CASE REPORT

DOI: 10.5336/caserep.2022-90399

# A Complication of a Frequent Procedure That is Uncommon but Can be Fatal: Activated Charcoal Aspiration

Hatice ALBAYRAK[a], Muhammed ÜDÜRGÜCÜ[a], Hatice Elif KINIK KAYA[a], Merve ÇELENK[b], Nazik YENER[a]

[a]Division of Pediatric Critical Care, Ondokuz Mayıs University Faculty of Medicine, Samsun, Türkiye
[b]Department of Pediatric Surgery, Ondokuz Mayıs University Faculty of Medicine, Samsun, Türkiye

**ABSTRACT** Activated charcoal is a safe and effective material widely used for decontamination in poisoning cases. The case is here presented of a 3-year-old male child who developed severe respiratory failure due to activated charcoal aspiration and recovered with supportive treatment and repeated bronchoscopic irrigation. When using activated charcoal it must be kept in mind that there could be complications resulting in severe morbidities or even be life-threatening. This case is presented to draw attention to the potentially serious complications of activated charcoal, which is relatively often used in pediatric emergency practice and to emphasize that serial bronchoscopic irrigation can contribute to the recovery of ventilation parameters.

**Keywords:** Activated charcoal; aspiration; bronchoscopy; respiratory failure

Activated charcoal, is an effective, inexpensive, and safe gastrointestinal absorbant that is used in several intoxications. It is applied following stomach lavage by the oral route or gastric catheter. Generally, activated charcoal is admininstered in a water solution or cathartically pre-mixed with sorbitol.[1] Contra-indications for the use of activated charcoal are airway not under control, if caustic or corrosive substances have been ingested, or if there is paralytic or mechanical ileus and endoscopy is to be applied. In literature, the aspiration of activated charcoal has been associated with pneumonia, pleural empyema, acute respiratory distress syndrome (ARDS), pneumomediastinum and death.[1-6]

The case is here presented of a patient who presented with drug intoxication and developed severe respiratory failure associated with activated charcoal aspiration. In this case, we aimed to draw attention to the contribution of repetitive bronchoscopies to ventilation in activated charcoal aspiration, which is a life-threatening complication. Consent was obtained from the family for the case presentation.

## CASE REPORT

A previously healthy 3-year-old male was brought to the Emergency Department with the suspicion that he had ingested approximately 40 tablets containing perindopril/indapamide 30 mins ago. In the first physical examination, vital signs were within normal limits and gastric lavage has performed. Drug fragments have been seen in gastric lavage content and then activated charcoal was administered with gastric catheter at the dose of 1 g/kg. After the administration, the patient became agitated so the gastric catheter was removed and the patient immediately vomited. A physical examination was again performed. Rales and wheezing were heard bilaterally in the lungs and the respiratory sounds were found to be

**Correspondence:** Hatice ALBAYRAK
Division of Pediatric Critical Care, Ondokuz Mayıs University Faculty of Medicine, Samsun, Türkiye
**E-mail:** hatice_albayrak52@hotmail.com

Peer review under responsibility of Turkiye Klinikleri Journal of Case Reports.

***Received:*** 07 Apr 2022 ***Received in revised form:*** 18 Jun 2022 ***Accepted:*** 21 Jun 2022 ***Available online:*** 28 Jun 2022

decreased in the left lung. Oxygen support was provided with a reservoir mask at 6 lt/min and nebulized salbutamol. On the pulmonary radiograph, a patch of consolidation was observed bilaterally in the basal zone and in the hilar region on the left (Figure 1). Venous blood gas results were determined as pH: 7.06, $pCO_2$: 68.6 mmHg, $pO_2$: 43.1 mmHg, and lactate: 4.4 mmol/L. As severe respiratory problems developed during the follow up, the patient was admitted to the Pediatric Intensive Care Unit, where high-flow oxygen support (25 lt/min, $FIO_2$: 60%) and antibiotherapy (ampicillin sulbactam) were started. Despite the treatment, respiratory failure developed and the patient was intubated in the 6$^{th}$ hour. Ventilation was provided in pressure regulated volume control mode, at tidal volume: 6 mL/kg, positive end expiratory pressure (PEEP): 5 cm $H_2O$, frequency: 40/min, peak inspiratory pressure: 26 cm $H_2O$. On the control pulmonary radiograph, the bilateral patches of consolidation were seen to have increased. At the 18$^{th}$ hour of follow-up, the first therapeutic bronchoscopy was performed. Dense activated charcoal was observed in the distal part of the right and left bronchi and bronchioles and this was cleaned as much as possible with lavage (Figure 2). After first bronchoscopy, the peak inspiratory pressure decreased to 20-22 cm $H_2O$ with same tidal volume and venous blood gas parameters returned to normal. Bronchoscopy was performed again on days 3 and 5 and each time activated charcoal was observed to have been aspirated in the airways. In the final bronchoscopy, fibrotic changes were also observed at the level of the carina (Figure 3). On the 10$^{th}$ day after aspiration, thoracic computed tomography was applied to the patient. More evident acinar alveolar densities were observed in the posterior of both lungs and accompanying this there was seen to be bronchial wall thickening and interlobular septal thickening. On the 11$^{th}$ day after admission, the respiratory parameters had recovered and the patient was discharged without any oxygen support. Chest radiography returned to normal (Figure 4).

**FIGURE 1:** First posteroanterior chest radiography after activated charcoal aspiration.

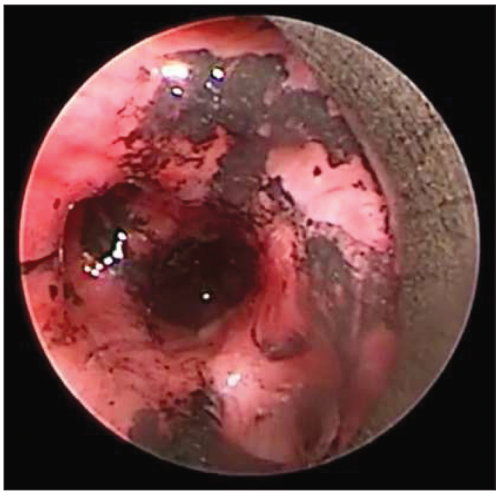

**FIGURE 2:** Bronchoscopic view of aspirated activated charcoal.

**FIGURE 3:** Fibrotic changes at the level of the carina.

## DISCUSSION

Aspiration of activated charcoal is a rare complication. In a study of patients receiving 878 multiple doses of activated charcoal, Dorrington et al. reported

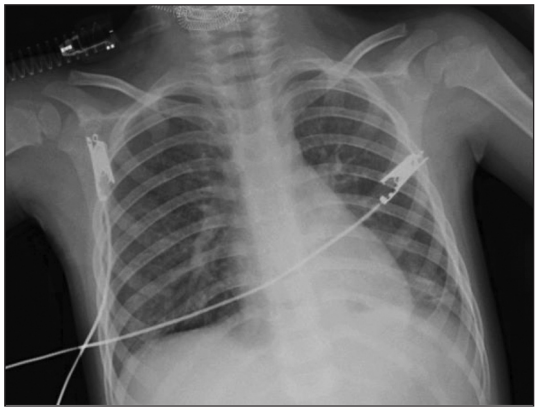

**FIGURE 4:** Posterior anterior chest radiography before discharge.

aspiration in 5 (0.6%).[2] In literature, the adverse events experienced with activated charcoal have been reported to originate mostly from unprotected airway, excessive doses of activated charcoal, concomitant drug use, inappropriate dilution, and malpositioning of the gastric catheter.[1,3,6,7]

It is thought that aspirated activated charcoal has no direct damaging effect on the lungs, but it may cause bronchospasm and complications may result from oral bacteria contamination and stomach acid aspiration.[8] Arnold et al. reported that by administrating activated charcoal directly to the lungs, there was an increase in pulmonary vascular permeability and consequently pulmonary oedema developed.[9] In that study, it was thought that the effect of activated charcoal was mediated by cytokines, proteases, and oxygen radicals expressed from macrophages, and the stenosis created by charcoal accumulation in the small airways leading to excessive alveolar distension in the healthy airways (volutrauma-like effect) contributed to this damage. Chronic lung disease developing after activated charcoal aspiration has also been reported. In the histopathological evaluation of these patients, particle deposits have been observed in addition to obliteration of the bronchioles and giant cell reaction.[6,10] Although histopathological evaluation was not made of the current patient, a fibrotic appearance was observed on bronchoscopy at the end of the first week. In the light of the data of experimental studies and case reports in literature, this condition has been thought to be a precursor for the development of chronic lung disease. Follow up of these patients after the acute period can contribute to reducing morbidity.

Activated charcoal aspiration treatment starts with prevention. To reduce the risk of aspiration, it is recommended that in patients with no gag reflex and altered mental status, intubation is performed with a cuffed tube to protect the airway before gastric lavage and the administration of activated charcoal.[1] The incidence of activated charcoal aspiration in intubated patients is extremely low.[11] Activated charcoal, sorbitol, or an excessive drug dose can cause vomiting. Vomiting is usually seen following removal of the endotracheal tube or gastric catheter. To prevent this, the endotracheal tube and gastric catheter should not be removed for at least 4 hours after the administration of activated charcoal, and gastric aspiration must be performed before removal.[12] In the current case, the catheter was removed because of agitation and it is thought that aspiration developed after vomiting. In these patients, waiting for the patient to become calm before the procedure, providing good stabilisation of the gastric catheter, and establishing good communication with the mother and child can prevent aspiration by avoiding removal of the gastric catheter.

If activated charcoal aspiration occurs, airway safety must be secured rapidly and then appropriate ventilation must be provided. In cases who develop ARDS, the use of high PEEP has been recommended.[4,7,13] Increasing bronchoalveolar clearance with bronchodilator therapy and clearing activated charcoal exposure with repeated bronchoscopy/aspiration is an important part of treatment.[4,5,14,15] Lung protective ventilation with low tidal volume was applied to the current patient and oxygenation was provided without the need for high PEEP values. Invasive mechanical ventilation was applied for a total of 6 days then the patient was successfully weaned. It was thought that serial bronchoscopic lavage at this stage facilitated the ventilation of the patient.

When using activated charcoal it must be kept in mind that it is not without harm and there could be complications resulting in severe morbidities and which are even life-threatening. To avoid these com-

plications, activated charcoal should be used with attention paid to the patient, the appropriate dose, and the safe application steps. As respiratory failure is often seen in cases that develop activated charcoal aspiration, this case has been presented with the aim of emphasizing that follow up in intensive care and serial bronchoscopic lavages will contribute to the recovery of ventilation parameters.

### *Source of Finance*

*During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.*

### *Conflict of Interest*

*No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.*

### *Authorship Contributions*

***Idea/Concept:*** *Hatice Albayrak;* ***Design:*** *Hatice Albayrak;* ***Control/Supervision:*** *Nazik Yener;* ***Data Collection and/or Processing:*** *Merve Çelenk, Hatice Elif Kinik Kaya;* ***Analysis and/or Interpretation:*** *Hatice Albayrak, Nazik Yener;* ***Literature Review:*** *Muhammed Üdürgücü, Hatice Elif Kinik Kaya;* ***Writing the Article:*** *Hatice Albayrak;* ***Critical Review:*** *Muhammed Üdürgücü, Nazik Yener;* ***Materials:*** *Merve Çelenk, Hatice Elif Kinik Kaya.*

## REFERENCES

1. Harris CR, Filandrinos D. Accidental administration of activated charcoal into the lung: aspiration by proxy. Ann Emerg Med. 1993;22(9):1470-3. [Crossref] [PubMed]
2. Dorrington CL, Johnson DW, Brant R; Multiple Dose Activated Charcoal Complication Study Group. The frequency of complications associated with the use of multiple-dose activated charcoal. Ann Emerg Med. 2003;41(3):370-7. [Crossref] [PubMed]
3. Godambe SA, Mack JW, Chung DS, Lindeman R, Lillehei CW, Colin AA. Iatrogenic pleuropulmonary charcoal instillation in a teenager. Pediatr Pulmonol. 2003;35(6):490-3. [Crossref] [PubMed]
4. Golej J, Boigner H, Burda G, Hermon M, Trittenwein G. Severe respiratory failure following charcoal application in a toddler. Resuscitation. 2001;49(3):315-8. [Crossref] [PubMed]
5. Durkan A, Çakmak M, Öztürk B, Kandemir MN, Birel FD. Aktif kömür aspirasyonu ile ilişkili pnömomediastinum [Pneumomediastinum associated with aspiration of activated charcoal]. İzmir Göğüs Hastalıkları Dergisi. 2016;3:183-6. [Link]
6. Elliott CG, Colby TV, Kelly TM, Hicks HG. Charcoal lung. Bronchiolitis obliterans after aspiration of activated charcoal. Chest. 1989;96(3):672-4. [Crossref] [PubMed]
7. Pollack MM, Dunbar BS, Holbrook PR, Fields AI. Aspiration of activated charcoal and gastric contents. Ann Emerg Med. 1981;10(10):528-9. [Crossref] [PubMed]
8. Osterhoudt KC, Alpern ER, Durbin D, Nadel F, Henretig FM. Activated charcoal administration in a pediatric emergency department. Pediatr Emerg Care. 2004;20(8):493-8. [Crossref] [PubMed]
9. Arnold TC, Willis BH, Xiao F, Conrad SA, Carden DL. Aspiration of activated charcoal elicits an increase in lung microvascular permeability. J Toxicol Clin Toxicol. 1999;37(1):9-16. [Crossref] [PubMed]
10. Graff GR, Stark J, Berkenbosch JW, Holcomb GW 3rd, Garola RE. Chronic lung disease after activated charcoal aspiration. Pediatrics. 2002;109(5):959-61. [Crossref] [PubMed]
11. Moll J, Kerns W 2nd, Tomaszewski C, Rose R. Incidence of aspiration pneumonia in intubated patients receiving activated charcoal. J Emerg Med. 1999;17(2):279-83. [Crossref] [PubMed]
12. Mauro LS, Nawarskas JJ, Mauro VF. Misadventures with activated charcoal and recommendations for safe use. Ann Pharmacother. 1994;28(7-8):915-24. [Crossref] [PubMed]
13. Schreiber T, Hueter L, Gaser E, Schmidt B, Schwarzkopf K, Rek H, et al. PEEP has beneficial effects on inflammation in the injured and no deleterious effects on the noninjured lung after unilateral lung acid instillation. Intensive Care Med. 2006;32(5):740-9. [Crossref] [PubMed]
14. Perkins GD, Gao F, Thickett DR. In vivo and in vitro effects of salbutamol on alveolar epithelial repair in acute lung injury. Thorax. 2008;63(3):215-20. [Crossref] [PubMed]
15. Bennett WD, Almond MA, Zeman KL, Johnson JG, Donohue JF. Effect of salmeterol on mucociliary and cough clearance in chronic bronchitis. Pulm Pharmacol Ther. 2006;19(2):96-100. [Crossref] [PubMed]