Marda M, Pandia MP, Rath GP, et al. Post-operative pulmonary complications in patients undergoing transoral odontoidectomy and posterior fixation for craniovertebral junction anomalies. J Anaesthesiol Clin Pharmacol. 2013;29:200–4.
31. Flexman AM, Merriman B, Griesdale DE, et al. Infratentorial neurosurgery is an independent risk factor for respiratory failure and death in patients undergoing intracranial tumor resection. J Neurosurg Anesthesiol. 2014;26:198–204.