

Early Career Forum

European Respiratory Society International Congress 2020: highlights from best-abstract awardees

Introduction

During the 2020 European Respiratory Society (ERS) International Congress, the author of the best abstract (highest average score of abstract reviewers and only those who had not applied or were not eligible for a sponsored award) of every Assembly was awarded “a best-abstract certificate”. Best-abstract awardees were invited to write a short summary about their virtual Congress experience and their view on the evolving field of research in light of their respective ERS Assembly. The purpose of this article is to give the readers a quick overview of some of the Congress highlights and to give the stage to the promising best-abstract awardees as they are the future of the ERS.

Assembly 2: Respiratory Intensive Care (Noel Britton)

Given the overwhelming challenge that coronavirus disease 2019 (COVID-19) has presented in 2020, it was fitting that much of Respiratory Intensive Care Assembly Congress content was related to describing patients with COVID-19 and how to care for them.

During the Hot Topic session on intensive care, Prof. Alexandre Demoule showed that patients in racial and ethnic minority groups were overrepresented in the clinical sample compared

to white people [1], which was likely due to socioeconomic factors including access to care rather than biological factors. While the majority of patients (75–85%) with COVID-19 were overweight or obese, the rate of patients with a comorbidity or risk factor associated with respiratory disease (smoking status, COPD, *etc.*) was lower than expected in patients with a severe respiratory infection. Mortality rates have been highly variable globally, but are estimated to be >30% for patients receiving care in the intensive care unit.

Older adults (aged >65 years) presented earlier in the disease course and with symptoms atypical of COVID-19 including falls, confusion, syncope and heart failure, and were more likely to have atypical findings on chest computer tomography (CT) imaging [1, 2]. Ground-glass opacities mixed with peripheral consolidations were common CT findings in older adults and these were associated with high mortality rates [3].

Much of the discussions, taking place around the care of patients with COVID-19, were about the treatment of hypoxaemia and appropriate ventilation. Many investigators presented single site observational studies examining the use of different ventilation methodologies including high-flow nasal cannula, different types of continuous positive airway pressure (CPAP) utilisation and mechanical ventilation settings. In the “Management of COVID-19” session, Prof. Paolo Navalesi presented a comprehensive review of the existing literature about pre-ventilation, noninvasive ventilation, mechanical ventilation and extracorporeal

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#ERSCongress 2020 best-abstract awardees summarise their virtual European Respiratory Society International Congress experience and views on the evolving field of research for their respective assembly <https://bit.ly/3kj9JrJ>



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membrane oxygenation (ECMO). In the Hot Topic session on intensive care, Prof. Stefano Nava shared data about the risk of viral transmission associated with different ventilation methodologies. There is agreement that there is enough data to provide clear conclusions about best practices for treatment of patients with COVID-19 requiring assisted ventilation and that further investigation is required to develop clinical guidelines and recommendations.

Assembly 4: Sleep and Breathing Disorders; and Clinical Physiology (Amany F. Elbehairy)

During the 2020 ERS International Congress, the link between obstructive sleep apnoea (OSA) and exercise intolerance was highlighted. Speakers in the “Exercise and sleep: from impaired function to new therapeutic strategies” symposium discussed the interactions between sleep and exercise from health-to-disease. Prof. Ludger Grote outlined the available data on reduced exercise capacity in OSA patients, a finding that was confirmed by recent meta-analyses [4, 5]. In this perspective, ELBEHAIRY *et al.* [6] have shown that OSA-associated resting systemic vascular dysfunction and pulmonary gas-exchange abnormalities during exercise are possible contributors for reduced exercise capacity and exertional dyspnoea.

Cardiovascular abnormalities are commonly associated with OSA. However, there was a debate after the ISAACC trial (Impact of Sleep Apnoea syndrome in the evolution of Acute Coronary syndrome. Effect of intervention with CPAP) results showing that, in non-sleepy patients with acute coronary syndrome (ACS), OSA was not associated with an increased prevalence of cardiovascular events [7]. On the contrary, a secondary analysis of the RICCADSA trial (Randomised Intervention with CPAP in Coronary Artery Disease and Sleep Apnoea) [8] showed that untreated OSA is an independent risk factor for major adverse cardiovascular/cerebrovascular events in revascularised patients with ACS. OSA has also been found to be an independent risk factor for faster expansion of thoracic aortic aneurysm over 3 years after controlling for blood pressure and baseline diameter [9].

In clinical physiology, a few studies presented during the ERS Congress have focused on assessing inspiratory neural drive (IND) using diaphragm electromyography. IND measurement provides a comprehensive insight into the mechanisms of dyspnoea and enables a more detailed mechanistic assessment of pharmacological and non-pharmacological therapeutic interventions in cardio-respiratory diseases. DOMNIK *et al.* [10] have shown that increased awake IND in COPD

(compared with controls) fell significantly during sleep with unaltered inspiratory effort. In addition, evening bronchodilation was found to be able to induce sustained overnight improvements in dynamic respiratory mechanics and IND in COPD [11]. Furthermore, neuro-mechanical uncoupling during inspiratory loading was found to be greater in COPD-heart failure compared with COPD alone [12] and JAMES *et al.* [13] have found that increased exertional dyspnoea intensity in mild COPD with low diffusing capacity could be explained by increased IND and reduced ventilatory efficiency. These studies have enriched our knowledge that measuring IND ultimately helps to better inform clinical approaches targeted at improving dyspnoea and/or exercise tolerance in various cardio-respiratory diseases.

Assembly 7: Paediatrics (Sara M. Mensink-Bout)

The results of many studies related to the theme of “Early life origins of respiratory diseases” were presented in the Paediatric Assembly. These included studies showing that a higher exposure to air pollutants in infancy was associated with an impaired lung function until adolescence [14, 15], studies that linked an early-life suboptimal dietary intake to an adverse respiratory health later in life [16, 17] and a study that showed that a reduced fetal length in the first trimester of pregnancy was linked to earlier onset of asthma in childhood [18]. In a symposium and a state-of-the-art session on “Paediatric Respiratory Diseases” it was emphasised by Prof. Alvar Agusti Garcia-Navarro and Prof. Peter Sly that lung function grows along trajectories which still need a better understanding, since a low lung function early in life is related to an increased risk of all types of respiratory and even non-respiratory diseases, such as cardiovascular diseases and mortality in later life. Furthermore, Prof. Sejal Saglani presented that one of the factors that can potentially affect the long-term lung function outcomes is the manipulation of the airway microbiome through early allergen exposure.

In the “Paediatric Year in Review”, an overview of the results of important studies on asthma in the past year were presented by Prof. Klaus Bonnelykke, including that: vitamin D supplementation during pregnancy seems to prevent preschool asthma symptoms, but not school-age asthma or reduced lung function [19]; airway microbiota and the candidate gene GSDMB (encoding gasdermin-B) might play a role in childhood asthma development [20, 21]; and asthma-like symptoms in childhood were related to a doubled risk of COPD in adulthood [22]. In the symposium on current paediatric asthma guidelines, the evidence of the paradigm shift to recommend earlier treatment with as-needed low-dose corticosteroids in children with mild asthma, proposed by Global Initiative for Asthma (GINA),

was discussed by Dr Louise Fleming. It was also mentioned by Dr James Paton and Dr Erick Forno that a shift to a more personalised medicine is needed, especially for obese children with asthma as a 5–10% reduction of weight can improve asthma outcomes.

In summary, the ERS Congress highlighted evidence that early life is of importance for respiratory outcomes later in life. A better understanding of the causal factors of chronic respiratory diseases may lead to better prevention and treatment throughout the life course.

Assembly 9: Allied Respiratory Professionals (Astrid Blondeel)

The 2020 ERS International Congress provided an interesting virtual programme for Assembly 9. In the symposium on “Exercise and sleep”, it was shown that several mechanisms are responsible for the positive effects of moderate intense exercise on sleep physiology (*i.e.* increase in sleep time, increase in deep sleep and decrease of rapid eye movement sleep) [23]. In patients with OSA, a combined treatment strategy is needed, including physical activity and exercise training, aiming to also address the cardiovascular and metabolic risk [24]. The symposium on “Frailty in chronic lung diseases” highlighted that frailty is not a disease, but rather a complex, multidimensional syndrome. The importance of personalised interventions was discussed, with the main focus on preserving physical function [25]. Frailty is common in patients with COPD (point prevalence of 10% in the Rotterdam study) and is related to a lower quality of life and increased risk for hospitalisation [26]. Pulmonary rehabilitation has a positive effect on preventing and reversing frailty, but targeting the rehabilitation to individual needs is crucial and therefore a comprehensive, multidisciplinary assessment is warranted [27].

Several exciting oral presentations discussed the feasibility and effect of diverse training modalities (*e.g.* game-based approach in patients with primary ciliary dyskinesia [28], whole-body vibration in patients with severe COPD [29], home-based rehabilitation in asthma [30], physical activity coaching (*e.g.* after hospitalisation for COPD exacerbation [31]) and recovery to training [32] in patients with chronic lung diseases in all types of clinical settings. Interesting findings of tele-rehabilitation and physical activity coaching in COPD were debated in the ALERT (Abstracts Leading to Evolution in Respiratory Medicine) session on rehabilitation by Dr Narelle Cox and Astrid Blondeel. Telerehabilitation in COPD was shown to be safe and can be provided if centre-based pulmonary rehabilitation is not available [33]. Physical activity coaching on top of pulmonary rehabilitation

improves the patient’s experienced amount of daily life activities [34].

Finally, in the symposium on “Fear and anxiety in chronic lung disease”, Ron, a patient with idiopathic pulmonary fibrosis (IPF), discussed his feelings of fear and anxiety regarding his diagnosis. Addressing psychological needs is important, as anxiety and depression are common in patients with respiratory diseases [35]; but also disease-specific fears (*e.g.* fear of dyspnoea or activity avoidance) should be taken into account, as they can negatively affect the outcomes of pulmonary rehabilitation [36]. Cognitive behaviour therapy, as a stand-alone intervention delivered by a respiratory nurse specialist, was found to improve symptoms of anxiety and decrease hospital admissions in patients with COPD [37]. Healthcare professionals can play an important role in patients’ well-being, as discussed by Debra Reynolds-Sandford in her talk on expressing empathy. It positively affects patients’ outcomes, which was endorsed by the statement of Ron.

Assembly 11: Thoracic Oncology (Yuanling Liu)

The 2020 ERS International Congress provided the latest developments in lung cancer screening, diagnostics, treatment and molecular biology. Jan Van Meerbeeck gave an overview on lung cancer screening to kick off the Congress in the joint ERS/Industry session “Frontiers of lung cancer screening”. In the “New perspectives in chest imaging: back to the future?” symposium on lung cancer screening, Hans-Ulrich Kauczor showed that the nodule in the lung under an ultralow-dose (sub-millisievert) CT was still easily visualised [38]. There have been some investigations performed to evaluate the accuracy of ultralow radiation dose CT of the chest. For detection of a nodule ≥ 5 mm, the sensitivity of ultralow radiation dose CT was 97.3% across all nodule types [38].

Lung cancer diagnostics and treatment is rapidly evolving. Song *et al.* [39] showed that circulating tumour DNA (ctDNA) clearance during treatment may serve as a predictive and prognostic marker across a wide spectrum of treatment regimens. Blood tumour mutational burden (bTMB) was used to evaluate the effect of treatment, and Rizvi *et al.* [40] reported that among 809 patients with evaluable bTMB, those with a bTMB ≥ 20 mutations per megabase showed improved overall survival for programmed death-ligand 1 (PD-L1) blockade *via* anti-PD-L1 antibody durvalumab plus cytotoxic T-lymphocyte-associated antigen 4 blockade with tremelimumab *versus* chemotherapy.

The relationship between the lung cancer microenvironment and the lung microbioma is currently a hot topic. Zitvogel *et al.* [41] showed that the microbiome might be involved in oncogenesis and immune activation to induce

tumour suppression. NEJMAN *et al.* [42] undertook an analysis of the microbiome of 1526 tumours and their adjacent normal tissues across seven cancer types, including breast, lung, ovary, pancreas, melanoma, bone and brain tumours. They found that different tumour types have distinct microbial compositions. In this Hot Topic session, Hortense Slevogt highlighted that integration of microbiome modulation in a microenvironment-targeting combination offered new directions for cancer immunotherapy.

Finally, abstracts presented about the biological aspects of lung cancer highlighted the role of novel mediators, such as extracellular vesicles and exosomes. MANSOURI *et al.* [43] emphasised the role of extracellular vesicles in chemotherapy-induced

lung metastasis. Furthermore, Liu *et al.* [44] showed that exosomes from intermittent hypoxia-treated lung adenocarcinoma cell lines upregulate PD-L1 expression through the hypoxia-inducible factor-1 α pathway in macrophages.

Concluding remarks

We hope to reach out to and inspire all clinicians and researchers to submit an abstract for the 2021 ERS International Congress as this gives them an opportunity to be elected as the 2021 best-abstract awardee of their Assembly. Abstract submission is open until mid-February 2021. Good luck and we hope to see all of you in person in Barcelona!

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Conflict of interest

None declared.

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References

- Gates J, Lonsdale D, Maudhoo A, *et al.* Clinical variation in presenting characteristics of COVID-19 at St George's Hospital, London. *Eur Respir J* 2020; 56: Suppl. 64, 3589.
- Arcadu A, Puglisi S, Dubini A, *et al.* Atypical clinical and radiological presentation of SARS-CoV-2 infection in the elderly. *Eur Respir J* 2020; 56: Suppl. 64, 3593.
- Yuan M, Yin W, Tao Z, *et al.* Association of radiologic findings with mortality of patients infected with 2019 novel coronavirus in Wuhan, China. *Eur Respir J* 2020; 56: Suppl. 64, 2392.
- Mendelson M, Marillier M, Bailly S, *et al.* Maximal exercise capacity in patients with obstructive sleep apnoea syndrome: a systematic review and meta-analysis. *Eur Respir J* 2018; 51: 1702697.
- Berger M, Kline CE, Cepeda FX, *et al.* Does obstructive sleep apnea affect exercise capacity and the hemodynamic response to exercise? An individual patient data and aggregate meta-analysis. *Sleep Med Rev* 2019; 45: 42–53.
- Elbehairy AF, Geneidy NM, El Hoshi MS, *et al.* Exertional dyspnea in patients with OSA: pulmonary gas exchange and systemic vascular abnormalities. *Eur Respir J* 2020; 56: Suppl. 64, 4992.
- Sanchez-de-la-Torre M, Sánchez-de-la-Torre A, Bertran S, *et al.* Effect of obstructive sleep apnoea and its treatment with continuous positive airway pressure on the prevalence of cardiovascular events in patients with acute coronary syndrome (ISAACC study): a randomised controlled trial. *Lancet Respir Med* 2020; 8: 359–367.

8. Peker Y, Thunström E, Glantz H, *et al.* Effect of obstructive sleep apnoea on cardiovascular outcomes in patients with acute coronary syndrome: a secondary analysis of the RICCADSA trial. *Eur Respir J* 2020; 56: Suppl. 64, 4993.
9. Gaisl T, Protazy R, Roeder M, *et al.* Is obstructive sleep apnea a risk factor for the progression of thoracic aortic aneurysm? A prospective cohort study. *Eur Respir J* 2020; 56: Suppl. 64, PA415.
10. Domnik NJ, Scheeren R, Ayoo G, *et al.* Inspiratory neural drive and muscle activity during sleep in moderate-to-severe COPD. *Eur Respir J* 2020; 56: Suppl. 64, 4995.
11. Domnik NJ, James MD, Scheeren RE, *et al.* Deterioration of nighttime respiratory mechanics in COPD: impact of bronchodilator therapy. *Chest* 2020; in press [<https://doi.org/10.1016/j.chest.2020.06.033>].
12. Estrada L, Lau E, Lozano-Garcia M, *et al.* Neural respiratory drive, respiratory mechanics and breathlessness in COPD patients with comorbid heart failure. *Eur Respir J* 2020; 56: Suppl. 64, 3220.
13. James MD, Milne K, Neder JA, *et al.* Mechanisms of exertional dyspnea in patients with mild COPD and low resting lung diffusing capacity for carbon monoxide (DLCO). *Eur Respir J* 2020; 56: Suppl. 64, 922.
14. Zhao Q, Markevych I, Berdel D, *et al.* Early-life exposure to air pollution and lung function development into adolescence: the GINIplus/LISA birth cohorts. *Eur Respir J* 2020; 56: Suppl. 64, 4982.
15. Lundberg B, Gruzjeva O, Eneroth K, *et al.* Impaired infant lung function in relation to air pollution exposure. *Eur Respir J* 2020; 56: Suppl. 64, 4983.
16. Mensink-Bout S, Van Meel ER, De Jongste JC, *et al.* Pro-inflammatory and low quality maternal diet in pregnancy and the risk of childhood lower lung function and asthma: a meta-analysis of 18,000 children. *Eur Respir J* 2020; 56: Suppl. 64, 4984.
17. Talaei Pashiri M, Lietz G, Granell R, *et al.* Dietary vitamin A intake and lung function in childhood: longitudinal study. *Eur Respir J* 2020; 56: Suppl. 64, 4985.
18. Turner S, Aucott L. Reduced antenatal and birth size and time to onset of asthma. *Eur Respir J* 2020; 56: Suppl. 64, 4986.
19. Litonjua AA, Carey VJ, Laranjo N, *et al.* Six-year follow-up of a trial of antenatal vitamin D for asthma reduction. *N Engl J Med* 2020; 382: 525–533.
20. Ober C, McKennan CG, Magnaye KM, *et al.* Expression quantitative trait locus fine mapping of the 17q12-21 asthma locus in African American children: a genetic association and gene expression study. *Lancet Respir Med* 2020; 8: 482–492.
21. Thorsen J, Rasmussen MA, Waage J, *et al.* Infant airway microbiota and topical immune perturbations in the origins of childhood asthma. *Nat Commun* 2019; 10: 5001.
22. Bisgaard H, Nørgaard S, Sevelsted A, *et al.* Asthma-like symptoms in young children increase the risk of COPD. *J Allergy Clin Immunol* 2020; in press [<https://doi.org/10.1016/j.jaci.2020.05.043>].
23. Chennaoui M, Arnal PJ, Sauvet F, *et al.* Sleep and exercise: a reciprocal issue? *Sleep Med Rev* 2015; 20: 59–72.
24. Mendelson M, Bailly S, Marillier M, *et al.* Obstructive sleep apnea syndrome, objectively measured physical activity and exercise training interventions: a systematic review and meta-analysis. *Front Neurol* 2018; 9: 73.
25. World Health Organization. Integrated Care for Older People: Guidelines on Community-Level Interventions to Manage Declines in Intrinsic Capacity. Geneva, World Health Organization, 2017.
26. Lahousse L, Ziere G, Verlinden VJ, *et al.* Risk of frailty in elderly with COPD: a population-based study. *J Gerontol A Biol Sci Med Sci* 2016; 71: 689–695.
27. Maddocks M, Kon SS, Canavan JL, *et al.* Physical frailty and pulmonary rehabilitation in COPD: a prospective cohort study. *Thorax* 2016; 71: 988–995.
28. Ulu H, Ince DI, Saglam M, *et al.* Effects of game based approach in patients with primary ciliary dyskinesia: a randomized controlled trial. *Eur Respir J* 2020; 56: Suppl. 64, 4111.
29. Gloeckl R, Schneeberger T, Jarosch I, *et al.* Whole-body vibration training versus conventional balance training in patients with severe COPD – a randomized, controlled trial. *Eur Respir J* 2020; 56: Suppl. 64, 4747.
30. Manzak A, Özyılmaz S, Güney PA. Efficiency of home-based pulmonary rehabilitation in adults with asthma. *Eur Respir J* 2020; 56: Suppl. 64, 5179.
31. Valeiro B, Valeiro B, Rodriguez E, *et al.* Efficacy of a physical activity coaching programme after hospitalisation for a COPD exacerbation. *Eur Respir J* 2020; 56: Suppl. 64, 4113.
32. Nyberg A, Desroches L, Frykholm E, *et al.* Oxygen consumption ($\dot{V}O_2$) kinetics during recovery after resistance exercises in COPD and matched controls. *Eur Respir J* 2020; 56: Suppl. 64, 4745.
33. Cox N, McDonald C, Mahal A, *et al.* Telerehabilitation compared to centre-based pulmonary rehabilitation: a randomised controlled equivalence trial. *Eur Respir J* 2020; 56: Suppl. 64, 4354.
34. Blondeel A, Demeyer H, Loeckx M, *et al.* The effect of tele coaching after pulmonary rehabilitation on patients' experience of physical activity in patients with COPD. *Eur Respir J* 2020; 56: Suppl. 64, 4355.
35. Willgoss TG, Yohannes AM. Anxiety disorders in patients with COPD: a systematic review. *Respir Care* 2013; 58: 858–866.
36. Reijnders T, Schuler M, Wittmann M, *et al.* The impact of disease-specific fears on outcome measures of pulmonary rehabilitation in patients with COPD. *Respir Med* 2019; 146: 87–95.
37. Heslop-Marshall K, Baker C, Carrick-Sen D, *et al.* Randomised controlled trial of cognitive behavioural therapy in COPD. *ERJ Open Res* 2018; 4: 00094–2018.
38. Messerli M, Kluckert T, Knitel M, *et al.* Ultralow dose CT for pulmonary nodule detection with chest x-ray equivalent dose – a prospective intra-individual comparative study. *Eur Radiol* 2017; 27: 3290–3299.
39. Song Y, Hu C, Xie Z, *et al.* Circulating tumor DNA clearance predicts prognosis across treatment regimen in a large real-world longitudinally monitored advanced non-small cell lung cancer cohort. *Transl Lung Cancer Res* 2020; 9: 269–279.
40. Rizvi NA, Cho BC, Reinmuth N, *et al.* Durvalumab with or without tremelimumab vs standard chemotherapy in first-line treatment of metastatic non-small cell lung cancer: the MYSTIC phase 3 randomized clinical trial. *JAMA Oncol* 2020; 6: 661–674.
41. Zitvogel L, Ayyoub M, Routy B, *et al.* Microbiome and anticancer immunosurveillance. *Cell* 2016; 165: 276–287.
42. Nejman D, Livyatan I, Fuks G, *et al.* The human tumor microbiome is composed of tumor type-specific intracellular bacteria. *Science* 2020; 368: 973–980.
43. Mansouri N, Keklikoglou I, Nassiri S, *et al.* Role of extracellular vesicles in chemotherapy-induced lung metastasis. *Eur Respir J* 2020; 56: Suppl. 64, 3944.
44. Liu Y, Gao X, Lu M, *et al.* Exosomes from intermittent hypoxia treated lung adenocarcinoma cell line up-regulate programmed death ligand 1 expression through HIF-1 α pathway in macrophages. *Eur Respir J* 2020; 56: Suppl. 64, 3945.