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Interventional oncology at the time of COVID-19 pandemic: Problems and solutions

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ABSTRACT

The COVID-19 pandemic has deeply impacted the activity of interventional oncology in hospitals and cancer centers. In this review based on official recommendations of different international societies, but also on local solutions found in different expert large-volume centers, we discuss the changes that need to be done for the organization, safety, and patient management in interventional oncology. A literature review of potential solutions in a context of scarce anesthesiologic resources, limited staff and limited access to hospital beds are proposed and discussed based on the literature data.

1. Introduction

The recent outbreak of the COVID-19 pandemic has deeply impacted the health organizations around the world [1]. Large institutions and even cancer centers have reoriented their clinical activity to accommodate the large number of patients with respiratory distress related to COVID-19 pneumonia. In many countries, official recommendations from authorities have asked to cancel non-urgent clinical activities and elective surgery, and reduce outpatient clinic visits. Some centers have even turned their operating theater to intensive care units and mobilized young oncologist for working in the intensive care unit (ICU) [2]. In Europe and in North America, there are no clear data on how long this crisis will impact cancer patient care and many physicians are concerned by the "distraction effect" of the pandemic on the continuous care of cancer patients [3]. In this unique situation, cancer patient management is particularly complex and one must balance the risk of a delayed cancer diagnosis or potentially curative treatment against the obvious risk of COVID-19. On the other hand, management of resources allocated to cancer care such as general anesthesia availability, nurses and medical staff shortage either for medical leave or reallocation may be limited. This means that triage measures must be appropriately taken and, in this context, some international cancer societies have issued some recommendations that we want to summarize and adapt here for interventional oncology (IO) patients. Based on our local experience and on a recent review of cancer guidelines issued by the European Society of Medical Oncology (ESMO), the American Society of Medical Oncology (ASCO) and the Cardio-Vascular and Interventional Radiology Society of Europe (CIRSE).

2. Evidence on the impact of COVID-19 on cancer patients

Liang et al. reported that 1% out of 1590 patients hospitalised for COVID-19 pneumonia had a cancer medical record and a median age of 63 years. Moreover, patients with a cancer record had a more severe form of COVID-19 that those without cancer (7/18 [39%] vs. 124/1572 [8%], respectively; $P = 0.0003$). Patients with history of surgery or chemotherapy in the months before COVID-19 have

Abbreviations: AASLD, American Association for the study of liver diseases; AEGP, aerosol generating procedure; ASCO, American Society of Medical Oncology; BCLC, Barcelona Clinic Liver Cancer staging; CIRSE, Cardio-Vascular and Interventional Radiology Society of Europe; CT, computed tomography; EASL, European Association for the study of the liver; ESMO, European Society of Medical Oncology; HCC, hepatocellular carcinoma; ICU, intensive care unit; IO, interventional oncology; IR, interventional radiology; MDTB, multidisciplinary tumor board; NHS, National Health Service; OS, overall survival; PPE, personal protective equipment; RCC, renal cell carcinoma; RFA, radiofrequency ablation; rt-PCR, reverse transcription polymerase chain reaction; SIRT, radio-embolization; TACE, transcatheter arterial chemoembolization.

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greater risk of developing severe disease (odd ratio [OR]: 5.34; 95% CI: 1.80 - 16.18; $P = 0.0026$) [4].

In another retrospective cohort in the city of Wuhan in China, out of 12 patients diagnosed with COVID-19, 66% were older than 60 years and 58.3% had non-small-cell lung cancer [5]. Interestingly only 42.7% were on active treatment (including chemotherapy with or without immunotherapy or radiation therapy). Regarding the outcome, 3/12 patients had serious illness, 1/12 required ICU level care, and 3/12 died [5]. Zhang et al. identified that the recent use of anticancer therapies in the 14 days before COVID-19 such as chemotherapy, radiotherapy and surgery was an independent predictor of death or severe events with a hazard ratio greater than 4. The patients aged over 60 years had higher incidence of COVID-19 infection (4.3% vs. 1.8%, respectively) [6]. Furthermore, in cancer patients the risk of COVID-19 when compared to the general population is increased by 3 times, the risk of severe is increased by 5 times, and the risk of death is increased by 8 times [6]. These findings have led the oncological groups to issue some cautiousness-raising recommendations. On the other side the risk taken by patients with postponed potentially curative options, or even palliative treatments has not been established yet for obvious reasons.

3. Reorganizing the IO clinic

The IO clinic activities encompass participation in multidisciplinary tumor boards (MDTB) meetings, running IO clinic for new patients and; treatment follow-up. The exceptional circumstances of the ongoing pandemic call for an urgent revision of the IO clinic's organization. The official ESMO recommendations recommendation for COVID-19 pandemic web-page (https://www.esmo.org/newsroom/covid-19-and-cancer/q-a-on-covid-19), do not refer to the organization of MDTB. However, Cortiula et al. insist on the risk of the so-called "distraction effect" on cancer patients outcome [3]. It is recommended to maintain a weekly MDTB meeting with one specialist per specialty with discussion limited to patients requiring critical decisions only; MDTB meeting should be held in rooms allowing for social distancing. Up to now, this strategy has been largely adopted by our institutions and makes sense for patient management. In addition, we recommend the creation of an organ-specific task force composed by the same specialists participating in MDTB that meet virtually or physically on a regular basis to define local guidelines for patients' management; these guidelines should be adapted to the situation/conditions of each institution in order to reduce patient and staff exposure.

The IO outpatient clinic itself has to be reorganized based on the 3 types of visits: the new patients; the follow up for clinical and laboratory evaluation; and the follow up with imaging. The critical point is that all types of patients should visit the clinic only when it is indispensable, meaning that we should screen all the follow-up patients in order to verify the necessity of their visit based on the national or regional guidelines in force. Telemedicine consultation in this setting has gained popularity; and it can be used in many different ways [7]. The patients with organized appointments for a consultation or an IO procedure should be informed that in case of infection symptoms instead of coming at the in- or out-patient clinic they rather get at the relevant department for testing the day before. At present, a major problem is that testing patients is time-consuming. Even rapid tests performed directly on site, that need less than two and a half hour to obtain the results (measured from the time the sample is taken to the time the result arrives), pose a genuine organizational problem as we are facing a disease with high prevalence of asymptomatic carriers, meaning that numerous patients require testing, and lack of isolated space for those waiting for their results.

Table 1
Procedures at risk for staff exposure in patients with COVID-19.

Exposure during anesthetic procedures	Procedure at risk of biologic liquid exposure (bronchial expectoration, digestive liquid or blood)
Patient requires intubation/extubation Patient is receiving a form of ventilatory support associated with the risk of mechanical dispersal of aerosolization (jet ventilation or laryngeal mask) Patient requires active airway suctioning (*i.e.*, tracheostomy patient)	Lung biopsy Lung tumor thermal ablation Thoracentesis Pleural drainage Chest tube placement for pneumothorax Bronchial artery embolization Bronchial stenting Nasogastric tube or orogastric tube placement Any procedure requiring nasogastric tube placement (gastrostomy or junostomy) Gastrointestinal stent placement Bone screwing or bone biopsy using high velocity device

Furthermore, the establishment of a database of our oncologic patients tested positive for SARS-Cov-2 and staying at home is an important matter for monitoring purposes. The creation of a post of a contact person to call the patients every 24/48 hours in order to verify their general condition and give them advice about when they need to go to the emergency department, is required. This service is of crucial importance for aged patients living alone who do not have either access to internet. These new practices raise several new issues inter alia relating to ethics, privacy, and billing.

4. Patient and staff safety measures

The CIRSE has already issued some practical and useful guidelines for interventional radiology (IR) service during the COVID-19 pandemic (https://www.cirse.org/wp-content/uploads/2020/04/CIRSE_APSCVIR_COVID19_Checklist.pdf). We will not reproduce here the long list of measures proposed by the CIRSE but we would like to insist on some particular aspects of them that do impact significantly our practice in IO.

4.1. Identify aerosol generating procedure (AEGP)

Many IO procedures involve general anesthesia and intubation and extubation are recognized risks for AEGP [8]. Similarly, all procedures at risk of coughing, as well as all procedures needing insertion of a nasogastric tube or using high speed device as used for bone biopsies are at risk of aerosol. Indeed, the use of jet ventilation for percutaneous thermal destruction has been abandoned in the context of COVID-19 [9]. It can be replaced by simple techniques available on any ventilation system such as repeated apnea or low tidal-volume ventilation (*i.e.*, tidal volume between 3 to 4 mL/kg, 320 mL/min minimum; Respiratory rate adjusted to maintain the end tidal carbon dioxide between 35 and 45 mmHg) which can be used to strongly limit liver movements [10].

The use of laryngeal mask anesthesia is not indicated neither due to the risk of air leaks and team exposure as recommended by the Société Francaise d'Anesthésie et de Réanimation (https://sfar.org/propositions-pour-la-prise-en-charge-anesthesique-dun-patient-suspect-ou-infecte-a-coronavirus-covid-19/).

4.2. Identify procedures at risk for virus exposure

In patients suspect for or with confirmed COVID-19, exposure to biological liquids should be reduced as much as possible (Table 1). For IO, all thoracic procedures such as lung biopsy, pleural drainage,

thermal ablation during which the patient is at risk of hemoptysis with severe coughing are at risk. Any procedure that requires nasogastric tube placement (i.e., gastrostomy or gastro-intestinal stent placement) is similarly considered at risk. The following list is adapted from the Society of Interventional Radiology (SIR) website and is of course not exhaustive.

4.3. When and how to screen for COVID-19?

Screening for COVID-19 patients coming for IO procedure would make sense. It carries some practical difficulties that are not easy to address. Since the hospital stay is aimed to be as short as possible, a rapid testing with reverse transcription polymerase chain reaction (rt-PCR) with a response within less than hour would make sense but are not readily available in many institutions. In the absence of available tests, the personal protective equipment (PPE) measures must be taken as previously described. The availability of angio-computed tomography (CT) systems is increasing [11]. Given the high sensitivity of angio-CT as compared to rt-PCR, those who have angio-CT equipment should probably perform chest CT examination before any IO procedure, especially for patients requiring intubation [12].

5. Working with scarce resources of general anesthesia

The requisitioning of anesthesiologist teams to work in the intensive care units in many countries has led to shortage of anesthesiology resources during the pandemic in many large centers (80% reduction in the CHUV for instance). There are alternative solutions to general anesthesia and recently alternative or complementary solutions to simple sedations have been proposed such as thoracic paravertebral block [13,14]. The infiltration of paravertebral nerves of tbl7 tbl8 and T9 allows the blockade of the sympathetic liver innervation but not the parasympathetic from the *vagus* nerve [13]. A double-blind study comparing sedation and local anesthesia associated of not to sham injection or paravertebral block nerve using 12.5 ml of bupivacaine 0.5% at each level, found a significant reduction of the pain assessed by pain analog scale (VAS) analysis during and after the procedure [13]. No patient required salvage general anesthesia in the experimental arm while it was necessary in 7/33 patients in the control arm [13]. The benefit persisted on patient discharge as well. Isolation of the diaphragm during thermal ablation of sub diaphragmatic liver tumors is also potentially useful since it reduced significantly the 24 hours cumulative dose of morphine by a factor of 20 [15]. One other option for liver [16,17] or lung [18,19] tumors ablation is to use cryotherapy instead of radiofrequency ablation (RFA) or microwave ablation. Although this method has been less reported than thermal hot ablation techniques, this method has the advantage of being painless during treatment. However, it carries the risk of bleeding and tumor seeding along the needle tract since it cannot be ablated during withdrawal of treatment applicators [20]. Of course, substitution of curative ablation techniques by less invasive out-patient procedure like radio-embolization (SIRT) can also be discussed. There are no randomized data comparing thermal ablation and SIRT, however radiation segmentectomy can provide local tumor control and 55% 5-years survival in cirrhotic patients with localized hepatocellular carcinoma [21]. This alternative is very well tolerated and limits the risk of short-term complications and secondary visits in the COVID-19 context.

6. Disease specific approach to patient triage

6.1. Colon cancer metastases

According to the French national recommendations, for treatment of digestive cancer during COVID-19 pandemic, it is not recommended to totally discontinue surgery and interventional therapies but to adapt practice to the context of COVID-19 [22]. Poly-chemotherapy, extensive surgery, and some targeted therapies are responsible for major decrease in immunity. On the other hand, local therapies, such as thermal ablation, induces induce low decrease in immunity if any, with then probably no risk of increasing the viral infection risk and severity, as far as patient coming to the hospital are correctly protected and stay as short as possible. Moreover IO treatments have a low risk of post-treatment adverse events that might require long stay in hospital or access to post-operative intensive care. Thus French national recommendations, for treatment of digestive cancer during COVID-19 pandemic state that “when possible, for lesion smaller than 3 cm and liver metastases, percutaneous thermal ablation that uses less or no intensive care or post-operative care resources and allows for very short hospital stay should be favored” [22]. For oligometastatic patients with a small tumor burden and a possible curative intent, the treatment must not be delayed, and they must be treated with short hospital stay, ideally as an out-patient procedure. Extensive liver resection will probably be delayed due to the possible lack of post-operative intensive care resources, but in some patient who require very extensive liver resection “liver preparation” before surgery with IO (*i.e.*, preoperative portal vein embolization, portal vein deprivation, and pre-operative biliary drainage) can be performed. In such patient performing these radiologic procedures as early as possible will not place the patient at high risk, and will avoid him to queue up on the waiting list of patients scheduled for the end of outbreak restrictions and make him ready for surgery as soon as it will be possible in regards to other limitations.

On the other end of the spectrum of the colorectal cancer disease is multi-metastatic patient after failure of chemotherapy including both oxaliplatin and irinotecan and possibly anti-antiangiogenics also called “third line chemotherapy patient”. Recommendations from the French group is that in front of in the absence of clear or major benefit, interruption of such third line treatment has to be discussed with the patient [22]. SIRT may be a possible option in this patient because it can provide a third line therapy treatment with only two short visits in the hospital, Of course any treatment adjustment must be discussed during MDTB meetings.

6.2. Hepatocellular carcinoma (HCC)

As mentioned in the recent European Association for the study of the liver EASL-ESCMID recommendations, it remains important to maintain care of patients with chronic liver disease and to identify potential ways to prioritize care of these patients in the era of limited healthcare resources [23]. Care should be maintained according to the guidelines but interventional radiologists must take into account this very uncommon context. However access to liver transplantation, extensive liver resection or new drugs through protocols have been stopped in this particular situation.

In that unique context of scarce resources of both surgery and newest systemic therapies, IO should gain a leading role to cure or at least to control HCCs. We are used to recommend and follow evidence-based medicine in IO but in the COVID-19 context such data are not yet available. The common medical sense must rather apply and one rule should guide us: prevent any loss of chance for the patient. That being said, our responsibility is to maintain high-quality treatments within short delays and with spared human and

hospital resources. The COVID-19 pandemic results in unusual allocation of healthcare resources. It is certainly not the appropriate time to try new techniques or new materials we are not used to, but rather to optimize what we already master, to avoid degrading oncological results or causing more complications.

As recommended by the American Association for the study of liver diseases AASLD (www.aasld.org):

- outpatient visits must be restricted to patients who must be seen in person, even in areas without significant COVID-19 spread. This applies for IR consultations before treatment and for follow-up;
- continue usual surveillance imaging in patients with HCC if possible. Ideally, these patients should not wait until the pandemic abates to undergo imaging because the prospective duration of the pandemic is unknown. Based on patient and facility-based circumstances, an arbitrary delay of 2 months is reasonable;
- proceed with HCC treatments rather than delaying them due to the pandemic.

In patients with HCC and proven COVID-19, locoregional therapies should be postponed until recovery.

6.2.1. Percutaneous thermal ablation

According to last EASL recommendations, radiofrequency ablation (RFA) is the standard of care for patients with Barcelona Clinic Liver Cancer staging (BCLC) 0 or A tumors, not suitable for surgery [24]. Therefore, ablation should be favored for small HCCs (i.e., < 3 cm) all the more so as liver ablation is usually a short procedure, with short hospital stay and very few complications [10]. In IR teams used to multi-bipolar RFA, the threshold can be extended up to 5 cm tumors with excellent oncological results [25,26].

Except extreme situations where minimal resources are not available anymore, there is no reason to postpone ablations to prevent any drift from curative to palliative care. For those who are used to cryoablation of tumors outside the liver, it can be an interesting option to use cryoablation to treat HCCs under local anesthesia in order to spare anesthesia resources. Oncological results of cryoablation seem comparable to those of RFA [17].

French recommendations stipulate that thermal ablation of liver tumors (and especially HCC) should be used as often as possible while keeping validated indications (1-3 nodules, < 3 cm, < 5 cm with advanced techniques such as multi-bipolar thermal ablation) [22].

6.2.2. Transcatheter arterial hemoembolization (TACE)

TACE still represents the mainstay of treatment in BCLC B patients. However, TACE is considered as a palliative treatment, meaning that the main objective is to control the tumor as long as possible. Among factors of TACE heterogeneity, time intervals between sessions may vary from 4-12 weeks [27,28]. With the objective of keeping the patient at-home as long as possible especially in quarantined areas and sparing hospital resources, some IRs may consider to postpone TACE sessions.

To try to bring up a rationale, it is interesting to look at HCC growth pattern. Though heterogeneous, median HCC doubling-time was 229 days (IQR: 89-627) in a Western series of 242 HCC patients [29]. Indolent growth was mainly observed in large tumors (OR = 1.15) with serum alfa-fetoprotein level < 20 ng/mL (OR = 1.9) and was more frequent in non-viral than in viral cirrhosis (50.9% *vs.* 32.1%, respectively) [29]. Postponing TACE for large tumors with low serum alfa-fetoprotein level in a context of non-viral cirrhosis is probably acceptable if necessary, while keeping in mind that we do not know the crisis duration.

Only 19% of patients undergo TACE as an outpatient procedure [28]. As for thermal ablation, it is desirable to limit patient's hospital stay. One major reason to keep the patient at hospital is to manage symptoms following TACE and especially the post-embolization syndrome. It has been shown in a randomized placebo-controlled trial that dexamethasone effectively reduce the occurrence of the post-embolization syndrome [30]. Short dexamethasone therapy (3 days) should be administered in TACE patients except those with contraindication (mainly uncontrolled diabetes mellitus) in order to lower post-TACE symptoms allowing a reduction of hospital duration. Except COVID-19 patients in the late phase (for whom TACE should be postponed), no warning against short-exposure of corticosteroids has been raised in the current context so far [31].

6.2.3. SIRT

In BCLC B patients, SIRT provides similar overall survival (OS) as compared to TACE but longer time to progression [32]. Furthermore, it is associated with fewer changes in liver function as compared with chemo-embolization [33]. In addition, the work-up phases for SIRT are routinely performed as outpatient procedures, especially when radial access or closure devices are used. However, this must be balanced against the need for two separated procedures (work-up and treatment) per SIRT treatment, explaining that TACE might be preferred.

In BCLC C patients and especially those with portal vein invasion, sorafenib is the only recommended and still available systemic treatment. Other systemic treatments under investigation in clinical trials are no longer available in most countries during the COVID-19 pandemic. Although randomized phase III trials reported no benefit for SIRT over sorafenib, the concept of personalized dosimetry has emerged and has been recently endorsed in IR recommendations [34]. With personalized dosimetry, OS can be considerably extended in selected patients as shown in a retrospective analysis with propensity-score matching (26.2 vs. 8.7months) [35].

Finally, for limited HCC disease (i.e., segmental), it has recently been proposed to eliminate the work-up phase because lung shunt fraction is negligible and great dose can be achieved anyway, thereby reducing time-to-treatment and number of procedures [36]. This option should be considered in the COVID-19 context for tumors that are not treatable with thermal ablation.

6.3. Lung metastases and primary lung tumors

Among cancer patient infected with COVID-19, lung cancer appears as the most frequent primary cancer. Indeed in a series of 28 COVID-19 cancer patients, lung cancer was the most frequent cancer (25%), with 53.6% of patients having severe events and mortality of 28.6% [12]. In this series, a last anti-tumor treatment within 14 days, including chemotherapy (10.7%), radiotherapy (3.6%), targeted therapy (7.1%) and immunotherapy combined with chemotherapy (3.6%), significantly increased the risk of developing severe events (HR = 4.079; 95% CI: 1.086-15.322; $P = 0.037$) [12]. Rapid death from COVID infection has been reported in a patient withnon small cell lung cancer favorably controlled with nivolumab before the infection [37].

The National Health Service (NHS UK) warned that individuals who are undergoing active chemotherapy or radical radiotherapy for primary lung cancer, are particularly vulnerable to serious illness if they become affected by COVID-19 [38]. In addition several factors/co-morbidities are likely to be linked with a poorer prognosis with coronavirus including age over 60 years, pre-existing cardiovascular disease and pre-existing respiratory disease. Thus it is advisable to avoid any biopsy or lung thermal ablation in patients with the above-mentioned comorbidities, which are quite frequent in the primary non-small cell lung cancer population.

Patients in good general condition with none of the above described comorbidities but who have lung metastases and can enter a curative therapy with more than 50% of chance of success

must be prioritized as level 1 according to NHS clinical guide for the management of non-COVID-19 patients requiring acute treatment [38]. They can be classified as prioritized as well because elective surgery/ablation with the expectation of cure must be performed within 4 weeks to save life/progression of disease beyond operability. It has been demonstrated that size and safety margins are prognostic factors of successful lung thermal ablation [39], and that median overall survival after lung ablation is beyond 5 years [40]. Microwave ablation seems to induce less pneumothorax than RFA [41]. Furthermore, the risk of prolonged intensive care is moderated when patient have a lung parenchyma without underlying disease even if the possibility of admission in such unit has to be discussed according the general status of the hospital. A downstream hospitalization solution must be defined in case of pneumothorax. According to anesthesiology resources, it might be needed to select therapy that can be delivered with minimal sedation or only general anesthesia, for example selecting cryoablation over RFA or microwave.

6.4. Kidney cancer treatment

The incidence of renal cell carcinoma (RCC) has steadily increased in Europe in the last 2 decades, with stage I tumors now accounting for 40% to 50% of new patients. Up to 75% of these small RCC are found incidentally on ultrasound or cross-sectional imaging performed for another reason, and approximately 50% of patients are now older than 65 years, and carry risk factors of RCC such as smoking, obesity and hypertension [42]. These comorbidities, along with the renal function, are key factors when determining the best treatment strategy. The overdiagnosis of incidentally detected small RCC could lead to overtreatment. In response to the changes in the epidemiology of RCC, nephron-sparing techniques have taken a prominent place in the management of these small renal masses to reduce the risk of chronic kidney disease. The guidelines now include the four contemporary approaches to the management of small renal masses to be discussed during the tumor board: partial nephrectomy, radical nephrectomy, ablative therapies and active surveillance, depending on patients' condition and tumor characteristics [43,44].

During COVID-19 pandemic, many hospitals are now recommending cancellations of elective surgeries. In order to clarify the vague term "elective", Stensland et al. proposed a triage of urologic surgeries, taking advantage of the lessons learned from Asian countries [45]. They recommend that surgery should not be delayed for cT3+ tumors, including all patients with renal vein and/or inferior vena cava thrombi. In order to spare ventilators and inpatient stay, they suggest that planned partial or radical nephrectomy for cT1 masses should be delayed, and IO ablative approaches should be considered in selected patients. In this perspective, cryoablation has the advantage of being feasible under conscious sedation or even local anesthesia due to its intrinsic anesthetic properties [46]. In addition, a short hospital stay is associated with IO ablative techniques, some procedures being done on an outpatient basis. However, the best candidates for non-surgical therapies are patients carrying several comorbidities. Admitting these patients in hospitals will leave them at greater risk for COVID-19.

Decision for treating patients must refer to the natural history of RCC. Small renal tumors have variable growth rates with a mean growth of 0.31 cm/year in the largest multicenter analysis [47]. A substantial number of small renal masses have a slow growth and some have zero growth under surveillance [48]. In a cohort of 457 patients with 544 renal masses followed for at least 5 years, the median overall linear growth rate was 1.9 mm/year and approximately one-third of their patients crossed over to delayed intervention [48]. Most of these patients were likely to do so within the first 2–3 years on active surveillance [48]. These findings show that postponing a renal tumor ablation is a safe oncologic practice. Cancer specific mortality will not be affected by a delay of weeks or even months before doing thermal ablation of eligible patients. These patients can safely remain in active surveillance as long as the COVID-19 pandemic lasts.

6.5. Palliative pain procedures

IO has now an increasing role in pain palliation. Percutaneous osteosynthesis and cementoplasty can be proposed to patient with bone metastases [49,50] [51–53]. Even if according to NHS guide, "Palliative radiotherapy where alleviation of symptoms would reduce the burden on other healthcare services, such as hemoptysis" is classified as a level 4 radiotherapy of priority on a scale from 1 to 5, and classified as a level 5 priority on the 1 to 6 scale level for of categorization of cancer patients inside of "curative therapy with a high (>50%) chance of palliation/temporary tumor control but < 1 year life extension" there is no mention of pain in this guide [38]. However, pain palliation must be considered as an integrated part of cancer treatment, as underline by the French «Plan cancer» [54]. For this reason we keep trying to treat pain in oncologic patients during COVID-19 pandemic. Once again pain treatment is beneficial to oncologic patients due to the possibility to treat patient in a single day hospital with very minor risks of prolonged hospitalization or need for intensive post-treatment care. The shortage in anesthetic resources including drugs such as curare and hypnotics lowers our access to general anesthesia and rachi-anesthesia is a very efficient surrogate to general anesthesia in the population of patients with painful pelvic bone metastases who can benefit from percutaneous osteosynthesis [50]. Short acting drug allows for treating a patient in the morning and discharge him on his feet in the late afternoon. Moreover these short acting drugs are not needed for treatment of COVID-19 patient ventilated in the ICU.

Preventive cementoplasty or osteosynthesis [51,52] in non-painful patients with impeding fractures has to be discussed on a specific patient basis. The patient should avoid any activity that increases the risk of fracture, which is probably easier to follow in these times of containment.

6.6. Biopsies

Biopsy of superficial organs must not be delayed when they are needed for a definite diagnosis that will decide for treatment. Deep abdominal biopsy carries a low risk of complication and must be performed when needed to decide for treatment strategy. At last, when compared to other deep organ biopsy, lung biopsy carries the specific risk of pneumothorax and the decision to expose the patient to a prolonged hospital stay must be weighted in front of the benefit of early diagnosis. Both clinical and technical considerations must be balanced and discussed with the patient and multidisciplinary tumor board [55]. The benefit of an early diagnosis with possible access to a curative treatment must push toward no delay in biopsy. On the other hand, severe emphysema, a small, deep lesion, pre-existing comorbidities, a long trans pulmonary path and all factors known to increase risks and severity of pneumothorax must be discussed. Technically, an access with no transpulmonary path must be preferred if possible. Any countermeasure to pneumothorax such as opposite position immediately after biopsy, or even better side decubitus at the time of the biopsy with biopsied lung down are recommended [56,57]. In addition, the use of blood patch [58,59] or gelatin sponge slurry [60] or even normal saline tract sealant [58] are effective countermeasure to pneumothorax and chest tube placement. Overall, after 3 weeks of COVID-19 pandemic, our lung biopsy program has been maintained to 70% of our usual practice avoiding biopsy in patients with emphysema as well as for nodule < 1 cm. Specific consideration must be taken

for patients requiring biopsy to enter clinical trial or precision medicine studies. Decisions must be discussed with the patient and during MDTB meetings taking into account the actual benefit. For each of these diseases it is recommended to consider tumor growth rate as established on imaging and the risk of delayed treatment.

7. Conclusion

Among surgery and IR departments, IO is the one that keeps the highest degree of activity. This activity is due to the essential role of biopsies, thermal ablations and palliative treatments such as cementoplasty and osteosynthesis. This is due to the low invasiveness of these procedures that require little post-treatment resources. This highlights the pivotal role played by IO in cancer treatment even during the COVID-19 pandemic.

Credit author statement

A Denys: Conceptualization, Writing, Reviewing editing, B Guiu, P Chevallier, A Digklia, Ede Kerviler, T De Baere: Writing, Draft preparation.

Authors' contributions

All authors attest that they meet the current International Committee of Medical Journal Editors (ICMJE) criteria for Authorship.

Compliance with ethical standards

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