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Musculoskeletal and Emergency Imaging

The impact of COVID-19 quarantine efforts on emergency radiology and trauma cases

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ABSTRACT

Objective: Amidst COVID-19 pandemic, many states have issued stay at home advisories and non-essential business closures to limit public exposure. During this “quarantine” period, it is important to understand the volume and types of emergency/trauma radiology cases to better prepare for the continuing and future pandemics. This study demonstrates new trends in pathologies and an overall increase in positive exams.

Methods: A retrospective review of emergency department's imaging during the initial two weeks of this state's quarantine period, 3/23/2020–4/5/2020 was compared to similar dates of the previous year (“pre-quarantine” period), 3/25/2019–4/7/2019. One thousand emergency radiology and 991 trauma cases were evaluated. Of the emergency radiology cases 500 studies from each period were assessed, and from the trauma cases, 783 cases from pre-quarantine and 315 from the quarantine period were examined. Chi-square analysis was performed to assess for statistical significance.

Results: Overall there were 43.0% fewer emergency radiology studies performed during the quarantine period ($n = 4530$) compared to pre-quarantine period ($n = 2585$). Additionally, the number of positive cases was significantly higher ($P = 0.0001$) during the quarantine period (43.0%) compared to the pre-quarantine period (30.2%). Several trends in types of trauma were observed, including a significant increase in domestic violence during the quarantine period ($P = 0.0081$).

Discussion: Different volumes and types of emergency/trauma imaging cases were observed during the recent quarantine period. Findings may assist emergency radiology departments to plan for future pandemics or COVID-19 resurgences by offering evidence of the types and volume of emergency radiology cases one might expect.

1. Purpose

As of November 10, 2020, there have been 9,913,553 reported cases and 237,037 deaths related to the COVID-19 virus in United States.¹ While there are treatments to alleviate symptoms and accelerate recovery from COVID-19, and current vaccine administration efforts are ongoing, a cure is not currently available.² Current methods to curb the infectious spread of COVID-19 primarily involve public health measures.^{3–5} In an attempt to slow the spread of the virus a number of states have implemented either stay at home orders or a limiting of commercial activities. On March 23, 2020, during the initial ascent of the pandemic, Ned Lamont, state governor of Connecticut issued an executive order/stay at home advisory directing all non-essential businesses and non-for-profit entities to prohibit all in-person functions (herein after the “quarantine”). Although initially successful in inhibiting the

spread, there continue to be fluctuations of COVID-19 cases and associated changes to public health policies.^{6,7} In light of resurgences of COVID-19 cases and a need for possible stricter stay-at-home regulations in the coming months, it is important to understand and prepare for the new volume and types of pathologies most commonly seen in this unfamiliar time. It may also aid in preparation for future pandemics.

Since the stay-at-home advisories have been in place (in Connecticut and elsewhere), decreases in emergency room visits have been noted worldwide. One study documented a 45.0% decrease in U.S. emergency department visits.^{8–11} In keeping with the decreased visits, decreased radiology case volume was noted.^{12,13} While there have been various reports of new trauma patterns in the emergency medicine literature, this study evaluates these trends from the emergency radiology perspective.^{14–24} The analysis of emergency/trauma imaging may offer additional insights with respect to radiology practice operations and

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social issues.

2. Materials and methods

IRB waiver was obtained. We performed a retrospective review of emergency department imaging at an academic hospital/level 1 trauma center during the early phase of the pandemic, when the quarantine/stay at home advisory was first issued, spanning 3/23/2020 to 4/5/2020. This quarantine period was then compared to similar dates the previous year, 3/25/2019 to 4/7/2019 (hereinafter the “pre-quarantine” period). If a patient obtained multiple imaging during the above periods, then the filter was set to select the most recent imaging.

Emergency radiology cases were selected by our radiology study search engine Nuance® mPower™ and the first 500 exams from both periods were selected. We assessed for any positive or acute findings. Most notable findings included trauma (fracture, dislocation, hematoma, gunshot wound, and foreign body), nonspecific pulmonary findings (pleural effusion, pulmonary edema, and/or pulmonary opacity), pulmonary embolism, pneumonia, congestive heart failure, neoplasm, ischemic stroke, intracranial hemorrhage, GI tract inflammation (esophagitis, gastritis, enteritis, and/or colitis), acute pancreatitis, appendicitis, acute cholecystitis, small bowel obstruction, cellulitis/abscess, and urinary tract infection. Some of the clinical diagnoses were designated as such if the report explicitly raised concern for the diagnosis. If a patient had multiple acute findings, then the highest acuity or first documented diagnosis listed was documented.

Trauma cases were identified by Nuance® mPower™ containing one or more of the following trauma related terms in the radiology report: running, playing, fell, fall, motor, lacerate, sprain, broke, shot, hit, domestic, crush, MTR or modified trauma, MVC or motor vehicle crash/collision, MCC or motorcycle crash/collision, GSW or gunshot wound, assault, driver, pedestrian, helmet, and seatbelt. The patient must have received physical trauma the day of their imaging to meet criteria.

We performed chi-square test to assess for statistical significance ($P < 0.05$).

3. Results

For emergency radiology cases, there were 4530 pre-quarantine and 2585 quarantine studies. There were 43.0% fewer emergency radiology studies performed during the quarantine period compared to pre-quarantine period. From these, 500 patients from each of the periods were selected for evaluation. The number of positive cases was significantly higher ($P = 0.04$) during the quarantine period (43.0%) when compared to the pre-quarantine period (30.2%). The most common etiology represented was trauma for both the quarantine (38.6%) and pre-quarantine (48.3%) periods. A significant increase in pneumonia was also noted during quarantine. These findings are tabulated on [Table 1](#).

For trauma cases, there were 1022 pre-quarantine and 315 quarantine studies. From these patients, 783 pre-quarantine patients and 208 quarantine patients met criteria, respectively. Trauma imaging demonstrated a significant ($P < 0.001$) or 73.4% decrease during quarantine as compared to the pre-quarantine period ([Table 2](#)). Furthermore, there were significant decreases in vehicular accidents ($P = 0.002$), outside falls ($P = 0.0301$), and other outdoor injuries ($P = 0.0053$). Conversely, a significant increase in falls at home was noted ($P < 0.0001$). While no significant difference was observed for overall physical assaults, there was a significant increase in clinician indicated domestic violence during the quarantine period ($P = 0.0081$). No significance difference was observed in work related and other indoor injuries.

4. Discussion

As a consequence of the pandemic, there has been significant overall decrease in emergency imaging at this institution, mirroring the overall

Table 1

Distribution of notable acute emergency radiology findings.

	Pre-quarantine period (n = 151)	Quarantine period (n = 215)	P-value
Trauma	73	83	0.07
Nonspecific	15	19	0.7
pulmonary finding			
Pulmonary embolism	5	3	0.2
Pneumonia	5	24	0.007
Congestive heart failure	4	1	0.08
Neoplasm	9	12	0.9
Ischemic stroke	4	7	0.3
Intracranial hemorrhage	4	5	0.8
GI tract inflammation	4	7	0.7
Acute pancreatitis	2	2	0.7
Appendicitis	2	6	0.3
Acute cholecystitis	2	2	0.7
Small bowel obstruction	1	5	0.2
Cellulitis/abscess	6	2	0.05
Urinary tract infection	1	10	0.03

decrease in emergency room visits around the world.^{8–11} Similar decreases in emergency department visits were seen with the previous Severe Acute Respiratory Syndrome (SARS) pandemic in 2003, despite a lack of similar stay at home advisories.²⁵ The significant reduction in emergency radiology volume suggests temporarily decreasing emergency radiologist staffing during this period. It may also be helpful in counteracting the financial strain from decreased emergency radiology studies performed.

Significantly higher positive emergency radiology studies were demonstrated. Authors attribute public effort to avoid outside contact resulting in higher threshold for coming to emergency department, particularly for non-urgent medical issues.^{26,27} The elevated threshold may also suggest some urgent issues were not being appropriately addressed in the emergency setting. These findings raise a concern of possible delays in care for conditions and consideration for easier access of telehealth to better evaluate those with urgent medical conditions. From the emergency radiology perspective, a higher level of suspicion should be undertaken for all studies as positive findings are significantly higher at this time.

While no significant differences are observed among most non-trauma findings, there was a significant increase in pneumonia during quarantine. We attribute this to both a rise in viral pneumonia directly associated with COVID-19, as well as a lower threshold of radiologists for reporting pneumonia given such prevalence. These findings suggest increased scrutiny of imaging for subtle findings, with a different sensitivity by radiologists for attributing nonspecific imaging findings to infectious etiologies. It also raises the question of whether it would be beneficial to enlist more help from chest radiology subspecialists during pandemic due to their heightened sensitivity for COVID-19 pneumonia. Further studies will need to be performed to assess for validity.

The decrease in trauma radiology cases during the COVID-19 quarantine in our study is mirrored by a decrease in overall trauma visits worldwide.^{14–19} Some of the trends of emergency trauma cases were as predicted. For example, the combination of stay-at-home advisories/executive orders, telecommuting, business closures and home delivery options likely led to a decline in vehicular accidents,¹⁹ as fewer non-essential drivers were on the roads. The decrease in outside falls were also likely related to some of these previously mentioned reasons. Given that many falls impact elderly patients, who face disproportionately severe COVID-19 risks, a greater number of elderly individuals may have been diligent in heeding stay at home orders, and a fear of COVID-19 exposure in the hospital setting may also have resulted in an under-presentation of such patients to the emergency room.^{28–32} Conversely and as expected, a significant increase in falls at home was also noted. Other outdoor

Table 2
Distribution of emergency radiology trauma cases.

	Fall at home	Fall outside	Motor vehicle accident	Physical assault	Domestic violence-physical assault	Other indoor injury	Other outdoor injury	Work related injury	Miscellaneous
Pre-quarantine n = 783 (%)	276 (35.2)	125 (16.0)	174 (22.2)	40 (5.1)	11 (1.4)	23 (3.0)	94 (12.0)	49 (6.3)	2 (0.6)
Quarantine n = 208 (%)	112 (53.8)	20 (10.0)	26 (12.5)	16 (7.7)	9 (4.3)	12 (5.8)	11 (5.3)	10 (4.8)	1 (0.5)
P-value	<0.0001	0.03	0.002	0.1	0.0081	0.05	0.005	0.4	0.9

injuries, which primarily consisted of sports related injuries, are believed to have decreased due to a discouragement of human-to-human contact while encouraging social distancing,^{33,34} as many contact and team sports are considered higher risk and nonessential. No significant difference in work related injuries was noted in our study despite a portion of the population now being encouraged to telecommute when possible.³⁵ We suspect the reason for this lack of change was that work related injuries were primarily associated with physical labor jobs unable to be performed remotely. Finally, although not statistically significant ($P = 0.05$), the number of indoor injuries (composed of miscellaneous injuries at home, excluding falls) during quarantine was also higher. This was expected, similar to increased falls at home, as quarantined individuals were spending more time in the home.

Although overall physical trauma did not significantly increase, there was a significant increase in clinician indicated domestic violence. Similar findings are echoed elsewhere in the literature.^{20–24} It is hypothesized that stresses related to prolonged enclosure in a confined space and inability to avoid an abusive individual resulted in increased conflict within households. Other etiologies such as stresses from economic hardship from business closures and unemployment may have also had an impact.³⁶ These findings suggest consideration for establishment of programs during times of quarantine to offer increased telehealth services and counseling to those at risk.

This study has several limitations. Due to a wide spectrum of acute findings, only the most common pathologies were evaluated and tabulated. In addition, because some of the diagnoses are clinically and not radiologically diagnosed, these diagnoses were dependent on report phrasing and the provided clinician indications, and will not have captured those cases diagnosed clinically without imaging, or those cases for which the clinician concerns and reasons for imaging did not match. Lastly, this is a single center retrospective study at an academic institution with a level 1 trauma center, and may not be equally applicable at every institution.

In summary, we report our findings to help assist emergency radiology departments to plan for future pandemics or COVID-19 resurgences by offering evidence of the types and volume of emergency radiology cases one might expect. While doing so, we seek to highlight some of the social issues, heightened during this unique period.

CRedit authorship contribution statement

Benjamin Jang: Critical draft and revision of manuscript along with data collection.

Jonathan L. Mezrich: Critical draft and revision of manuscript along with project oversight.

Declaration of competing interest

The authors declare that they had full access to all of the data in this study and the authors take complete responsibility for the integrity of the data and the accuracy of the data analysis. The authors have no conflict of interest to disclose.

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