Acta Biomed 2020; Vol. 91, N. 2: 89-96 DOI: 10.23750/abm.v91i2.9636

Proximal femur fractures in COVID-19 emergency: the experience of two Orthopedics and Traumatology Departments in the first eight weeks of the Italian epidemic

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Summary. *Introduction:* CoVID-19 (Coronavirus disease) is a worldwide infection which is causing millions of deaths. A significant number of elderly patients require hospitalization and develop serious and sometimes life-threatening complications. The aim of this study is to evaluate the preliminary impact (8 weeks) of CoVID-19, focusing on proximal femur fractures, analyzing data and results compared to the same period of 2019. *Materials and methods:* From February 22nd to April 18th, 2020 we surgically treated 121 proximal femur fractures (61 in Piacenza; 60 in Parma, 16 male, 44 female, mean age 81.1). In the same period of 2019, we treated 169 proximal femur fractures (90 in Piacenza, 33 male, 57 female, mean age 81.9; 79 in Parma, 29 males, 50 female, mean age 80.2). We had 21/61 (34.4%) patients resulted positive for COVID-19 and 11/61 in Parma (18.3%), based on nasal-pharyngeal swab, chest CT scan and/or lung US findings. *Results:* The incidence of proximal femur fractures had a significant reduction during CoVID-19 spread in Piacenza and Parma. Authors have noticed an elevated number of deaths within 21 days after surgery. Piacenza: 4 cases in 2019 (4.4%) and 11 in 2020 (18.0%), of which 9 cases CoVID positive. In Parma in 2019 two deaths were encountered; in 2020 6 patients died and 5 cases were CoVID positive. *Conclusion:* In the first two months of the Italian epidemic, in the cities of Piacenza and Parma over 80% of deaths have occurred in patients over 70 years old. Even if preliminary, our study shows a significant increase in death in elderly patients surgically treated for proximal femur fractures, particularly in the Piacenza Hospital. (www.actabiomedica.it)

Key words: Coronavirus, Elderly patient, Proximal femur fracture, CoVID-19, Italian outbreak

Introduction

Since the emergence of the 2019 novel coronavirus (2019 n-CoV) (1) in China in December 2019 it spread all over the world like a "tsunami" causing a global outbreak. Coronaviruses are a family of virus, that can cause disease in both humans and animals. They can cause respiratory infections ranging from the common cold to more serious syndromes, such as MERS (Middle East Respiratory Syndrome) and SARS (Severe Acute Respiratory Syndrome) (2,3). CoVID-19 (coronavirus disease) can cause different clinical scenario: from asymptomatic patients to flu-like symptoms and severe respiratory failure for interstitial pneumonia (4,5). Some patients can complain of headache, fatigue, vomiting, diarrhoea and abdominal pain (6,7). Dysgeusia and anosmia are frequently reported by CoVID-19 patients (8,9).Mild infections may be self-limiting in few days, but in some cases the respiratory symptoms can develop into acute respira-

tory distress syndrome (ARDS) with a high risk of death from multiorgan failure . On 30th January 2020, the World Health Organization (WHO) declared CoVID-19 a public health emergency of international concern (10) .

The first Italian case of CoVID-19 patient was diagnosed on February 21st in Codogno (Lodi, Lombardy, Northern Italy). This date marks the beginning of the Italian CoVID-19 epidemic. The most important way to fight CoVID-19 is to detect CoVID-19 patients early, isolate cases, trace contacts and deliver the correct information to the general public (11). As consequence, on 23rd February 2020 the Italian Government declared the quarantine for the so-called Red Zone in Lombardy (Codogno and the neighbouring cities) and subsequently, the national lockdown on 10th March 2020 due to the high number of infected people and CoVID-19 related deaths, particularly in Piacenza (Emilia- Romagna) and Bergamo (Lombardy). While writing, 107 771 Italian people are positive for CoVID-19, 44 927 are cured, and 23 227 are died. 27740 patients are still hospitalized, 2733 among them are recovering in Intesive Care Units. 80 031 people are in quarantine at home. A total of 1 305 833 nasalpharyngeal swabs have been carried out. (Tab. 1)

Elderly people are at high risk for CoVID-19 and fatal consequences, especially if affected by blood hypertension and diabetes (12) or if suffering from 3 or more pathologies. In addiction, 84.1% of people die for CoVID-19 are aged over 80 years old.

In the orthopedic area, the largest number of surgeries concern fractures of the proximal femur, which are the most frequent cause of disability in patients over 65 years old. Several classifications to describe these fractures have been proposed. AO/TA is the most complete classification (14), which sorts all fractures according to the region involved. Regarding proximal femur, we therefore have:

Trochanteric region (31A):

Simple pertrochanteric (31A1), subsequently divided into isolated single trochanter (31A1.1), 2-part (31A1.2), lateral wall intact (>20.5mm) (31A1.3).

Multifragmentary pertrochanteric lateral wall incompetent (≤20.5mm) (31A2), subsequently divided, provided each of them having 1 intermediate fragment (31A2.2) 2 or more intermediate fragments (31A2.3).

Intertrochanteric reverse obliquity (31A3), subsequently divided into simple oblique (31A3.1), simple transverse (31A3.2) and wedge or multifragmentary (31A3.3).

Neck (31B):

- Subcapital (31B1), subsequently divided in valgus impacted (31B1.1), non-displaced (31B1.2) and displaced (31B1.3).
- Transcervical (31B2), subsequently divided in simple (31B2.1), multifragmentary (31B2.2) and shear 31B2.3).
- Basicervical (31B3).

Head (31C):

- Split (31C1), subsequently divided in avulsion of ligamentum teres (31C1.1), intrafoveal (31C1.2) and suprafoveal (31C1.3).
- Depression (31C2), subsequently divided in chondral lesion (31C2.1), depression impaction (31C2.2) and split depression (31C2.3).

For the proximal femur fractures, other important classifications must also be considered: Garden classification, Pauwels classification and Evans-Jensen classification.

The Garden classification divides intracapsular fractures into 4 categories: incomplete and valgus impacted (Type I), complete and non-displaced (Type II), complete and partially displaced (Type III), and complete and fully displaced (Type IV) (15).

The Pauwels classification describes the medial fractures basing on the angle they form with the horizontal plane: up to 30° (type I), 30°–50° (type II), 50° and more (type III) (16).

The Evans-Jensen classifications divides intertrochanteric hip fractures into three categories: type I (IA 2-part non displaced, IB 2-part displaced), type II (IIA 3-part fracture with separate greater trochanter fragment, IIB 3-part fracture with separate lesser trochanter fragment) and type III (4-part fracture) (17).

The cities of Piacenza and Parma have been hit hard by CoVID-19. The first nasopharyngeal swabs positive for SARS-CoV-2 were recorded on 22nd February in Piacenza and two days later, on 24th February in Parma.

The purpose of this study is to evaluate the impact that CoVID-19 had on the Orthopedics and Traumatology Departments of Piacenza and Parma Hospitals,

focusing the attention on proximal femur fractures in the elderly patients. We analyzed data reported in the first 8 weeks of the Italian outbreak, comparing the results obtained with the specular ones of 2019.

Materials and Methods

We retrospectively analyzed data relating to the surgical operations performed at Guglielmo da Saliceto Hospital in Piacenza and Parma University Hospital (Emilia-Romagna, Northern Italy), between 22nd February 2020 and 18th April 2020 (the first 8 weeks from the beginning of the Italian epidemic). The period from 23rd February 2019 to 20th April 2019 (total 8 weeks) was used as control group.

As for Piacenza, the 2019 cohort includes 90 patients with proximal femoral fractures: 33 males (36.7%) and 57 females (63.3%), with mean age 81.9 ± 10.9 years (range 45 - 98). Fractures were subcapital in 21 cases (23.3%), transcervical in 10 cases (11.1%), basicervical in 8 (8.9%) cases, pertrochanteric in 42 cases (46.7%), subtrochanteric in 5 cases (5.6%) and periprosthetic in 4 cases (4.4%). We treated these fractures with Total Hip Arthroplasty (THA) in 10 cases (11.1%), Hemiarthroplasty (HA) in 17 cases (18.9%), cannulated screws in 4 cases (4.4%), plate in 3 cases (3.3%), short intramedullary nail in 49 cases (54.4 %), long intramedullary nail in 5 cases (5.6%), prosthetic revision in 2 cases (2.2%). Fractures were treated surgically within 48 hours in 52 cases (57.8%). (Figure 1,2)

The 2020 cohort includes 61 patients operated for proximal femur fracture: 16 males (26.2%) and 45 females (73.8%) with mean age 82.4 ± 9.6 years (range 55 - 97). Fractures were subcapital in 12 cases (19.7%), transcervical in 4 cases (6.6%), basicervical in 6 cases (9.8%), pertrochanteric in 32 cases (52.5%), subtrochanteric in 6 cases (9.8%) and periprosthetic in 1 case (1.6%). They were surgically treated with THA in 4 cases (6.6%), HA in 9 cases (14.8%), cannulated screws in 7 cases (11.5%), blade-plate in 1 case (1.6%), plate in 1 case (1.6 %), short intramedullary nail in

Regione	AGGIORNAMENTO 18/04/2020 ORE 17.00								
	POSITIVI AL nCoV				DIMESSI/ GUARITI	DECEDUTI	CASI TOTALI	INCREMENTO CASI TOTALI *(rispetto al giorno precedente)*	TAMPONI
	Ricoverati con sintomi	Terapia intensiva	Isolamento domiciliare	Totale attualmente positivi					
Lombardia	10.042	947	23.206	34.195	19.136	12.050	65.381	*+ 1.246*	255.331
Emilia Romagna	3.234	296	10.054	13.584	5.635	2.965	22.184	*+ 350*	121.220
Piemonte	3.271	323	10.629	14.223	3.989	2.252	20.464	*+ 661*	91.844
Veneto	1.287	190	8.967	10.444	4.189	1.059	15.692	*+ 318*	247.329
Toscana	883	198	5.389	6.470	1.149	618	8.237	*+ 127*	99.903
Liguria	901	105	2.406	3.412	1.992	897	6.301	*+ 113*	29.322
Marche	804	88	2.280	3.172	1.754	795	5.721	*+ 53*	39.909
Lazio	1.376	186	2.720	4.282	1.046	340	5.668	*+ 144*	89.553
Campania	605	76	2.364	3.045	643	300	3.988	*+ 37*	46.294
Trento	276	42	1.667	1.985	1.098	348	3.431	*+ 55*	23.147
Puglia	594	60	2040	2.694	401	314	3.409	*+ 82*	40.423
Friuli V.G.	141	27	1.235	1.403	1.106	222	2.731	*+ 56*	43.293
Sicilia	526	42	1.603	2.171	305	196	2.672	*+ 47*	47.715
Abruzzo	321	41	1.609	1.971	263	253	2.487	*+ 44*	27.016
Bolzano	179	28	1.349	1.556	530	239	2.325	*+ 29*	28.888
Umbria	109	32	290	431	856	57	1.344	*+ 7*	24.106
Sardegna	112	23	746	881	231	86	1.198	*+ 20*	14.087
Calabria	152	7	673	832	106	73	1.011	*+ 20*	22.794
Valle d'Aosta	107	10	432	549	400	124	1.073	*+ 80*	4.521
Basilicata	60	8	194	262	54	23	339	*+ 2*	6.056
Molise	27	4	178	209	44	16	269	*0*	3.082
TOTALE	25.007	2.733	80.031	107.771	44.927	23.227	175.925	*+ 3.491*	1.305.833

Figure 1. COVID 19: NATIONAL CASUISTRY (official data from Italian Civil Protection).

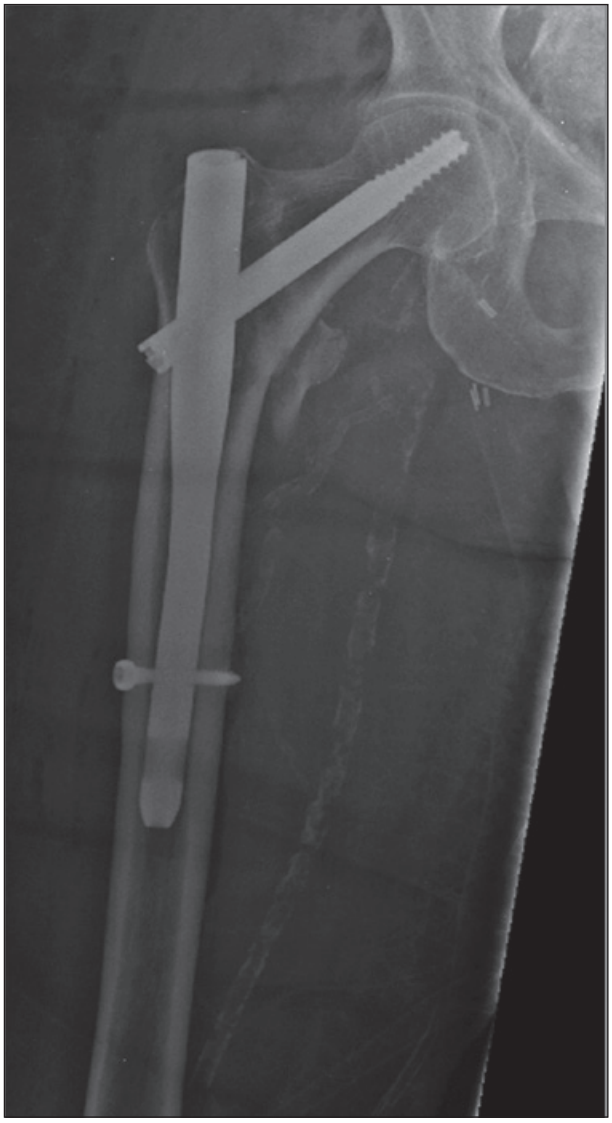

Figure 2. Intertrochanteric fracture treated with short intramedullary nail

34 cases (55.7%), long intramedullary nail in 5 cases (8.2%). Fractures were treated surgically within 48 hours in 42 cases (68.9%).

Among the admitted patients in Piacenza, 34/61 (55.7%) were investigated for CoVID-19 using nasopharyngeal swab (16 cases, 47.1%) or high resolution chest CT scan (9 cases, 42.9%) in the Emergency Room or in the ward. Patients positive to CT scan were then submitted to swab. A total of 21 patients tested positive to nasopharyngeal swab.

As for Parma, the 2019 cohort includes 79 patients with proximal femoral fractures: 29 males (36.1%) and

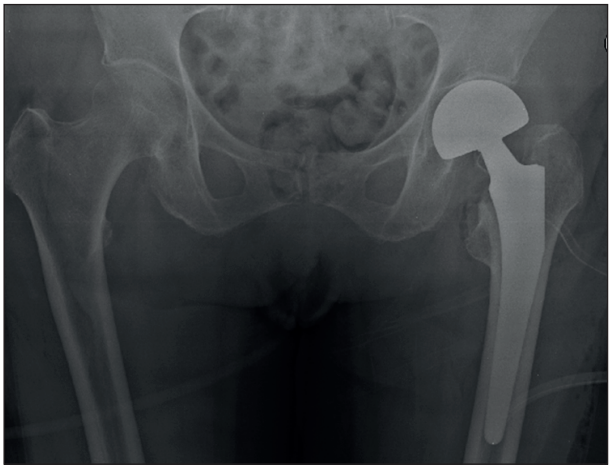

Figure 3. Subcapital Fracture Trated With Hemiarthroplasty

50 females (63.9%), with mean age 80.2 ± 10.4 years (range 51 - 95). Fractures were subcapital in 20 cases (25.3%), transcervical in 10 cases (12.6%), basicervical in 5 (6.3%) cases, pertrochanteric in 33 cases (41.8%), subtrochanteric in 4 cases (5.1%) and intertrochanteric in 7 cases (8.9%). We treated these fractures with Total Hip Arthroplasty (THA) in 9 cases (11.4%), Hemiarthroplasty (HA) in 22 cases (27.8%), cannulated screws in 4 cases (5.1%), short intramedullary nail in 36 cases (45.6%) and long intramedullary nail in 8 cases (10.1%). Fractures were treated surgically within 48 hours in 53 cases (68.9%).

The 2020 cohort includes 60 patients operated for proximal femur fracture: 16 males (26.7%) and 44 females (73.3%) with mean age 81.1 ± 9.9 years (range 41 - 99). Fractures were subcapital in 14 cases (23%), transcervical in 6 cases (10%), basicervical in 9 cases (15%), pertrochanteric in 20 cases (33.3%), subtrochanteric in 4 cases (6.7%) and intertrochanteric in 7 cases (11.7%). They were surgically treated with THA in 7 cases (11.7%), HA in 12 cases (20%), cannulated screws in 7 cases (11.7%), short intramedullary nail in 26 cases (43.3%), long intramedullary nail in 8 cases (13.3%). Fractures were treated surgically within 48 hours in 43 cases (71.7%).

Among the admitted patients in Parma, 30/60 (50.0%) were investigated for CoVID-19 using high resolution chest CT scan (46.4%) in the Emergency Room. Eleven patients (18.3%) resulted infected by CoVID-19 and positive to chest CT scan (18.3% of all patients, 36.7% of suspected CoVID patients). Naso-

pharyngeal swab was performed after ward admission and it always confirmed the positivity of the CT scan.

Results

From the analyzed data, it is evident that during the outbreak of CoVID-19 Italian epidemic there was a decrease in fractures of the proximal femur. In fact, we passed from the 169 fractures treated in February-March 2019 to the 121 in the same months of 2020, equal to a decrease of 28.4%. The Hospital of Piacenza recorded 90 surgeries in 2019 and 61 in 2020, with a reduction of 32.2%; 79 fractures were instead recorded in the University Hospital of Parma in 2019 and 60 in 2020, with a decrease of 24.1%. The national Italian lockdown, with traffic restrictions and the closure of many commercial activities, schools, companies and factories, has surely limited the movement of the population. In the same way, the news broadcasted by Government and mass media that warned above all the elderly population contributed to this purpose. Old people are considered one of the most exposed to risk category since more often their immune system is weakened by the presence of other pathologies or recent surgical intervention. In the Piacenza Hospital, the total number of accesses to the emergency room for domestic accidents has increased significantly, going from 43% in the month of March 2019 (319 domestic accidents out of 741 total accesses) to 69.8% in March 2020 (171 domestic injuries against 245 total accesses), an increase of 62.3%. From the data in our possession, it seems that these restrictions, carried mainly to prevent CoVID-19 infections, have further led to a decrease in proximal femoral fractures.

On the other hand, the number of complications during hospitalization and the total number of deaths have significantly increased. We rechecked all the cohort patients, focusing the attention on the first 21 days after the surgery.

In the period under review, in Piacenza, we recorded 4 deaths in 2019 (4.44%) and 11 in 2020 (18.0%), with an increase of 305.4%. The dead of 2020 were 4 males (36.4% of the total, 25.0% of the males) and 7 females (63.6% of the total, 15.6% of the females), with average age of 84.4 ± 6.4 years (min 74 - max 95). In Parma, instead, 2 deaths in 2019 (2.5%) and 6 in 2020 (10.0%), with an increase of 300% were recorded. The deads of 2020 were 5 males (71.4% of the total, 31.2% of the males) and 2 females (28.6% of the total, 15.6% of the females), with an average age of 81 years ± 5.1 (min 75 - max 98). Consequently, during the pandemic we found a percentage increase in proximal femur fractures in females (in Piacenza 63.8% in 2019, 73.8% in 2020; in Parma 63.3% in 2019, 73.3% in 2020), but deaths during the pandemic are proportionately more frequent in male individuals: in Piacenza 25.0% in males (4/16 surgical interventions) and 15.6% in females (7/45 surgical interventions); in Parma 31.3% (5/16) in males and 4.5% in females (2/44).

The main cause of death, in Piacenza, was cardiac arrest (4 cases, 36.7% of deaths), followed by Multi-Organ Failure (MOF, 3 cases, 27.3% of deaths), septic shock (1 case, 9.1% of deaths), renal failure (1 case, 9.1% of deaths), brain hemorrhage (1 case, 9.1% of deaths) and progression of neoplastic disease (1 case, 9.1% of deaths). Of these patients, 9 (81.8% of the deaths) had suspected symptoms for CoVID-19 during the hospitalization (i.e. fever, tiredness, dry cough, runny nose, sore throat, nasal congestion, aches and pains, diarrhoea) and underwent one or more specific diagnostic tests (nasopharyngeal swab, chest CT scan, CUS), testing positive for at least one test: 2 patients resulted positive to both nasopharyngeal swab and chest CT scan (2.2%), 1 patient positive to both nasopharyngeal swab and LUS (11.1%), 5 patients positive to chest CT scan (55.6%) and 1 patient positive to LUS (11.1%). The main causese of death in CoVID-19 patients were cardiac arrest (4 cases, 44.4%), MOF (3 cases, 33.3%), septic shock (1 case, 11.1%) and renal failure (1 case, 11.1%).

The other 2 death were not tested: both died the day after surgery, one for brain hemorrhage and one for the worsening of clinical condition (progression of neoplastic lung disease already known before admission).

Among the other 50 patients, in 12 cases (24.0% of alive patients) diagnostic investigations were performed during hospitalization. The diagnostic investigations were carried out due to the onset of symptoms attributable to CoVID-19 (10 cases, 83.3%) or be-

cause the patient was in quarantine at the time of the trauma, since the patient was living with a CoVID-19 subject (2 cases, 16.7%).

In Parma, the main cause of death was cardio-respiratory arrest (4 cases, 66.7% of deaths), septic shock (1 case, 16.7% of deaths), and progression of neoplastic disease (1 case, 16.7% of deaths). Of these patients, 5 (83.3% of the deaths) had symptoms for CoVID-19 before the hospitalization (i.e. fever, tiredness, dry cough, runny nose, sore throat, nasal congestion, aches and pains, diarrhoea) and the diagnsosis was confirmed by CT scan and nasopharyngeal swab. The death CoVID positive patients died for cardio-respiratory arrest (4 cases, 66.7%) and septic shock (1 case, 16.7%).

The other death was not positive to CT scan and she died 5 days after surgery for progression of neoplastic liver disease already diagnosed before admission.

Among the other 54 patients, in 24 cases diagnostic CT scan investigations was performed during hospitalization in the emergency ward. This diagnostic investigation was carried out as consequence of the presence of symptoms attributable to CoVID-19 (19 cases) or because the patient was in quarantine at the time of the trauma, since he was living with a CoVID + subject (5 cases).

Discussion

The analysis of these data shows the decrease in fractures of the proximal femur, especially in Piacenza. This figure is, however, relative as in Piacenza, for 3 years now, all fractures of the proximal femur have been centralized by the peripheral hospitals (Fiorenzuola d'Arda and Castel San Giovanni) on the Guglielmo da Saliceto Hospital, so the 90 fractures of 2019 and 61 fractures of 2020 are all those that occurred in the province of Piacenza. The province of Parma is instead organized differently, as generally the fractures are not centralized at the Maggiore Hospital of Parma, but can also be treated in other Hospital (Fidenza and Borgotaro). Since the beginning of the epidemic, however, Parma has decided to use all other Hospitals for CoVID patients and to centralize all the fractures on the Maggiore Hospital. This analysis, therefore, shows that even in the province of Parma there has been a significant reduction in this type of pathology.

In Piacenza, during the Coronavirus pandemic, the total number of surgeries sharply decreased. In fact, from February 23rd all the election surgery was suspended and we operated only urgent patients. Furthermore, the total numbers of surgical fractures have decreased, especially those related to sports injuries, road accidents and accidents at work, also in this case especially thanks to the restrictive decrees. As a result, 68.9% of patients (42 cases) managed to operate in 48 hours, with a significant improvement compared to 57.8% in 2020. For the other patients, we had to wait longer due mainly to anticoagulant / antiplatelet therapies (10 cases, 50.0% of delays), trauma close to the weekend (3 cases, 16.7% of delays%), the need for time to implement diagnostic tests and / or specific treatments related to CoVID-19 (3 cases, 16.7%), full operating room (2 cases , 11.1% of delays). Even Parma, albeit to a lesser extent, increased the number of surgeries performed within 48 hours, going up from 68.9% to 71.7%.

One of the critical issues related to SARS-CoV-2 pandemic found by the Orthopedics department of Piacenza was the forced transfer to another local building in Piacenza, the Clinic "Casa di Cura Piacenza", made necessary to allow the expansion of the Emergency Department (which also occupied a large part of the operating rooms) and the creation of a COVID Emergency Health department, where patients with suspicion or diagnosis of SARS-CoV-2 infection could be hospitalized. The transfer took place on March 13th and, from that moment, specialist visits could be performed either with the Clinic's specialists (anesthesiologists, internists, otolaryngologists, neurosurgeons, radiologists) or remotely with the specialists of Piacenza Hospital. In only one case, an urgent consultation was performed by a thoracic surgeon of the Hospital at the Clinic, as we had found a pneumothorax in one of our patients and it was, therefore, necessary a chest drain insertion. Among the 61 femoral fractures operated in 2020, 20 (32.8%) were executed at Guglielmo da Saliceto Hospital (18 operated before the transfer) and 41 (67.2%) at Casa di Cura Piacenza.

There are two important data that could, in part, explain the greater number of deaths in Piacenza. The

first is linked to the average age of the population: in fact, the inhabitants of the province of Piacenza have an average age that settles on 46.22 years, exactly one year more than those of the province of Parma, which with 45.22 years of average age approach the Italian National average (44.91 years) (25). The second concerns the percentage of infected people on the total number of inhabitants of the province. While writing, the latest data issued by Italian Civil Protection speak of 3751 infections in Piacenza and 3073 in Parma (26). The population of the 2 provinces is however very different, as there are 286997 inhabitants in the Piacenza province, while in Parma 447779. This means that in the province of Piacenza 1.3% have contracted the infection, in Parma instead only 0.7%.

The SARS-CoV-2, therefore, has led to a more difficult perioperative management of this type of patients, who have required further diagnostic tests, specialist visits, specific pharmacological treatments. Besides, these complications have in many cases led to an increase in hospitalization times.

Conclusion

CoVID-19 has had a devastating effect on our population, particularly on the elderly category. Proximal femur fractures have decreased, probably thanks to the Government's restrictions on circulation and the fear of falling victim to this virus that forced elderly people to severely limit exits. On the other hand, CoVID-19 infection caused a more complex post-operative course, as well as a reorganization of the Hospitals, resulting in a significant percentage increase in deaths in the first 3 postoperative weeks. Proportionally, the deaths mostly concerned the older population, male and with a clinical picture attributable to CoVID-19 infection.

From this study, even if preliminary, it is evident that the CoVID-19 infection caused an increase of perioperative mortality in proximal femoral fractures. Parma and Piacenza have been severely affected by the infection, both in terms of contagion and death. Piacenza paid the most expensive price, mainly due to a higher average age and a more conspicuous spread of the virus among the inhabitants.

Conflict of interest: Each author declares that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article

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Received: 26 April 2020
Accepted: 28 April 2020
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