

Geriatric Syndromes in Older Adults Hospitalized with COVID-19 in Montreal, Canada



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ABSTRACT

Background

Older adults are more vulnerable to severe infection and mortality due to COVID-19. They have atypical presentations of the disease without respiratory symptoms, making early diagnosis clinically challenging. We aimed to compare the baseline characteristics, presentation, and disease course of older (≥ 70 yrs & ≥ 90 yrs) and younger (< 70 yrs) patients hospitalized with COVID-19.

Methods

Retrospective review of 429 consecutive patients hospitalized at two tertiary care hospitals in Montreal, Canada, with PCR-confirmed COVID-19. Baseline characteristics, presentation, in-hospital complications, and outcomes were recorded. Desegregation by age was performed to compare older versus younger individuals. Additional subgroup analyses were performed amongst patients ≥ 70 stratifying by sex, living situation, and those presenting with geriatric syndromes compared to those without.

Results

Patients ≥ 70 (n=260) presented less frequently with respiratory symptoms compared to patients < 70 (n=169) (52% vs. 32%). 11% of patients ≥ 70 and 24% of patients ≥ 90 presented with a geriatric syndrome as their sole symptom compared to 3% of those < 70 . Older adults were more likely to develop disease complications (including delirium, acute kidney injury, and hypernatremia) and had higher in-hospital mortality (32% vs. 13%). Subgroup analyses revealed heightened vulnerability to complications in older men, those from long-term care, and those with at least one geriatric syndrome upon presentation.

Conclusions

Older adults presenting to hospital with COVID-19 often have no respiratory symptoms and can present with only a geriatric syndrome. New geriatric syndromes in older individuals should trigger evaluation for COVID-19 and consideration for early initiation of multidisciplinary care to prevent complications.

Key words: COVID-19, older adults, geriatric syndromes, outcomes, clinical research

INTRODUCTION

Older adults are amongst the most vulnerable to complications and mortality from COVID-19.⁽¹⁻³⁾ During the first wave of the pandemic in Quebec, Canada, older adults aged 70 years and older accounted for 26.7% of confirmed COVID cases and for 63.6% of those hospitalized with the disease, while representing only 13.8% of the province's population.⁽⁴⁾ Furthermore, older adults aged 70 and above accounted for the majority (91.3%) of COVID-related deaths.⁽⁴⁾

There is growing evidence that older adults are more likely to have atypical presentations of COVID-19 with lack of fever, cough, or dyspnea.⁽⁵⁻⁷⁾ Reports from Europe and the US suggest that COVID-19 may present as geriatric syndromes, including falls and delirium, in this population.⁽⁷⁻¹⁰⁾ This is especially common in older adults from long-term care.^(8,11,12) A recent Canadian study demonstrated that delirium was highly prevalent in older adults aged 65 and above with COVID-19 at the time of hospitalization and was associated with higher in-hospital mortality.⁽¹³⁾ The nuances of the clinical presentation of older patients with COVID-19 have critical implications for early diagnosis, timely isolation, and

infection control. An improved understanding of the disease course is crucial for enabling optimal care and prognostication in this high-risk population. Further Canadian data are required to fully characterize the impact of a non-respiratory presentation of COVID-19 in older adults on the disease course and outcomes.

The aims of this study are 1) to describe the clinical characteristics and outcomes of old persons (≥ 70) and older old persons (≥ 90) hospitalized with COVID-19 during the first wave in Montreal, Canada; and 2) to determine whether adults ≥ 70 presenting with at least one geriatric syndrome have different in-hospital course and mortality compared to those without.

METHODS

We conducted a retrospective review of electronic medical records (EMR) of all patients aged 18 and above with laboratory-confirmed COVID-19 admitted between March 26th and July 16th, 2020 to two academic hospitals in Montreal, Canada. Both institutions provide tertiary and quaternary care to a large, diverse urban population. A confirmed case of COVID-19 was defined as a positive result of a real-time reverse transcriptase polymerase chain reaction (RT-PCR) assay from a nasal swab.

Data Collection

The following data were extracted from the EMR: baseline demographics, living situation, pre-existing medical conditions, home medications, and symptoms at presentation. The Charlson Comorbidity Index⁽¹⁴⁾ was calculated to capture the degree and severity of comorbidities. We extracted laboratory and imaging findings at the time of admission, as well as complications, need for intensive care or ventilatory support, and discharge destination or in-hospital death until July 16th, 2020. Data were extracted independently by two of the investigators based on a standardized form. In case of disagreement between reviewers, assistance of a third reviewer was sought for resolution.

Definitions

Patients < 70 years old are classified as younger and those ≥ 70 as older. A subgroup of ≥ 90 year-olds is also presented, classified as the older old. The threshold of 70 years old was selected in order to align with Quebec-sourced epidemiological data from the first wave of the pandemic that found 70–79-year-olds to be the youngest cohort, representing a higher proportion of hospitalizations (21.0%) and deaths (18.0%) compared to next-youngest cohort (14.3% of hospitalizations, 6.2% of deaths for 60–69-year-olds).⁽⁴⁾ The ≥ 90 subgroup is considered to explore our hypotheses in the extremely old.

We defined non-respiratory presentations as absence of cough, dyspnea, hemoptysis, sputum production, nasal congestion, and sore throat. In keeping with the American Geriatrics Society's recommendations to define geriatric

syndromes as common conditions in older adults having significant consequences for functioning and quality of life,⁽¹⁵⁾ we considered falls, delirium, and functional decline as geriatric syndromes at presentation. Malnutrition, deconditioning, and pressure injury were also considered geriatric syndromes when assessing for in-hospital complications.

Statistical Analysis

Continuous variables are presented as means and standard deviations (SD). Categorical variables are summarized as counts and percentages. Based on our findings, we performed three subgroup analyses within the ≥ 70 age group comparing complications and outcomes between men and women, between those coming from independent living situations (home and autonomous private residence) and those from long-term care facilities, and lastly between those presenting with a geriatric syndrome and those without. Descriptive statistics were performed with IBM SPSS Statistics for Mac v27.0 (SPSS Inc. Chicago, IL).

Ethics Approval

Institutional review board approval was obtained for data collection. All patient information was de-identified with respect to names and dates.

RESULTS

Population Characteristics and Medical Status at Baseline (Table 1)

Four hundred and twenty-nine patients were hospitalized with PCR-confirmed COVID-19 between March 26th and July 16th, 2020. Sixty-one per cent were ≥ 70 years old. Adults ≥ 70 averaged 83 years old (SD 7.3) and adults < 70 averaged 55 yrs (SD 11.7). Forty-nine per cent of patients ≥ 70 and 37% of patients < 70 were women. Fifty-one patients (12%) were ≥ 90 years old.

Patients ≥ 70 had more pre-existing medical conditions at baseline than patients < 70 (mean Charlson Comorbidity Index 6 vs. 2). These comorbidities included higher proportions of hypertension, coronary artery disease, heart failure, cerebrovascular disease, chronic obstructive pulmonary disease, chronic kidney disease, major neurocognitive disorder, and active cancers. This was reflected by a greater number of home medications: 75% of patients ≥ 70 had polypharmacy (> 5 medications) compared to 41% of patients < 70 . Amongst all patients ≥ 70 , those ≥ 90 had more geriatric syndromes at baseline including history of falls and dementia.

Fifty-nine per cent of patients ≥ 70 originated from long-term care facilities and 32% were living at home in the community. Seventy-two per cent of patients ≥ 90 came from long-term care facilities.

Clinical Presentation (Table 2)

Patients ≥ 70 had a lower proportion of respiratory symptoms of cough (27% vs. 47%) and dyspnea (33% vs. 48%) compared to their younger counterparts. Fifty-two per cent

of patients ≥ 70 and 63% of patients ≥ 90 presented without any respiratory symptoms, compared to 32% of patients < 70 .

Patients ≥ 70 had a higher proportion of delirium (29% vs. 7%), functional decline (14% vs. 1%), and falls (15% vs. 5%). Patients ≥ 90 had higher proportion of falls at presentation compared to the overall ≥ 70 group (31% vs. 15%). Eleven per cent of patients ≥ 70 and 24% of patients ≥ 90 presented with a geriatric syndrome as their sole symptom, compared to 3% of patients < 70 .

TABLE 1.
Population characteristics of patients < 70 , ≥ 70 , and ≥ 90 admitted to hospital with COVID-19

	< 70	≥ 70	≥ 90
N	169	260	51
Age: mean (SD)	55 (11.7)	83 (7.3)	93 (3.0)
Sex: no. (%)			
Male	107 (63)	133 (51)	15 (29)
Female	62 (37)	127 (49)	36 (71)
<i>Home Medications: no. (%)</i>			
0 medication	37 (22)	4 (2)	2 (3)
1-5 medications	63 (37)	61 (23)	15 (29)
6-10 medications	44 (26)	110 (42)	20 (39)
≥ 11 medications	25 (15)	85 (33)	14 (28)
<i>Charlson Comorbidity Index (CCI): mean (SD)</i>	2 (2.1)	6 (2.1)	7 (1.9)
<i>Past Medical History: no. (%)</i>			
<i>Geriatric syndromes</i>			
Fall(s)	2 (1)	18 (7)	11 (22)
Dementia	10 (6)	121 (47)	29 (57)
<i>Cardiovascular disease</i>			
Hypertension	79 (47)	171 (66)	31 (61)
Heart failure	7 (4)	53 (20)	13 (25)
Coronary artery disease	17 (10)	62 (24)	16 (31)
<i>Malignancy</i>			
Remote cancer	5 (3)	32 (12)	5 (10)
Active cancer	6 (4)	24 (9)	2 (4)
<i>Endocrine disease</i>			
Type 2 diabetes	42 (25)	87 (33)	10 (20)
<i>Pulmonary disease</i>			
Chronic obstructive pulmonary disease	12 (7)	59 (23)	12 (24)
<i>Renal disease</i>			
Chronic kidney disease	14 (8)	53 (20)	11 (22)
<i>Neurological disease</i>			
Parkinson's	3 (2)	17 (7)	2 (4)
Cerebrovascular disease	6 (4)	48 (18)	12 (24)
<i>Hematological disease</i>			
Venous thromboembolism	12 (7)	10 (3)	1 (2)
<i>Living Situation</i>			
Home	126 (75)	83 (32)	7 (14)
Autonomous private residence	4 (2)	22 (8)	7 (14)
Long-term care	29 (17)	154 (59)	37 (72)

Complications and Outcomes (Table 3)

Eighty-five per cent of patients ≥ 70 developed complications during their hospitalization compared to 56% of patients < 70 . A higher proportion of acute kidney injury (AKI) (35% vs. 22%) and hypernatremia (32% vs. 17%) was observed in patients ≥ 70 compared to the < 70 group. Patients ≥ 70 had higher proportion of delirium acquired in hospital (30% vs. 17%). The patients ≥ 90 had fewer venous thromboembolisms (0 vs. 17%) and bacterial pneumonia superinfections (6% vs. 17%) compared to the overall ≥ 70 group. Complication profiles were otherwise similar.

Per institutional policy, goals of care were either based on previously available advanced directives or discussed with the patients and their family at the time of admission. Two hundred and sixty-two of 429 patients were eligible (143 or

TABLE 2.
Clinical presentation of patients < 70 , ≥ 70 , and ≥ 90 admitted to hospital with COVID-19

	< 70	≥ 70	≥ 90
<i>Presenting Symptom(s): no. (%)</i>			
Asymptomatic	12 (7)	24 (9)	3 (6)
<i>Geriatric Syndromes</i>			
Fall(s)	9 (5)	39 (15)	16 (31)
Delirium	11 (7)	76 (29)	14 (28)
Functional decline	1 (1)	37 (14)	7 (14)
<i>Geriatric syndrome(s) as the only symptom</i>	5 (3)	30 (12)	12 (24)
<i>Upper respiratory symptoms</i>			
Nasal congestion	8 (5)	12 (5)	1 (2)
Sore throat	11 (7)	5 (2)	0 (0)
<i>Lower respiratory symptoms</i>			
Cough	80 (47)	69 (27)	8 (15)
Sputum production	10 (6)	16 (6)	0 (0)
Hemoptysis	2 (1)	1 (0)	0 (0)
Dyspnea	81 (48)	86 (33)	14 (28)
<i>Respiratory symptoms alone</i>	22 (13)	32 (12)	7 (14)
<i>Absence of respiratory symptoms (upper and lower)</i>	54 (32)	134 (52)	32 (63)
<i>Gastrointestinal Symptoms</i>			
Anorexia (loss of appetite)	14 (8)	46 (18)	7 (14)
Nausea or vomiting	14 (8)	15 (6)	2 (4)
Diarrhea	33 (20)	36 (14)	2 (4)
Abdominal pain	4 (2)	8 (0)	3 (4)
Gastrointestinal symptoms alone	4 (2)	6 (2)	0 (0)
<i>Other</i>			
Fatigue	22 (13)	28 (11)	2 (4)
General weakness	25 (15)	48 (18)	11 (22)
Subjective fever	53 (31)	17 (7)	3 (6)
Objective fever ($\geq 38.3^{\circ}\text{C}$ x1 or 38.0°C x2)	37 (22)	53 (20)	6 (12)
Anosmia	6 (4)	1 (0)	0 (0)

TABLE 3.

Course in hospital and outcomes of patients <70, ≥70, and ≥90 admitted to hospital with COVID-19

	<70	≥70	≥90
N	169	260	51
Complications: no. (%)			
Any	95 (56)	220 (85)	45 (88)
<i>Cardiovascular</i>			
NSTEMI ^a or unstable angina	11 (7)	34 (13)	9 (18)
STEMI ^b	12 (7)	34 (13)	9 (18)
<i>Hematological</i>			
Disseminated intravascular coagulation	1 (1)	3 (1)	0 (0)
Thrombocytopenia (<100 x10 ⁹ /L)	8 (5)	6 (2)	10 (20)
Venous thromboembolism ^{c,d}	30 (18)	44 (17)	0 (0)
<i>New Geriatric Syndrome</i>			
New fall(s)	3 (2)	7 (3)	1 (2)
New delirium	29 (17)	77 (30)	12 (24)
Pressure injury	3 (2)	10 (4)	3 (6)
Malnutrition or denutrition	6 (4)	24 (9)	4 (8)
Deconditioning	8 (5)	21 (8)	6 (12)
<i>Infectious</i>			
Clostridioides difficile infection	1 (1)	3 (1)	0 (0)
Septic shock	8 (5)	6 (2)	1 (2)
Bacterial pneumonia superinfection	30 (18)	44 (17)	3 (6)
<i>Renal and Metabolic</i>			
Acute kidney injury	37 (22)	92 (35)	19 (37)
Hyponatremia (≤128 mmol/L)	22 (13)	21 (8)	2 (4)
Hypernatremia (≥ 148 mmol/L)	28 (17)	82 (32)	15 (29)
Rhabdomyolysis	1 (1)	5 (2)	2 (4)
Transaminitis (ALT ^e x3 upper normal limit)	21 (12)	13 (5)	1 (2)
<i>ICU and Ventilatory Support</i>			
Admission to ICU if within goals of care (N= 143 for <70, N= 119 for ≥70, N=10 for ≥90)	71 (50)	39 (33)	1 (10)
Intubation and mechanical ventilation (N= 143 for <70, N= 119 for ≥70, N=10 for ≥90)	42 (29)	20 (17)	0 (0)
<i>Outcomes</i>			
Discharged from hospital: no. (%)	147 (87)	178 (68)	29 (57)
Mean length of stay - days (SD)	19 (19.0)	21 (14.6)	17 (11.3)
Death: no. (%)	22 (13)	82 (32)	22 (43)
Mean length of stay - days (SD)	19 (17.3)	16 (20.5)	14 (13.4)

^aNon-ST Elevation Myocardial Infarction.^bST Elevation Myocardial Infarction.^cDefinitive diagnose of pulmonary embolism via CT-angio or V/Q scan at any point in time.^dIncludes massive, hilar, segmental, and subsegmental pulmonary embolisms.^eAlanine Aminotransferase.

85% of patients <70 and 119 or 46% of patients ≥70). Of these, 39 patients ≥70 were cared for in the ICU (33% of eligible and 15% of all adults ≥70), compared to 71 patients <70 (50% of eligible and 42% of all adults <70). One patient ≥90 was cared for in the ICU (10% of eligible, 2% if all patients ≥90).

Patients ≥70 had higher in-hospital all-cause mortality (32% vs 13%). Amongst this group, 49 patients who were not eligible for ICU care due to their established goals of care died (19%), compared to 35 patients (13%) who were eligible based on their goals of care.

Patients ≥90 had higher in-hospital mortality compared to the overall ≥70 group (43% vs. 32%).

Subgroup Analyses

Characteristics, complications, and outcomes of adults ≥70 presenting with at least one geriatric syndrome compared to those without are presented in Table 4. Of the adults ≥70 presenting with at least one geriatric syndrome, 73% were from long-term care residences compared to 48% of those without. Adults aged 70 or older presenting with a geriatric syndrome had a higher proportion of complications from their disease in hospital (93% vs. 77%) compared to those without, including new delirium (40% vs. 21%), AKI (45% vs. 28%), and hypernatremia (44% vs. 21%). Thirty-seven per cent of patients ≥70 presenting with a geriatric syndrome died compared to 28% of those who did not.

Characteristics, complications, and outcomes of patients aged 70 and older according to their sex are presented in Table 5. Men had higher proportions of cardiac complications (17% vs. 9%) and bacterial pneumonia superinfection (24% vs. 9%) compared to women in this age group. When considering their goals of care, men ≥70 were more likely to be cared for in ICU (44% vs. 16%) and receive mechanical ventilation than women ≥70 (23% vs. 8%). In this age group, mortality was higher amongst men than women (35% vs. 29%).

Characteristics, complications, and outcomes of adults ≥70 from independent living situations compared to those from long-term care are presented in Table 6. Patients from long-term care were more likely to present with delirium (39% vs. 15%) and to develop delirium in hospital (34% vs. 24%) compared to patients from independent living situations. Complication profiles and outcomes were otherwise similar.

DISCUSSION

We report the characteristics, presenting features, and in-hospital outcomes of 429 COVID-19-affected patients hospitalized in two academic hospitals in Montreal, Canada, with particular attention to those above age 70 having a geriatric syndrome at their presentation to hospital. Patients ≥70 differed from patients <70 in their presentations. Over 50% of adults ≥70 lacked any respiratory symptoms, presenting with geriatric syndromes like functional decline, fall, and delirium; these were the only symptoms in 12% of the ≥70 group. Adults ≥70 had more complications during hospitalization with higher proportions of new delirium, AKI,

TABLE 4.
 Characteristics, complications, and outcomes of patients ≥ 70 admitted
 to hospital after presenting with at least one geriatric syndrome^a

	<i>At Least One Geriatric Syndrome^a</i>	<i>No Geriatric Syndrome</i>
N	119	141
<i>Characteristics</i>		
<i>Demographics</i>		
Mean age (SD)	84 (7.3)	82 (7.2)
Women: no. (%)	54 (45)	73 (52)
<i>Living Situation: no. (%)</i>		
Home	23 (19)	60 (43)
Autonomous private residence	9 (8)	13 (9)
Long-term care (private and public)	87 (73)	67 (48)
<i>Complications: no. (%)</i>		
Any	111 (93)	109 (77)
Cardiovascular		
NSTEMI ^b or unstable angina	20 (17)	14 (10)
STEMI ^c	20 (17)	14 (10)
Hematological		
Disseminated intravascular coagulation	1 (1)	1 (1)
Thrombocytopenia ($<100 \times 10^9/L$)	20 (17)	21 (15)
Venous thromboembolism ^{d,e}	0 (0)	3 (2)
Infectious		
Clostridiodes difficile infection	2 (2)	1 (1)
Septic shock	3 (3)	3 (2)
Bacterial pneumonia superinfection	22 (18)	22 (16)
New geriatric syndrome		
New fall(s)	6 (5)	1 (1)
New delirium	48 (40)	29 (21)
Pressure injury	3 (3)	7 (5)
Malnutrition or denutrition	12 (10)	12 (9)
Deconditioning	9 (8)	12 (9)
Renal and metabolic		
Acute kidney injury	53 (45)	39 (28)
Hyponatremia (≤ 128 mmol/L)	7 (6)	14 (10)
Hypernatremia (≥ 148 mmol/L)	52 (44)	30 (21)
Rhabdomyolysis	3 (3)	2 (1)
Transaminitis (ALT ^f x 3 upper normal limit)	8 (7)	5 (4)
ICU and ventilatory support		
Admission to ICU if within goals of care (N=48 for those with geriatric syndrome, N=71 for those without)	14 (29)	21 (30)
Intubation and mechanical ventilation (N=48 for those with geriatric syndrome, N=71 for those without)	7 (15)	11 (15)
<i>Outcomes</i>		
Discharge from hospital: no. (%)	75 (63)	103 (73)
Mean length of stay: days	23	20
Death: no. (%)	44 (37)	40 (28)
Mean length of stay: days	14	18

^aGeriatric syndromes included on presentation were fall(s), functional decline, and delirium.

^bNon-ST Elevation Myocardial Infarction.

^cST Elevation Myocardial Infarction.

^dDefinitive diagnose of pulmonary embolism via CT-angio or V/Q scan at any point in time during admission and of deep vein thrombosis via duplex.

^eIncludes massive, hilar, segmental, and subsegmental pulmonary embolisms.

^fAlanine Aminotransferase.

TABLE 5.
 Characteristics, complications, and outcomes of older patients ≥ 70 hospitalized with COVID-19 according to sex

	Women	Men
N	127	133
<i>Characteristics</i>		
Living situation: no. (%)		
Home	31 (24)	52 (39)
Autonomous private residence	10 (8)	12 (9)
Long-term care (private and public)	86 (68)	69 (52)
Geriatric Syndrome at Presentation: no. (%)		
Fall(s)	18 (14)	21 (16)
Delirium	31 (24)	45 (34)
Functional decline	21 (17)	16 (12)
<i>Complications: no. (%)</i>		
Any	104 (82)	116 (87)
Cardiovascular		
NSTEMI ^a or unstable angina	12 (9)	22 (17)
STEMI ^b	12 (9)	22 (17)
Hematological		
Disseminated intravascular coagulation	0 (0)	2 (2)
Thrombocytopenia ($< 100 \times 10^9/L$)	21 (17)	20 (15)
Venous thromboembolism ^{c,d}	3 (2)	5 (4)
Infectious		
Clostridiodes difficile infection	1 (1)	2 (2)
Septic shock	2 (2)	4 (3)
Bacterial pneumonia superinfection	12 (9)	32 (24)
New geriatric syndrome		
New fall(s)	3 (2)	4 (3)
New delirium	33 (26)	44 (33)
Pressure injury	5 (4)	5 (4)
Malnutrition or denutrition	9 (7)	15 (11)
Deconditioning	12 (9)	9 (7)
Renal and metabolic		
Acute kidney injury	40 (31)	52 (39)
Hyponatremia (≤ 128 mmol/L)	11 (9)	10 (8)
Hypernatremia (≥ 148 mmol/L)	34 (27)	48 (36)
Rhabdomyolysis	2 (2)	3 (2)
Transaminitis ($ALT^e \times 3$ upper normal limit)	2 (2)	11 (8)
ICU and ventilatory support		
Admission to ICU if within goals of care (N= 71 for men, N= 48 for women)	8 (16)	31 (44)
Intubation and mechanical ventilation (N= 71 for men, N= 48 for women)	4 (8)	16 (23)
<i>Outcomes</i>		
Discharge from hospital: no. (%)	90 (71)	86 (65)
Mean length of stay: days	19	23
Death: no. (%)	37 (29)	47 (35)
Mean length of stay: days	15	16

^aNon-ST Elevation Myocardial Infarction.

^bST Elevation Myocardial Infarction.

^cDefinitive diagnose of pulmonary embolism via CT-angio or V/Q scan at any point in time during admission and of deep vein thrombosis via duplex.

^dIncludes massive, hilar, segmental, and subsegmental pulmonary embolisms.

^eAlanine Aminotransferase.

TABLE 6.

Characteristics, complications, and outcomes of older patients ≥ 70 hospitalized with COVID-19 according to living situation

	<i>Independent Living (Home or Autonomous Residence)</i>	<i>Long-Term Care</i>
N	106	154
<i>Characteristics</i>		
Female – no. (%)	41 (39)	86 (56)
Mean age (yr)	82	83
<i>Geriatric Syndrome at Presentation: no. (%)</i>		
Fall(s)	14 (13)	25 (16)
Delirium	16 (15)	60 (39)
Functional decline	8 (8)	29 (19)
<i>Complications: no. (%)</i>		
Any	85 (80)	135 (88)
<i>Cardiovascular</i>		
NSTEMI ^a or unstable angina	16 (16)	18 (12)
STEMI ^b	16 (15)	18 (12)
<i>Hematological</i>		
Disseminated intravascular coagulation	0 (0)	2 (1)
Thrombocytopenia ($<100 \times 10^9/L$)	17 (16)	22 (14)
Venous thromboembolism ^{c,d}	4 (4)	1 (1)
<i>Infectious</i>		
Clostridiodes difficile infection	1 (1)	2 (1)
Septic shock	4 (4)	2 (1)
Bacterial pneumonia superinfection	19 (18)	25 (16)
<i>New geriatric syndrome</i>		
New fall(s)	1 (1)	6 (4)
New delirium	25 (24)	52 (34)
Pressure injury	5 (5)	5 (3)
Malnutrition or denutrition	8 (8)	16 (10)
Deconditioning	10 (9)	11 (7)
<i>Renal and metabolic</i>		
Acute kidney injury	40 (38)	52 (34)
Hyponatremia (≤ 128 mmol/L)	11 (10)	11 (7)
Hypernatremia (≥ 148 mmol/L)	27 (26)	50 (32)
Rhabdomyolysis	3 (3)	2 (1)
Transaminitis (ALT ^e x 3 upper normal limit)	12 (11)	5 (3)
<i>ICU and ventilatory support</i>		
Admission to ICU if within goals of care (N = 68 for independent, N = 51 for long-term care)	30 (44)	9 (18)
Intubation and mechanical ventilation (N = 68 for independent, N = 51 for long-term care)	17 (25)	3 (6)
<i>Outcomes</i>		
Discharge from hospital: no. (%)	73 (70)	105 (68)
Mean length of stay: days	21	21
Death: no. (%)	32 (30)	50 (32)
Mean length of stay: days	22	11

^aNon-ST Elevation Myocardial Infarction.^bST Elevation Myocardial Infarction.^cDefinitive diagnose of pulmonary embolism via CT-angio or V/Q scan at any point in time during admission and of deep vein thrombosis via duplex.^dIncludes massive, hilar, segmental, and subsegmental pulmonary embolisms.^eAlanine Aminotransferase.

and hypernatremia. Patients ≥ 70 were more likely to die of their disease. These findings were exacerbated by increasing age, as patients ≥ 90 even more commonly had a geriatric syndrome as their sole presenting symptom and had higher mortality than the overall older group.

The high proportion of non-respiratory COVID-19 presentations in our study is concordant with reports from France and the United Kingdom where delirium and falls were common reasons for hospitalizations in patients above age 80 with COVID-19.^(7-9,16,17)

Geriatric syndromes appear especially prominent in long-term care residents as 73% of our patients with a geriatric syndrome at presentation were from long-term care. Similarly, delirium was a more common presenting feature amongst those residing in long-term care compared to those in independent living situations. This was shown in a single-centre cohort study in the United Kingdom where 18.8% of patients from nursing homes had atypical symptoms, as well as in a point-prevalence survey in United States nursing homes where 8% of COVID-19-positive patients had atypical symptoms, defined in both studies as absence of fever, cough, and dyspnea.^(8,11)

Adults ≥ 70 in our study, especially those presenting with a geriatric syndrome, had higher proportions of AKI and hypernatremia in-hospital compared to younger patients. An analysis of the international HOPE-COVID-19 registry demonstrated more frequent dysnatremias in patients in this age group and increased mortality in patients with both hyponatremia and hypernatremia.⁽¹⁸⁾ A French study of 821 patients hospitalized to geriatric wards with COVID-19 further observed AKI as a frequent complication, which was significantly more frequent in older adults who died.⁽¹⁹⁾ The occurrence of these complications suggests a vulnerability of older adults hospitalized with COVID-19 and especially of those presenting with a geriatric syndrome to dehydration. Dehydration in older persons can have severe consequences. If left untreated, mortality can exceed 50%.^(20,21) Furthermore, it is a common precipitating factor for geriatric syndromes, including delirium and falls.^(22,23) In our study, adults ≥ 70 who had a geriatric syndrome at presentation were also more prone to develop a new delirium in hospital compared to those without.

Our findings are consistent with previous studies that have demonstrated an association between older age and mortality.^(3,6,24) However, our study may underestimate complications and mortality in the older population as some patients were discharged to community inpatient centres to offload acute care beds during the first wave of the pandemic in Montreal. We suspect multiple patients may have died in the community. Amongst our subgroup analyses, our study suggests a trend for higher mortality in older adults presenting with a geriatric syndrome. This was previously demonstrated in American and Italian studies of the association between delirium and death in COVID-19 patients.^(10,25)

Amongst our subgroup analyses, our study further demonstrated a different pattern of disease between

older men and women, with older men exhibiting more complications and lethal disease. Men had higher proportion of cardiovascular complications and bacterial pneumonia superinfection in hospital. Additionally, men had higher frequency of intensive care admission, intubation and mechanical ventilation, and death. The association between male sex and severity of disease, as well as mortality, was demonstrated in reports of patients of all-ages hospitalized cases from China, Europe, and the United States.⁽²⁶⁻²⁹⁾ A French study specifically conducted amongst older adults hospitalized on geriatric wards with COVID-19 demonstrated the probability of in-hospital mortality was increased with male sex.⁽¹⁹⁾ The sexual dimorphism in COVID-19 follows previous data demonstrating men and women have different immune responses to viral infections.^(30,31)

Limitations

Our study has limitations. First, it only considers older adults hospitalized with COVID-19. It is therefore not representative of all COVID-19 infections amongst older adults. Second, we only included patients from two hospitals within the Montreal area. However, we included all admitted patients, providing a comprehensive portrait of the most affected geographic area during the first wave of COVID-19 in Quebec. Moreover, the retrospective nature of the study required reliance on review of medical records for data extraction. Certain information was missing from baseline assessment, or may be less reliable due to being based on other physicians' interpretation of findings or on patients' recall of events (some of whom presented with delirium). We only assessed patients' in-hospital course, limiting our assessment of long-term repercussions of disease. If a patient's goals of care were geared towards comfort, imaging and laboratory examinations were limited. Lastly, comparisons in our study are descriptive and are intended to be regarded as hypothesis-generating for further studies.

CONCLUSION

This one of the first studies reporting the disease course of a Canadian cohort of older patients hospitalized with COVID-19 from presentation to in-hospital outcomes. The data emphasize the importance of non-respiratory presentations, especially of geriatric syndromes, as presenting features of COVID-19 in older adults. Our findings further demonstrate the heightened vulnerability of older adults presenting with a geriatric syndrome to complications, more so the extremes of age, men, and those from long-term care, emphasizing the need for early well-coordinated multidisciplinary care for these populations. We hope that the descriptive comparisons presented here will foster further discussion and exploration of new hypotheses.

Implications for Practice

- Beware of non-respiratory presentations of COVID-19 in older persons. An older person developing a new geriatric syndrome in the context of the COVID-19 pandemic should prompt early isolation and testing.

- A geriatric syndrome at presentation to hospital in a COVID-19–positive patient should trigger proactive measures to prevent and treat delirium and dehydration.

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Not applicable.

CONFLICT OF INTEREST DISCLOSURES

We have read and understood the Canadian Geriatrics Journal's policy on conflicts of interest disclosure and declare no conflict of interest for this paper.

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