Impact of sex and age on respiratory support and length of hospital stay among 1792 patients with COVID-19 in Wuhan, China

Zheng, Hua; Tan, Juan ; Zhang, Xianwei; Luo, Ailin; Wang, Liuming ; Zhu, Wentao

Published in:
British Journal of Anaesthesia

DOI:
10.1016/j.bja.2020.07.001

Publication date:
2020

Citation for published version (APA):
Zheng, H., Tan, J., Zhang, X., Luo, A., Wang, L., Zhu, W., Hebert, H. L., Meng, W., Smith, B. H., Colvin, L. A., & Hu, J. (2020). Impact of sex and age on respiratory support and length of hospital stay among 1792 patients with COVID-19 in Wuhan, China. *British Journal of Anaesthesia*, *125*(4), E378-E380. https://doi.org/10.1016/j.bja.2020.07.001

Impact of sex and age on respiratory support and length of hospital stay among 1,792 patients hospitalised with COVID-19 in Wuhan, China

Hua Zheng[1,†], Juan Tan[1,†], Xianwei Zhang[1], Ailin Luo[1], Liuming Wang[2], Wentao Zhu[3], Harry L. Hébert[4], Weihua Meng[4], Blair H. Smith[4], Lesley A. Colvin[4,*], Junbo Hu[5,*]

1. Department of Anesthesiology and Pain Medicine, Tongji Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan 430030, China
2. Medical Affairs Office, Tongji Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan 430030, China
3. Department of Orthopedics, Tongji Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan 430030, China
4. Division of Population Health and Genomics, School of Medicine, University of Dundee, Ninewells Hospital and Medical School, Dundee DD2 4BF, Scotland, UK
5. Department of Gastrointestinal Surgery Center, Tongji Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan 430030, China

[†]These authors contributed equally to this work

*Corresponding authors. E-mails: l.a.colvin@dundee.ac.uk, jbhu@tjh.tjmu.edu.cn

Keywords: COVID-19; SARS-CoV-2; respiratory support; length of hospital stay; sex; age

Editor-

The coronavirus disease-19 (COVID-19), associated with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), has spread rapidly since the early cases identified in Wuhan, China, with over 8,061,550 laboratory-confirmed COVID-19 cases worldwide and 84,867 patients in China, as of 18th June 2020 [1, 2]. Among the latter, 19% were severe or critically ill cases, who required some form of respiratory support due to hypoxaemia or respiratory failure [3]. The respiratory support ranged from low-flow or high-flow oxygen therapy via nasal cannula or mask; non-invasive or invasive positive pressure ventilation; to extracorporeal membrane oxygenation. Considering the potential of the COVID-19 pandemic to overwhelm healthcare systems, even in developed countries, there is a need to identify subgroups requiring different respiratory support techniques, as well as those requiring prolonged hospital admission, to inform service provision, allocate scarce medical resources appropriately and maximize treatment benefits. Previous studies have reported that older age and male gender were risk factors for poor prognosis in COVID-19 patients, with limited information about the need for respiratory support [4, 5]. A recent study has found that high levels of respiratory complications in COVID19 patients requiring surgery, with an associated high mortality [6].

We have retrospectively reviewed demographic and clinical data available from electronic medical records at a branch of Tongji Hospital (Wuhan, China), a 1,050 bed hospital designated for severe and critically ill COVID-19 patients. This was approved by Tongji Hospital Ethics Commission with the need for patients' written informed consent waived. Diagnosis and treatment of COVID-19 were performed according to the protocol released by China’s National Health Commission [7]. Since the outbreak of COVID-19 in China, the Chinese National Health Commission has published and updated "Chinese Clinical Guidance for COVID-19 Pneumonia Diagnosis and Treatment”. The guidance outlined recommendations for general treatment, as well as treatment of severe and critically ill cases. This guidance was adopted as hospital policy, with a requirement to follow this, although it is a limitation that we have not reviewed all medical records to confirm adherence for every patient. Possible treatments included antiviral medications, antibacterial medications, human immunoglobulin, steroids and traditional Chinese medicine. For patients with partial pressures of arterial oxygen (PaO_2)/fraction of inspired oxygen (FiO_2) between 200 mmHg and 300 mmHg, low-flow or high-flow oxygen therapy via nasal cannula or mask was started. For patients with PaO_2/FiO_2 between 150 mmHg and 200 mmHg, or who did not respond to high flow oxygen therapy in the first 2 hours, non-invasive positive pressure ventilation was considered. If symptoms worsened or the PaO_2/FiO_2 was < 150mmHg, invasive mechanical ventilation was implemented as soon as possible. When the patient's PaO_2/FiO_2 was < 80mmHg for more than 3 hours, with FiO_2 > 90% or the airway platform pressure ≥ 35cmH_2O, even after lung protective ventilation and prone position ventilation were performed, extracorporeal membrane oxygenation was used. The highest level of respiratory support required during hospitalisation is reported here.

A total of 1,792 patients hospitalised with COVID-19 between January 27, 2020, and April 20, 2020, were consecutively included. Median age was 62 years (interquartile range, 51-70; range, 0-95 years) and 48.4% of them were females (Table 1). Of the included 1,792 patients, 72 (4.0%) patients were admitted from the emergency department and 1,720 (96.0%) patients were transferred from other hospitals. On admission, most cases were classified as severe (79.9%; ie, respiratory frequency ≥ 30/min, blood oxygen saturation at rest ≤ 93%, PaO_2/FiO_2 ≤ 300 mmHg, or increased lung infiltration >50% within 48 hours) or critical (14.0%; ie, shock, respiratory failure or other organ or failure). Only 109 (6.1%) cases were moderate (ie, having symptoms and radiological findings of pneumonia, with no requirement for respiratory support). The percentage of patients who were categorised as critical cases on admission was higher in the male groups and older groups.

Among all patients, high-flow nasal cannula oxygen therapy, non-invasive positive pressure ventilation and invasive positive pressure ventilation were given to 60 (3.3%), 135 (7.5%), 104 (5.8%) patients, respectively, with increased requirement for this amongst male and older patients. Extracorporeal membrane oxygenation was given to 10 (0.6%) patients and 8 (80.0%) of them were male patients.

The overall case-fatality rate (CFR) was 12.7% (228 deaths among 1,792 confirmed cases) and the median of length of stay among deceased patients was 11 days (interquartile range, 6-20). CFR was elevated among male patients and groups with increasing age. Among surviving patients, 22 (1.2%) were transferred to other hospitals to treat comorbidities after recovery from pneumonia and 1,542 (86.0%) patients were discharged to the isolation centres for 14 days of quarantine. The length of stay among patients discharged was age dependent increasing from 22 (interquartile range, 14-31.3) days in those aged under 40 to 34 (interquartile range, 24-43.8) days in those aged 80 or over. Of the 1,542 patients who were discharged, 514 (33.3%) still required low-flow oxygen therapy at discharge and the requirement increased with age.

A strength of the current study is the size of the cohort of COVID-19 patients requiring respiratory support we report on. This data, from a single centre in Wuhan, provide insights into sex-specific and age-related factors. The findings in this study could be a useful supplement to previous studies about morbidity and mortality from COVID-19 [3, 8, 9], to help inform allocation of scarce health care resources (especially respiratory support) and mitigation of adverse effects of the COVID-19 pandemic in other countries. Furthermore, one third of COVID-19 patients had abnormal pulmonary function at time of hospital discharge with a higher percentage in older patients. Our results are consistent with the findings of a previous study, which found that 84.2% of severe cases with COVID-19 were discharged with impairment of diffusion capacity [10]. Future studies to address persistent impairment of pulmonary function of COVID-19 and the impact of age are warranted.

A limitation with our study is that the adherence to the national COVID-19 guidelines might be varied in individual patients, and therefore we are unable to assess the standard of management applied. While our impression is that adherence was rigorous, we plan to assess this as part of the future research with this cohort. Another limitation is that extraction of other relevant patient level data was restricted, such that more extensive analyses were not possible within the timescale and resources available. This highlights the challenges in rapidly developing a high quality evidence base, in the midst of a global pandemic. Limitations of existing healthcare data systems (eg paper medical records, no facility to efficiently extract data from individual records, etc), lack of appropriately trained personnel, as staff diverted to dealing with acute crisis, and the impact of lockdown on collaborative working are all barriers that need to be considered.

Despite these issues, we believe that it is important to report this data, as an incremental addition to the evolving evidence base. It is clear from this, that that health and social care provision, for both acute care and postCOVID-19 management, may need to be realigned. Understanding the factors that impact on research in global challenges such as COVID-19, is important when urgent good quality clinical guidance is needed. As we move forwards, perhaps one of the key learning points is to consider how, as a global research community, we can work most effectively together.

Authors' contributions

Study design: HZ, BHS, LAC, JH

Data collection: HZ, JT, XZ, AL, LW, WZ

Writing of article: HZ, LAC

Critical revision: XZ, HLH, WM, BHS, JH

Approval of final version: all authors

Declaration of interest

The authors declare that they have no conflicts of interest.

References

1. Zhu N, Zhang D, Wang W, et al. A Novel Coronavirus from Patients with Pneumonia in China, 2019. *N Engl J Med* 2020; **382**: 727-33

2. WHO. Coronavirus disease 2019 (COVID-19) Situation Report-149. https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200617-covid-19-sitrep-149.pdf?sfvrsn=3b3137b0_6 (accessed June 18, 2020).

3. Wu Z, McGoogan JM. Characteristics of and Important Lessons From the Coronavirus Disease 2019 (COVID-19) Outbreak in China: Summary of a Report of 72 314 Cases From the Chinese Center for Disease Control and Prevention. JAMA Feb 24, 2020.

4. Wu C, Chen X, Cai Y, et al. Risk Factors Associated With Acute Respiratory Distress Syndrome and Death in Patients With Coronavirus Disease 2019 Pneumonia in Wuhan, China. *JAMA Int*ern Med Mar 13, 2020.

5. Zhou F, Yu T, Du R, et al. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. *Lancet* 2020; **395**: 1054-62

6. COVIDSurg Collaborative. Mortality and pulmonary complications in patients undergoing surgery with perioperative SARS-CoV-2 infection: an international cohort study. *L*ancet May 29, 2020.

7. China's National Heath Commission. Diagnosis and Treatment Scheme of COVID-19 (Interim Version 7). Available from: http://www.nhc.gov.cn/yzygj/s7653p/202003/46c9294a7dfe4cef80dc7f5912eb1989.shtml. English version translated by the Chinese Society of Cardiology. Available from: http://kjfy.meetingchina.org/msite/news/show/cn/3337.html (Date last accessed: June 26, 2020).

8. Guan WJ, Ni ZY, Hu Y, et al. Clinical Characteristics of Coronavirus Disease 2019 in China. *N Engl J Med* 2020; **382**: 1708-20

9. Dudley JP, Lee NT. Disparities in Age-Specific Morbidity and Mortality from SARS-CoV-2 in China and the Republic of Korea. *Cli*n Infect Dis Mar 31, 2020.

10. Mo X, Jian W, Su Z, et al. Abnormal pulmonary function in COVID-19 patients at time of hospital discharge. *Eur R*espir J May 12, 2020.

Table 1 Demographic and clinical characteristics of patients with COVID-19.

	Total	Sex group		Age group			
	(n=1792)	Male (n=924)	Female (n=868)	< 40 (n=208)	40-59 (n=568)	60-79 (n=866)	≥80 (n=150)
Spectrum of disease							
Moderate	109 (6.1)	59 (6.4)	50 (5.8)	14 (6.7)	38 (6.7)	48 (5.5)	9 (6.0)
Severe	1,432 (79.9)	712 (77.1)	720 (82.9)	181(87.0)	470 (82.7)	674 (77.8)	107 (71.3)
Critical	251 (14.0)	153 (16.6)	98 (11.3)	13 (6.3)	60 (10.6)	144 (16.6)	34 (22.7)
Respiratory support during hospitalisation[a]							
No	247 (13.8)	126 (13.6)	121 (13.9)	56 (26.9)	98 (17.3)	90 (10.4)	3 (2.0)
LFNC	1,133 (63.2)	553 (59.8)	580 (66.8)	133 (63.9)	373 (65.7)	539 (62.2)	88 (58.7)
LFM	77 (4.3)	41 (4.4)	36 (4.1)	5 (2.4)	20 (3.5)	39 (4.5)	13 (8.7)
HFNC	60 (3.3)	41 (4.4)	19 (2.2)	3 (1.4)	15 (2.6)	33 (3.8)	9 (6.0)
NIPPV	135 (7.5)	84 (9.1)	51 (5.9)	1 (0.5)	29 (5.1)	86 (9.9)	19 (12.7)
IPPV	104 (5.8)	57 (6.2)	47 (5.4)	4 (1.9)	22 (3.9)	63 (7.3)	15 (10.0)
ECMO	10 (0.6)	8 (0.9)	2 (0.2)	0 (0)	6 (1.1)	4 (0.5)	0 (0)
Outcomes							
Discharged	1,542 (86.0)	760 (82.3)	782 (90.1)	201 (96.6)	520 (91.5)	716 (82.7)	105 (70.0)
Died	228 (12.7)	150 (16.2)	78 (9.0)	5 (2.4)	42 (7.4)	138 (15.9)	42 (28.0)
Transferred	22 (1.2)	14 (1.5)	8 (0.9)	2 (1.0)	5 (0.9)	12 (1.4)	3 (2.0)
Length of stay (days)[b]							
Discharged	28 (20-41)	28 (20-42)	28 (20-40)	22 (14-31.3)	28 (21-41)	29.5 (21-42)	34 (24-43.8)
Died	11 (6-20)	10 (5-19)	13 (6.5-22)	10 (4.5-19)	11.5 (5-20.8)	12 (6-21)	10 (5-16.5)
Transferred	32.5 (20.8-46.3)	31 (20.5-38)	37 (19.5-62)	24 (17-31)	27 (17.5-35.5)	37 (25-61.3)	17 (4-56)
Respiratory support at discharge[c]							
No	1,006 (65.2)	495 (65.1)	511 (65.3)	173 (86.1)	344 (66.2)	434 (60.6)	55 (52.4)
LFNC or LFM	514 (33.3)	256 (33.7)	258 (33.0)	28 (13.9)	168 (32.3)	270 (37.7)	48 (45.7)

Data are presented as median (interquartile range) or n (%).

COVID-19, the coronavirus disease-19; LFNC, Low-flow nasal cannula oxygen therapy; LFM, Low-flow mask oxygen therapy; HFNC, high-flow nasal cannula oxygen therapy; NIPPV, non-invasive positive pressure ventilation; IPPV, invasive positive pressure ventilation; ECMO, extracorporeal membrane oxygenation.

[a] Only the highest level of respiratory support during hospitalisation is presented.

[b] Transfers from one hospital to another were merged.

c Only patients who were discharged were included.