SCAN ME

THE TSRM ON THE FRONT LINE TO FACE THE COVID-19 EMERGENCY: DUTIES AND RESPONSIBILITY TO AVOID CONTAGION AND CONTAMINATION OF ENVIRONMENTS AND RADIOLOGICAL TOOLS

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ABSTRACT

Covid-19 infection is strongly increasing, becoming an emergency at a global level: the incredible number of infections as well as the large number percentage of deaths forced the WHO (World Organization of Health) to declare the pandemic emergency, pushing a large part of world governments to adopt important security measures.
The whole medical-health community has the duty to deal with the emergency by considering that the infection has a high viral load which causes an easy diffusion, especially among health workers, currently the subjects more exposed.
To avoid infection it is important to ritualize your own professional practice with specific protocols and maximum means of prevention and protection.
The clinical background of the most serious infected patients is actually characterized by a chest imaging due to interstitial pneumonia, this circumstance gives radiology a key role in the battle against this enemy that is still completely unknown.
The Radiographers are among the most exposed categories in the healthcare landscape as they are they operate with direct contact to the patient during radiological examinations, that is although they are not always properly trained for this kind of events.
This work has an ambitious claim to clarify which are the indispensable PPE (personal protective equipment), but above to point out all behaviors and procedures to be implemented to avoid contagion and contamination of the workplace.

INTRODUCTION

In December, 2019, in the city of Whuan, China, a high number of pneumonia patients with unknown aetiology is found. They also show flu symptoms such as high fever, cough and wheezing.
In the first weeks of the following month, the Chinese scientific authorities claim to have isolated a new Coronavirus in these individuals, named *SARS- CoV-2*, at least similar to 70% of its gene sequence to the *SARS-CoV*, responsible for thousands of infections throughout the world territory.
In the last weeks of January 2020 the virus expands outside the Chinese borders reaching central Europe, the US and Africa with cases sporadic and immediately isolated in the various reference infectious centers.
On January 30, 2020, WHO declares the global state of emergency for the Covid-19 epidemic (*Corona Virus Disease 2019*) while already since halfway February the number of infected people rises to tens of thousands around the world.
After China, Japan and South Korea, the country with the most important outbreak is Italy that in the beginning of March 2020 records about 5000 cases of contagion and 200 deaths, forcing the institutions to isolate the original outbreaks circumscribing the perimeter as "*Red Zone*" and asking the country's health authorities to face a real and national emergency.

THE ROLE OF RADIOLOGY

In about 80% of affected patients, Covid-19 has no symptoms or it regresses autonomously, "only" the remaining 20% need of hospitalization and therefore of a diagnostic and therapeutic process.
The predominant clinical framework is represented by severe pneumonia interstitial clearly visible in the HRCT exam (high resolution CT) in the form of bilateral multifocal opaque with "*ground glass*" flanked by significant areas of consolidation mostly present in lower lobes and in the posterior areas of the lungs.
These characteristics invest the radiology of a fundamental role in the study of this new pathology, not only in the initial diagnostic phase, but especially subsequently to follow the clinical course in each individual patient.
Although the CT study is essential for the treatment of the infection, Chest X-ray instead plays a marginal role, especially in the early stages of the disease in which radiographic imaging is often negative while with its increasing it is possible to notice multifocal alveolar opacities up to total opacification of both lungs.
The contribution of our branch therefore seems limited to these 2 simple methodologies, but it is necessary to remember that about 10% of infected patients needs an ICU bed and that for most of them complications of the disease are the result of a combination of Covid-19 and

past pathologies. Therefore the diagnostic tests are not limited only to those related to Coronavirus viral pneumonia, but also to other investigations related to different and concomitant problems of a patient, making radiological function of primary importance throughout the his medical-health path.
Having clarified that every patient admitted, and not only, with Covid-19 suspicion or positive full-blown, sooner or later, needs a radiological exam, it is important to point out how the Medical Radiology Healthcare Technician should be trained in the better to do your job in total safety in order to avoid infect and/or contaminate surrounding equipment and environments.

DRESSING AND UNDRESSING PROCEDURES AND SUBSEQUENT DECONTAMINATION

Sars-cov2 is highly contagious given its high microbial burden. Therefore it is strongly advisable to use a "*full barrier*" approach to avoid the contagion that can occur or by contact (present on surfaces contaminated) or by "*Droplet*" (droplets in air coming from patient through a sneeze or cough).
The ways to prevent infection consist of 2 main stages:

- ***Dressing and Undressing***
- ***Decontamination and Sanitation***

For both processes, all PPE and tools should be found necessary to protect the operator and allow him to sanitize equipment and furnishings on which the virus could settle during the execution of the due diagnostic investigations in order to reduce the risk of contagion is minimized even for other users.
At our "*D. Cotugno" Hospital* Radiology, after studying and interpreted the *ISS (Italian National Institute of Health)* guidelines and specific international procedures for this type of infection, we have identified 2 levels of dressing, which change according to the kind of contact with the patient: if we have to interact directly with the patient as in the case of an x- ray chest in bed where we are going to place the X-ray cassette behind his/her shoulders and therefore it will be inevitable to approach less than a meter, then we could also adopt the highest level of "*harness*".
In the case that instead we will be able to maintain the minimum distance of 1 meter, a first level dress will be enough.
It must be said that both harness levels are extremely safe and, however, they guarantee a high percentage of non-contamination on the condition that the delicate phase of Undressing is performed following a well ritual specific and without any kind of mistake. We will list the procedures below dressing and undressing of both levels with related PPE, remembering that for any type of exam it is always preferable to work in pairs because help the colleague can give will often be fundamental.

Dressing procedure, 1st level:
As a first step (valid for both procedures) it is appropriate discard any accessories or objects that will not be useful to us during the examination (watches, rings, pens, necklaces, etc.) both to avoid that these could compromise our bio-coverage and to avoid the contamination of unnecessary objects.
Second and fundamental step is washing hands and their sanitization with gel (*Amukina*, etc.) or disinfectants in charge.
At this point we can wear the various devices following the order:

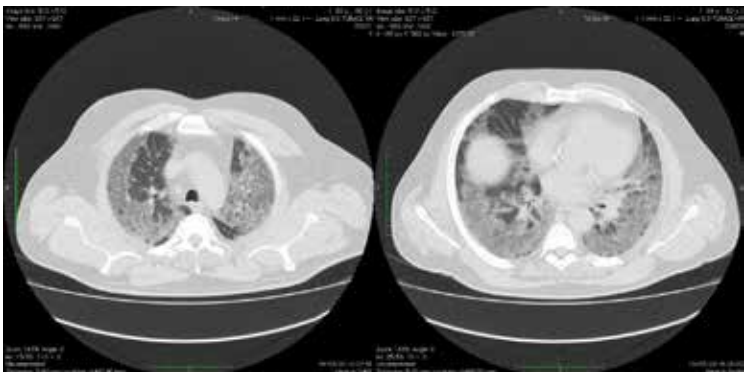

Image 1 – CT scans of a patient hospitalized at Cotugno with Covid-19 pneumonia

- First pair of long disposable latex gloves
- Long waterproof boots
- *FFP2* or *FFP3* mask
- Water repellent headgear
- Water repellent surgical gown
- Second pair of long gloves (over the sleeves of the gown)
- Visor
- Third pair of gloves

Dressing procedure, 2nd level
Obviously, the premises made for the previous procedure value also for this procedure. So, once free from unnecessary objects and after having sanitized the hands we proceed with wearing:

- First pair of disposable gloves in long latex
- Long waterproof boots
- *FFP2* or *FFP3* mask
- Water repellent headgear
- *Googles* safety glasses
- *Biocontainment suit* (before close the hinges and then seal them with adhesive bands
(called welds) of which are equipped)
- Second pair of long gloves
(to wear above the sleeves of the suit)
- Visor
- Third pair of long gloves

Undressing Procedure:
As previously anticipated, the part concerning the undressing is of sure the most delicate. It is often influenced by the surrounding environment and from the equipments at your disposal. For example in the First Aid at *Cotugno Hospital*, and as probably in other centers of infectious reference, the undressing is preceded by a hydrochloric shower, in an identified area as a pre-filter, and only after we can go to the "***filter area***" where

Image 2 - Dressing 1° level.

Image 3 -. Dressing 2° level.

we will start, one step at a time, to take off the various gears. Unfortunately, we often will find ourselves to operating in departments not equipped with this "*path*" of disinfection, as probably very few operating Radiology departments undertake this same system, so we will be arrange to take advantage from the surrounding environment to create our *filter areas* and use it at its best in the crucial undressing practice. The best wise is to locate the room closer to the area where you work with patients and organize it in a right way. As first step we will arrange the biological bins where we will throw our used disposable devices probably contaminated. Then we should provide for each entrance and each exit some mats impregnated with sodium hypochlorite (suggesting sleepers easy to find in a hospital environment). Now we need to provide some chairs being necessary for the next phases.

Only now we begin the real undressing remembering that it is always better to work in two:

-Remove the first of the 3 pairs of gloves, immediately after the colleague has spray a solution with a high concentration of sodium hypochlorite.

- Slip off the visor
- Start to gently pull the various protection straps (in case we have the full body overalls) or undo the surgical gown (also in this phase is fundamental the help of the colleague)
- Take away the googles glasses (reusable after washing with water and sodium hypochlorite)
- Take off the head covering

-take off the overall or the gown trying to wrap them from the inside to outside without touching in any case the contaminated parts.

- Remove the second pair of gloves and sanitize the remaining ones
- Remove the shoes cover
- Remove the last pair of gloves and the surgical template

Once out the filter area it is appropriate to carry out a correct hands washing.

Disinfection and decontamination procedures

Disinfection procedures are subject to the type of examination, equipment and especially from the place where it is held. In case we perform an examination in the ward where patient is hospitalized our task will concern only the sanitization of the tools used and cleaning with solutions with high concentration of sodium hypochlorite, vice versa if the patient reaches our Radiological Operating Unit we are also responsible for the environment sanitizing to avoid infections to our, to other operators, to the patients and to the users in transit at our facility.

The infected patient who has to reach Radiology will pass through a path closed to the public, before, during and after the radiological examination.

Considering the high virulent potential of the Coronavirus, that can remain in the air for long time, even if the patient has gone out from the radiological departments, we have adopted further precautions to dissolve the 99% of viral load through an air exchange forced system. The *D. Cotugno Hospital* being highly specialized in infectious disease has already the equipped system, that consists of 6 spare parts in 69 minutes; if you do not have one it is possible to contact specialized companies or even just rent it. Only after the established time mentioned up, we should left the environment in isolation, and only then you can proceed to manual decontamination.

Precautions for radiological examinations

When working with patients affected by major infectious diseases, the main warning is to limit exposure as little as possible, only touching a limited amount of objects. In order to respect this criterion, most of the International Radiological Community has adopted the 1+1 system ("*Dirty Technician*" + "*Clean Technician*"). This procedure is based on a pair work and a precise organization and distribution of the roles: the "dirty technician" will be the one who will implement the closest maneuvers or will have direct physical contact with the patient (how to positionate the patient into CT or in case of X-ray to put through the radiographic cassette); in the meantime the "clean technician" will have the duty to maneuver the equipments as well as providing aid to his colleague during the delicate phases of sanitation and undressing.

Execution of Chest X-ray in patient's room

The execution of this test is composed of a real ritual which each passage is fundamentally crucial to avoid contamination.

First, it is needed to get plastic water repellent bags to put through the X-ray cassette in order to hermetically close it.

Once the bag has been put through a triple wrap (3 plastic bags) that we will remove in 3 different steps, we can proceed with the first level dressing procedure without forgetting to wear the leaded gown underneath the surgical gown water repellent. During the second level procedure, the shieldings will be on top of the overall. The "dirty" technician places the X-ray cassette behind the patient's shoulder, he positions the tube perpendicularly to the chest and diaphragms the area.

The "clean' technician dispenses the radiant dose.

The 'dirty' technician extracts cassette and removes the first plastic bag crumpling it from inside versus the outside part and meanwhile the clean technician extracts the box still packaged into the other two remaining plastic bags.

The dirty technician can now get rid of the bag and of the gloves into the waste container located into the patient's room. Both technicians can move towards the filter zone where they sanitize hands and the box. Successively they will get rid of the second envelope in the filter zone together with the other PPE during the undressing procedure

The last bag and the last pair of gloves (almost already sanitized) will be removed into the Radiology area before developing the image.

Image 4 - Listing Procedure of X-ray box into the water repellent envelops.

Execution TC exam

Also in this case, the technician works in a pair work mode: the Clean Technician stays behind the console during the entire CT session of the positive patients, while the Dirty Technician is responsible for the positioning and centering.

Once the patient has been positioned, the dirty technician stays put and awaits for the test into the selected room used as "*filter zone*." Once the diagnostic survey has been terminated he will tend to the patient and deliver him to the operators who carried him there for the exam.

Once finished, the clean technician will help during the undressing phase and sanitization of the dirty colleague.

Once the pre-set time of isolation has passed due to a flux of aerations, it is possible to proceed with the environments' and equipments' sanitation.

CONCLUSIONS

Unfortunately, we still have limited information and data about this disease and the virus causing it, but thanks to the experience acquired over the years in the infectious field and the interpretation of the national and international protocols we have been able to draft procedures that if operated correctly, can reduce to a minimum risk of contamination. These simple guidelines can be adopted into any facility thanks to their versatility. They do not need important structural interventions, but it is possible to realize them into any working reality.

With this manuscript, we hope to demonstrate that even if the medical environment had a short time to get prepared to this duty: the preparation, the professionalism and the shrewdness of the *Radiographer* is able to face it without any hesitation or concern, as long as he is equipped with all the necessary equipments and the collaboration of the colleagues. Also on this occasion we have proved that the Radiology Technician does not play a marginal role, but he is deployed into the battlefield to fight against this difficult war, providing and ensuring a first level health care service despite the risks are still unknown. It is important and correct to remember, that with our profession, the first precaution to be taken is the caution: we show respect for the risks, but not fear.

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