Hoffmann J, et al., J Clin Stud Med Case Rep 2024, 11: 248
DOI: 10.24966/CSMC-8801/1000248

HSOA Journal of
Clinical Studies and Medical Case Reports

Case Report

High Flow Oxygen Therapy and Secondary Spontaneous Pneumothorax a case report

Julia Hoffmann[1], Olga Morath[2], Helmut Schiffl[3] and Susanne M. Lang[1]*

[1]*Klinik für Innere Medizin V, University Hospital UKJ, Jena, Germany*

[2]*Klinik für Innere Medizin II, University Hospital UKJ, Jena, Germany*

[3]*Medizinische Klinik IV, University Hospital LMU, München, Germany*

Abstract

Treatment of secondary spontaneous pneumothorax in high-risk surgical patients with chronic pulmonary disease is a challenge in standard and emergency care. The observation that supplementary oxygen may lead to better reabsorption of pneumothorax has been known for over 50 years. It can help to avoid potential high-risk interventions or surgery in multimorbid patients. Nevertheless, due to insufficient physician´s knowledge of this non-invasive approach and the lack of representation in recent guidelines the conservative approach is seldomly considered as an alternative to interventional management.

We present a case of successful conservative treatment of symptomatic secondary spontaneous pneumothorax with high dose oxygen therapy and discuss the underlying literature regarding safety and efficacy of this treatment method.

Keywords: Pneumothorax; Conservative management; Oxygen therapy

Key Message

High flow oxygen therapy seems to be an effective, safe, and widely available conservative treatment option for small SSP, particularly for patients who are not fit for surgery or needle aspiration or drainage due to any reason.

***Corresponding author:** Susanne M Lang, Klinik für Innere Medizin V, University Hospital UKJ, Jena, Germany. Email: susanne.lang@med.uni-jena.de

Citation: Hoffmann J, Morath O, Schiffl H, Lang SM (2024) High Flow Oxygen Therapy and Secondary Spontaneous Pneumothorax a case report. J Clin Stud Med Case Rep 11: 248.

Received: July 31, 2024; **Accepted:** August 08, 2024; **Published:** August 16, 2024

Introduction

Secondary spontaneous pneumothorax (SSP) represents a medical emergency where the lung collapses in patients with underlying lung disease [1]. Hospitalization with initial interventions is the recommended management algorithm. In current national guidelines alternative treatment is not considered [2]. However, patients with SSP are often poor candidates for interventions due to their high risk for potential complications. There is ongoing interest in non-invasive conservative approaches to SSP, and a trend to shift from the strict symptom / size driven approaches to a more liberal conservative management of SSP [3,4]. We report the case of a multimorbid 67-year-old male severely symptomatic patient with SSP managed effectively and safely by high flow oxygen therapy.

Case History

A 67-year-old male was admitted to the emergency department of the university hospital Jena with increasing right sided pleuritic chest pain (over 3-days), severe dyspnoea, and haemoptysis. The patient had multiple pre-existing conditions impacting his health status, especially chronic extensive damage to the lungs caused by chronic obstructive pulmonary disease stage 3, chronic interstitial lung fibrosis due to chronic graft versus host disease after allogenic stem cell transplantation for aggressive B-Cell lymphoma, and recurrent broncho-pleural infections as a result of secondary immunodeficiency. The patient had been prescribed long-term oxygen therapy for chronic hypoxic respiratory failure with a flow-rate between 2-3 l/min. Upon arrival, the patient was hemodynamically stable. The contrast enhanced computer tomography of the chest showed a ventral-based small pneumothorax in the right lung without signs of tracheal deviation to the contralateral side or flattening of the hemidiaphragm on the ipsilateral side (tension pneumothorax). The management of the pneumothorax was discussed in a multi-disciplinary team. In view of pre-existing severe lung-damage (emphysema, lung fibrosis), the attending physicians decided for conservative management and against video-assisted thoracoscopic surgery with attached thoracic drainage. The patient received high flow oxygen (up to 15 l/min, reservoir mask) for resolution of the pneumothorax and hypoxic respiratory failure. Prednisolone and antibiotics were added for COPD exacerbation and epinephrine inhalation for alveolar haemorrhage. The treatment resulted in a rapid improvement of dyspnoea, chest pain and haemoptysis. Ten days after admission, a non-contrast CT showed a relevant reduction in the size of the ventral pneumothorax (17 mm vs 10 mm, Fig 1 and 2). Close monitoring of the blood gases disclosed hypercapnia. The patient was discharged after 12 hospital days. There was no re-occurrence of a SSP during long-term follow up.

Discussion

There is a large heterogeneity of SSP patients regarding lung function, co-existing health conditions, clinical symptoms and radiologic size of the pneumothorax. Patients with SSP are often poor candidates for interventions (needle aspiration, chest tube) due to their overall health state and their high risk for potential complications resulting

from invasive techniques. There is one randomized controlled trial comparing conservative with interventional management of moderate to large sized primary spontaneous pneumothorax (PSP) in unselected patients without hemodynamic compromise or intractable chest pain. The results challenged the fundamental concept that initial routine drainage is required in most patients with PSP [5]. Moreover, the results of the meta-analysis conducted by Liu et al suggested that conservative treatment offers a safe and effective alternative as compared with interventional treatment approaches for patients with PSP [6]. The question remains if this conservative treatment is also suited for patients with SSP. Retrospective case series [7] as well as a cohort analysis [8] described successful conservative management of SSP patients when a significant proportion of them met accepted criteria for pleural interventions (breathlessness, interpleural distance at the hilum of >1 cm). None of these conservatively managed patients required a delayed or subsequent intervention. But as it is now, there is considerable heterogeneity in the management of SSP as clinical guidelines make room for individual clinical preferences. Individual care decisions of SSP patients are hampered by the availability of therapeutic choices, the substantial inconsistency in international guidelines for the treatment of pneumothorax, and a lack of high-quality trials and evidence for one method or the other. It is also not clear if the same approach should be applied to every patient with SSP, and if the symptom / size driven management choice should also appraise a risk stratification (patient's chronic health status and the risk for surgical interventions).

The recent evidence of successful conservative management of SSP challenges current guidelines [9]. There is a need to re-evaluate management and to design a simple and pragmatic approach to hypoxemic patients with small / moderate unilateral pneumothorax. This is particularly true for older patients with a high burden of comorbid diseases, or increased risk regarding needle aspiration, intercostal chest tube or anaesthesia. The primary goals of treatment in SSP are air elimination, reduction of the air leakage, healing of the pleural fistula, promoting expansion of the lung and prevention of future recurrences. Hypoxemic patients with moderate to large pneumothorax may be breathless and hypoxemic and may require at least supplementary oxygen up to 5L/min for symptom relief (pending definitive treatment by conservative or interventional approach). The BTS guidelines [10] and the recent edition of the Textbook for Respiratory Medicine recommend hospitalisation and high flow oxygen therapy for symptomatic patients with small pneumothorax. Currently, available evidence is rather limited. There are few cohorts [11-13], case series [7,14-16] or anecdotal case reports [17]. Within the methodological limitations of predominantly retrospective observational studies and with regard to the heterogeneity of patient characteristics, oxygen therapy was useful for the treatment of all types of spontaneous pneumothorax presented in the studies listed above. It was found to be safe and effective for the removal of air from pleural cavity and prevention of its recurrence. In most patients it was associated with reduced length of hospital stay. Recently, Li and colleagues [11] reported a clinical analysis describing patient features and success rates of treatment modality in 350 cases with SSP due to pneumoconiosis stages 1 to 3. Approximately one half of these patients also had a history of COPD and pulmonary infections. High flow oxygen therapy was effective in 93% of 233 patients receiving high flow oxygen therapy. In contrast, the efficiency of thoracic chest tube placement in 114 cases was only 86 %. The prospective clinical study by Northfield et al. studied 10 patients with SSP of varying volumes treated with high flow oxygen (8 l/min). Each patient had a daily chest x-ray from which the pneumothorax rate was calculated. The resolution rate of these participants was compared to a historic cohort of 12 patients who had been treated with bed rest only. The resolution rate of pneumothorax was 4.2 cm2/day, but increased with high flow oxygen administration to 17.9 cm2 /day. The rate of resolution was dependent on pneumothorax size, with larger pneumothoraxes having significantly greater resolution in patients on oxygen. There were no side effects recorded from high flow oxygen therapy [12]. Other therapeutic studies assessing the effect of oxygen therapy on resolution rate of SSP reproduced the findings of this original study [13,14]. Moreover, well-designed experimental investigations using models of pneumothoraxes provided the strongest evidence of a cause- effect relationship between high flow oxygen administration and reduction of pneumothorax [18-20]. The theory behind high flow oxygen therapy is that both higher flow rate and increased fraction of inspired oxygen reduce the partial pressure of nitrogen in the alveolar space compared with the pleural cavity, and that the resulting diffusion gradient for nitrogen accelerates the resolution rate of the pneumothorax (principle of nitrogen washout) (Figures 1-3). The concept of high flow oxygen therapy may represent an effective and safe approach for the conservative management of patients with small SSP, but its importance has been under-appreciated and/ or misunderstood. Common barriers such as weak evidence for the clinical utility of high flow oxygen therapy, the fear of risks arising from oxygen administration, lacking evidence for cost-effectiveness or benefit/risk analyses, and insufficient physician´s knowledge of this alternative approach prevent the widespread application of this therapeutic approach to SSP.

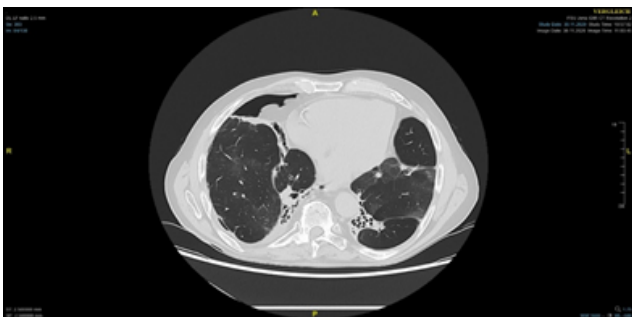

Figure 1: Contrast-enhanced chest CT on admission: ventral-basal pneumothorax in the right lung without signs of a tension component. Diffuse alveolar haemorrhage in the right lobe.

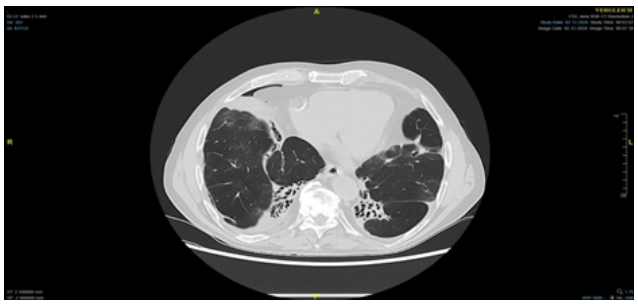

Figure 2: Non contrast-enhanced chest CT on day 10: Ventral pneumothorax reduced by 50% (7 mm on day 10 compared to 14mm on day one).

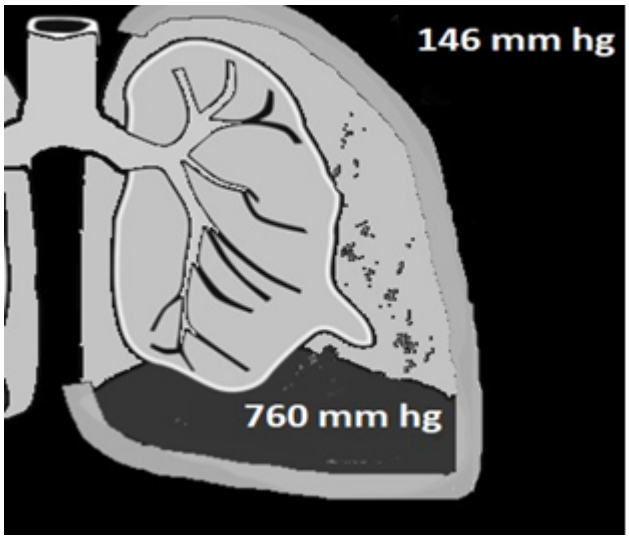

Figure 3: Permanent gas exchange between pleural capillaries and pleural cavity results in reabsorption of the pneumothorax. The effects are driven by the pressure gradient between pleural capillaries and pleural space. High flow oxygen raises arterial oxygen pressure. The total gas pressure in capillary and venous blood decreases. A high-pressure gradient develops between pleural cavity and pleural capillaries, resulting in a better reabsorption of air.

One major underlying factor hindering evidence of clinical efficacy is the general lack of published randomized controlled trials comparing the rates of pneumothorax resolution by high flow oxygen therapy with supplemental oxygen on one hand, and with interventional techniques on the other hand. The few reported studies, the low quality (evidence level 3), the large heterogeneity in patient and treatment characteristics, as well the limitations of single centre studies impact on the widespread clinical adoption of high flow oxygen therapy. Larger pneumothoraxes exhibited a significantly greater reduction in area than smaller pneumothoraxes when on oxygen therapy: Thus, a vocal cadre of scientists [13,17] doubts the clinical usefulness of high flow oxygen therapy for the following reasons:

1. The absolute difference in the rate, particularly of small / moderate sized pneumothoraxes is not great;
2. Small pneumothoraxes also resolve by breathing room air;
3. Oxygen therapy has potential adverse effects;
4. Patients with small pneumothoraxes usually maintain adequate oxygenation without oxygen administration;
5. Some studies reported no association between oxygen therapy and the resolution of neonatal pneumothorax.

There is an ungrounded fear that adequately performed high flow oxygen causes hypercapnia in patients with SSP [17]. However, the BTS guidelines recommend high-flow oxygen to hypoxic patients with SSP only with close monitoring and maintenance of oxygen saturation within generally accepted ranges. None of the available observations reported any adverse effect of high flow oxygen therapy. High flow oxygen therapy seems to be an effective, safe, and widely available conservative treatment option for small SSP, particularly for patients who are not fit for surgery or needle aspiration or drainage due to any reason. If it is used with caution even in patients with pre-existing chronic lung disease with chronic respiratory failure serious complications are not necessarily observed. However, well-controlled prospective studies are required to confirm the indications for high flow oxygen therapy.

Conflicts of Interest

nil

References

1. Schnell J, Koryllos A, Lopez-Pastorini A, Lefering R, Stoelben E (2017) Spontaneous Pneumothorax. Dtsch Arztebl Int 114: 739-744.
2. Schnell J, Beer M, Eggeling S, Gesierich W, Gottlieb J, et al. (2018) Management of Spontaneous Pneumothorax and Postinterventional Pneumothorax: German S3-Guideline. Zentralbl Chir 143: S12-S43.
3. Hallifax RJ, Roberts M, Russell N, Laskawiec-Szkonter M, Walker SP, et al. (2022) Pneumothorax management: current state of practice in the UK. Respir Res 23: 23.
4. Nava GW, Walker SP (2022) Management of the Secondary Spontaneous Pneumothorax: Current Guidance, Controversies, and Recent Advances. J Clin Med 11.
5. Brown SGA, Ball EL, Perrin K, Asha SE, Braithwaite I, et al. (2020) Conservative versus Interventional Treatment for Spontaneous Pneumothorax. N Engl J Med 382: 405-415.
6. Liu WL, Lv K, Deng HS, Hong QC (2021) Comparison of efficiency and safety of conservative versus interventional management for primary spontaneous pneumothorax: A meta-analysis. Am J Emerg Med 45: 352-357.
7. Cortes-Telles A, Ortíz-Farias DL, Perez-Hernandez F, Rodriguez-Morejon D (2021) Secondary spontaneous pneumothorax: a time to re-evaluate management. Respirol Case Rep 9: e00749.
8. Gerhardy BC, Simpson G (2021) Conservative versus invasive management of secondary spontaneous pneumothorax: a retrospective cohort study. Acute Med Surg 8: e663.
9. Hallifax R, Janssen JP (2019) Pneumothorax-Time for New Guidelines? Semin Respir Crit Care Med 40: 314-322.
10. MacDuff A, Arnold A, Harvey J, Group BTSPDG (2010) Management of spontaneous pneumothorax: British Thoracic Society Pleural Disease Guideline 2010. Thorax 65: 8-31.
11. Li Y, Zhang XH, Long ZY, Kang DP (2020) [Clinical analysis of 350 cases of pneumoconiosis complicated with spontaneous pneumothorax]. Zhonghua Lao Dong Wei Sheng Zhi Ye Bing Za Zhi 38: 48-50.
12. Northfield TC (1971) Oxygen therapy for spontaneous pneumothorax. Br Med J 4: 86-8.
13. Park CB, Moon MH, Jeon HW, Cho DG, Song SW, et al. (2017) Does oxygen therapy increase the resolution rate of primary spontaneous pneumothorax? J Thorac Dis 9: 5239-5243.
14. Chadha TS, Cohn MA (1983) Noninvasive treatment of pneumothorax with oxygen inhalation. Respiration 44: 147-152.
15. Pallin M, Open M, Moloney E, Lane SJ (2010) Spontaneous pneumothorax management. Ir Med J 103: 272-275.
16. Panjwani A (2017) Management of pneumothorax with oxygen therapy: a case series. Chest Disease Reports 5.

17. Roberts D, Wacogne I (2010) Question 3. In patients with spontaneous pneumothorax, does treatment with oxygen increase resolution rate? Arch Dis Child 95: 397-398.

18. England GJ, Hill RC, Timberlake GA, Harrah JD, Hill JF, et al. (1998) Resolution of experimental pneumothorax in rabbits by graded oxygen therapy. J Trauma 45: 333-334.

19. Hill RC, DeCarlo DP, Hill JF, Beamer KC, Hill ML, et al. (1995) Resolution of experimental pneumothorax in rabbits by oxygen therapy. Ann Thorac Surg 59: 825-827.

20. Zierold D, Lee SL, Subramanian S, DuBois JJ (2000) Supplemental oxygen improves resolution of injury-induced pneumothorax. J Pediatr Surg 35: 998-1001.

HERALD

Advances In Industrial Biotechnology | ISSN: 2639-5665

Advances In Microbiology Research | ISSN: 2689-694X

Archives Of Surgery And Surgical Education | ISSN: 2689-3126

Archives Of Urology

Archives Of Zoological Studies | ISSN: 2640-7779

Current Trends Medical And Biological Engineering

International Journal Of Case Reports And Therapeutic Studies | ISSN: 2689-310X

Journal Of Addiction & Addictive Disorders | ISSN: 2578-7276

Journal Of Agronomy & Agricultural Science | ISSN: 2689-8292

Journal Of AIDS Clinical Research & STDs | ISSN: 2572-7370

Journal Of Alcoholism Drug Abuse & Substance Dependence | ISSN: 2572-9594

Journal Of Allergy Disorders & Therapy | ISSN: 2470-749X

Journal Of Alternative Complementary & Integrative Medicine | ISSN: 2470-7562

Journal Of Alzheimers & Neurodegenerative Diseases | ISSN: 2572-9608

Journal Of Anesthesia & Clinical Care | ISSN: 2378-8879

Journal Of Angiology & Vascular Surgery | ISSN: 2572-7397

Journal Of Animal Research & Veterinary Science | ISSN: 2639-3751

Journal Of Aquaculture & Fisheries | ISSN: 2576-5523

Journal Of Atmospheric & Earth Sciences | ISSN: 2689-8780

Journal Of Biotech Research & Biochemistry

Journal Of Brain & Neuroscience Research

Journal Of Cancer Biology & Treatment | ISSN: 2470-7546

Journal Of Cardiology Study & Research | ISSN: 2640-768X

Journal Of Cell Biology & Cell Metabolism | ISSN: 2381-1943

Journal Of Clinical Dermatology & Therapy | ISSN: 2378-8771

Journal Of Clinical Immunology & Immunotherapy | ISSN: 2378-8844

Journal Of Clinical Studies & Medical Case Reports | ISSN: 2378-8801

Journal Of Community Medicine & Public Health Care | ISSN: 2381-1978

Journal Of Cytology & Tissue Biology | ISSN: 2378-9107

Journal Of Dairy Research & Technology | ISSN: 2688-9315

Journal Of Dentistry Oral Health & Cosmesis | ISSN: 2473-6783

Journal Of Diabetes & Metabolic Disorders | ISSN: 2381-201X

Journal Of Emergency Medicine Trauma & Surgical Care | ISSN: 2378-8798

Journal Of Environmental Science Current Research | ISSN: 2643-5020

Journal Of Food Science & Nutrition | ISSN: 2470-1076

Journal Of Forensic Legal & Investigative Sciences | ISSN: 2473-733X

Journal Of Gastroenterology & Hepatology Research | ISSN: 2574-2566

Journal Of Genetics & Genomic Sciences | ISSN: 2574-2485

Journal Of Gerontology & Geriatric Medicine | ISSN: 2381-8662

Journal Of Hematology Blood Transfusion & Disorders | ISSN: 2572-2999

Journal Of Hospice & Palliative Medical Care

Journal Of Human Endocrinology | ISSN: 2572-9640

Journal Of Infectious & Non Infectious Diseases | ISSN: 2381-8654

Journal Of Internal Medicine & Primary Healthcare | ISSN: 2574-2493

Journal Of Light & Laser Current Trends

Journal Of Medicine Study & Research | ISSN: 2639-5657

Journal Of Modern Chemical Sciences

Journal Of Nanotechnology Nanomedicine & Nanobiotechnology | ISSN: 2381-2044

Journal Of Neonatology & Clinical Pediatrics | ISSN: 2378-878X

Journal Of Nephrology & Renal Therapy | ISSN: 2473-7313

Journal Of Non Invasive Vascular Investigation | ISSN: 2572-7400

Journal Of Nuclear Medicine Radiology & Radiation Therapy | ISSN: 2572-7419

Journal Of Obesity & Weight Loss | ISSN: 2473-7372

Journal Of Ophthalmology & Clinical Research | ISSN: 2378-8887

Journal Of Orthopedic Research & Physiotherapy | ISSN: 2381-2052

Journal Of Otolaryngology Head & Neck Surgery | ISSN: 2573-010X

Journal Of Pathology Clinical & Medical Research

Journal Of Pharmacology Pharmaceutics & Pharmacovigilance | ISSN: 2639-5649

Journal Of Physical Medicine Rehabilitation & Disabilities | ISSN: 2381-8670

Journal Of Plant Science Current Research | ISSN: 2639-3743

Journal Of Practical & Professional Nursing | ISSN: 2639-5681

Journal Of Protein Research & Bioinformatics

Journal Of Psychiatry Depression & Anxiety | ISSN: 2573-0150

Journal Of Pulmonary Medicine & Respiratory Research | ISSN: 2573-0177

Journal Of Reproductive Medicine Gynaecology & Obstetrics | ISSN: 2574-2574

Journal Of Stem Cells Research Development & Therapy | ISSN: 2381-2060

Journal Of Surgery Current Trends & Innovations | ISSN: 2578-7284

Journal Of Toxicology Current Research | ISSN: 2639-3735

Journal Of Translational Science And Research

Journal Of Vaccines Research & Vaccination | ISSN: 2573-0193

Journal Of Virology & Antivirals

Sports Medicine And Injury Care Journal | ISSN: 2689-8829

Trends In Anatomy & Physiology | ISSN: 2640-7752

Submit Your Manuscript: https://www.heraldopenaccess.us/submit-manuscript

Herald Scholarly Open Access, 2561 Cornelia Rd, #205, Herndon, VA 20171, USA.
Tel: +1 202-499-9679; E-mail: info@heraldsopenaccess.us
http://www.heraldopenaccess.us/