Aus der Klinik und Poliklinik für Radiologie
der Ludwig-Maximilians-Universität München

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Oncologic Imaging in a Multidisciplinary Context

Onkologische Bildgebung im interdisziplinären Kontext

Habilitationsschrift
Zur Erlangung der Venia Legendi
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Vorgelegt von

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1. Foreword

Advances in our understanding of cancer and the development of multiple innovative and often expensive treatments have resulted in an increasing complexity in the management of cancer cases. Personalised or precision medicine has become a cornerstone of modern cancer management and requires a multidisciplinary approach that utilises expertise from various specialities to ensure precise diagnostics, effective treatments, and optimal patient outcomes. This thesis discusses the role of radiologists in multidisciplinary cancer care and emphasises their contributions to diagnostic accuracy, minimally invasive interventional therapies, and collaborative decision-making within oncologic multidisciplinary team meetings (MDTMs).

Through a series of interrelated studies, this thesis emphasises the influence of specialised radiologic expertise on cancer patient management. It commences with a study on subspecialised second-opinion reviews in gynaecologic oncologic imaging, which showed that such reviews lead to significant changes in treatment strategies. Through three further studies, it explores the use of minimally invasive interventional radiological techniques in managing oncological surgical complications, emphasising the integration of radiology into the broader context of oncological care. It subsequently analyses the role of radiologists in multidisciplinary tumour boards, including the shift to virtual oncological MDTMs during the COVID-19 pandemic, a testament to the adaptability of radiological practice even in the face of new, unexpected challenges.

This thesis highlights the importance of radiologists as core members of multidisciplinary teams. By improving imaging quality, optimising interventional treatments and outcomes, and promoting collaborative planning, radiologists play a fundamental role in modern oncologic care.

2. Introduction and Summary

This cumulative thesis focuses on the indispensable role of oncologic imaging and oncologic radiologists within multidisciplinary cancer care models, where precision and specialist expertise are critical for patient outcomes. The adoption of multidisciplinary tumour boards (MTBs) worldwide has transformed cancer care and enabled collaborative treatment planning, enhancing adherence to clinical guidelines. Radiologists play a crucial role in these meetings through their expert interpretation of imaging studies such as CT, MRI and PET-CT scans, assessing disease extent, response to treatment and advising on appropriate imaging modalities to refine the diagnosis and guide treatment strategies.

In Chapter 4, subspecialised reporting, namely second-opinion subspecialised reviews of gynaecological oncological magnetic resonance imaging (MRI) examinations, has been shown to significantly impact patient management. The study results show a 20-22% change in patient management plans following a subspecialised second-opinion review, underlining the importance of subspecialisation in achieving greater diagnostic accuracy, which can significantly impact patient management and clinical outcomes.

In Chapter 5, the thesis explores the use of interventional radiological techniques, including CT-guided fluoroscopic procedures and transcatheter embolisation. These minimally invasive techniques are invaluable methods for managing complications arising from oncologic surgeries, such as infected renal/perirenal fluid collections/abscesses, lymphoceles, and renal pseudoaneurysms. They reduce the need for more invasive surgical interventions and result in faster patient recovery.

In Chapter 6, the thesis discusses the role and involvement of the radiologist in the MTB and related issues in a first study. In a subsequent study, the transition from in-person to online oncologic multidisciplinary team meetings (MDTMs) during the COVID-19 pandemic is analysed. The study reveals the benefits of online MDTMs and addresses technical and other challenges as well as the importance of optimising radiologist participation to maintain high-quality multidisciplinary care.

In conclusion, this thesis demonstrates the important and evolving role of radiologists in multidisciplinary cancer care, where subspecialised expertise, innovative imaging techniques and interventional therapies enhance diagnostic accuracy and improve patient outcomes. The findings of these studies highlight radiologists' contributions and the need for continued technological and organisational support to maximise the benefit of their contributions towards the multidisciplinary care of cancer patients.

3. Oncologic imaging as an essential component of multidisciplinary cancer care

The last decades have witnessed widespread adoption of a multidisciplinary cancer care model by healthcare systems worldwide with the aim of improving overall decision-making and quality of care. Central to this model is the multidisciplinary tumour board (MTB) or tumour board review, defined by the National Cancer Institute's dictionary as "a treatment planning process in which a group of cancer doctors and other health care specialists meet regularly to review and discuss new and complex cancer cases" (1). The aim of these meetings is to take a collective decision on the optimal treatment plan for each patient. Such meetings are attended by multiple specialists from different areas, including oncologists, radiation oncologists, surgeons, radiologists, pathologists, palliative care physicians, nurses, physiotherapists and social workers (2). Other specialists may also attend as required, according to the needs of each case.

The implementation of tumour boards is supported by a wide body of evidence, and they have been shown to be beneficial, particularly with regard to adherence to clinical guidelines (3-5), improvements in clinical decision-making and patient management (6, 7), with some studies showing improved outcomes (2, 8-10). In an international survey by the American Society of Clinical Oncology, participants reported changes of 1% to 25% in treatment plans for 44% to 49% of patients with breast cancer and in 47% to 50% of those with colorectal cancer (11). Respondents reported 25% to 50% changes in surgery type and/or treatment plans for 14% to 21% of patients with breast cancer and 12% to 18% of patients with colorectal cancer (11). A large number of national and international guidelines recommend the establishment of MTBs for the multidisciplinary management of cancer patients (2). In a series of articles on Essential Requirements for Quality Cancer Care, the European CanCer Organisation (ECCO) lists the multidisciplinary approach as a mandatory requirement for the management of several types of tumours, e.g. sarcomas, melanomas, oesophageal and gastric cancer, prostate cancer, lung cancer, pancreatic cancer, colorectal cancer in order to ensure quality of care (12-18). Multidisciplinary management in high-volume centres is particularly beneficial in rare or less common cancer types, e.g. sarcomas or HCCs, as it ensures access to specialised expertise necessary for developing the most effective individualised treatment plan for each patient (2). Oncological MDTs may also improve patient outcomes by recruiting patients into a clinical trials portfolio (19). Limitations of tumour boards include the high time expenditure for the involved specialists and associated costs as well as possible treatment delays due to meeting schedules and waiting lists (2).

The radiologist, as one of the core members of the MTB, plays a central role in the determination of the treatment plan for each patient by the MTB. Following an expert review of a patient's imaging examinations, such as CT scans, MRIs, PET-CTs, the radiologist presents the salient findings and helps the members of the MTB understand the extent of the disease. This is done by providing detailed information about the tumour size, location, stage and any metastatic lesions, which is essential for staging and treatment planning and may involve chemotherapy, surgery and/or radiotherapy. Comparisons with prior imaging studies help assess changes in tumour size or response to previous therapy. If additional imaging is required to answer specific clinical questions, the radiologist can advise on the most appropriate imaging modality to be used. Radiologists' subspecialised expertise within MTBs, combined with their experience in diagnosing and staging both common and rare cancer cases, uniquely positions them to provide expert second-opinion reports on imaging examinations of specific organs or organ systems.

Within the MTB, the radiologist may assist in planning image-guided biopsies in order to obtain tissue samples for histopathological examination. A number of MTBs are often attended by interventional radiologists, who in addition to their diagnostic insights may contribute to treatment plans by offering minimally invasive tumour therapies, e.g. percutaneous ablation (e.g. radiofrequency or microwave ablation), embolisation (chemoembolisation or radioembolisation for liver tumours/metastases) and other image-guided therapies. Interventional radiologists may offer interventional therapies to deal with post-surgical complications and may also recommend palliative interventions to improve the patient's quality of life.

Imaging examinations and image-guided therapies in cancer patients, along with the expert contributions of diagnostic and interventional radiologists to the MTB, therefore, play a critical role in the overall strategy for managing cancer cases and ensuring a personalised, multidisciplinary approach to cancer care.

4. Quality improvement through subspecialized reporting

Subspecialised radiologists bring a higher level of expertise to the interpretation of imaging examinations specific to their field (e.g. thoracic, gynaecological or abdominal oncologic imaging). This leads to more accurate diagnoses, as subspecialised radiologists can better identify subtle findings, differentiate between benign and malignant processes and better understand the clinical context relevant to specific types of cancer (20). Second-opinion reviews by subspecialised radiologists often reveal discrepancies in initial reports from general radiologists. These reviews, which are a common feature of MTBs, ensure that findings important to the patient’s management are not overlooked and are taken into consideration when developing an individualised treatment plan for that patient. By improving the accuracy and relevance of imaging interpretations, subspecialised reporting supports value-based healthcare (21). It helps reduce unnecessary procedures, lowers costs associated with misdiagnoses or incorrect treatments and contributes to better patient outcomes (21).

4.1. Added value of subspecialised second-opinion reporting of gynaecological oncological MRIs

Publication 1: Lakhman Y*, D'Anastasi M* et al. European Radiology. 2016

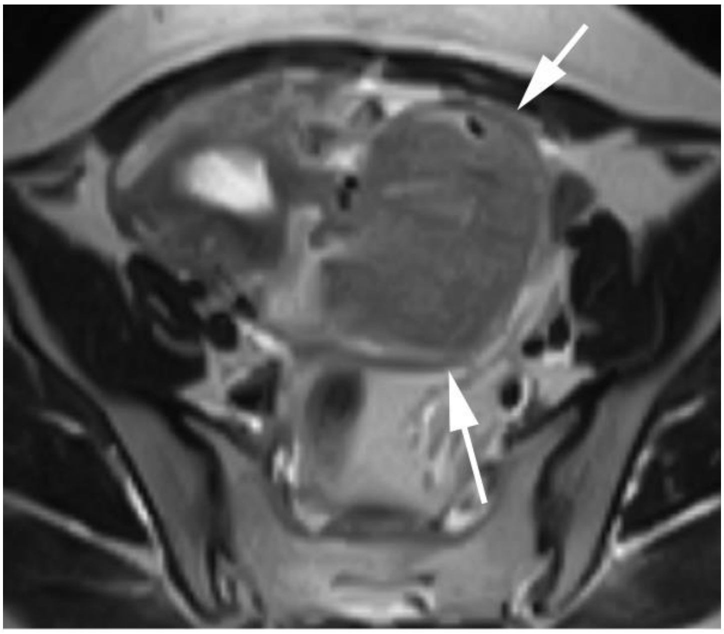
Patients referred to specialised oncology centres frequently arrive with various imaging studies performed elsewhere. These initial outside imaging examinations are often essential for the multidisciplinary management team to decide on the patient's individual management. Requests for second-opinion reporting for outside imaging studies are, therefore, very frequent and have been shown to constitute a significant portion of a tertiary centre's radiology department's daily workload (22, 23).

Various studies have examined the rate of disagreements between initial reports and second-opinion imaging interpretations in several radiological specialities (23-32). This study aimed to determine the added value of second-opinion review of gynaecological magnetic resonance imaging examinations (MRIs) by gynaecological oncologic radiologists as assessed by the treating gynaecologists, which to our knowledge had not been previously investigated.

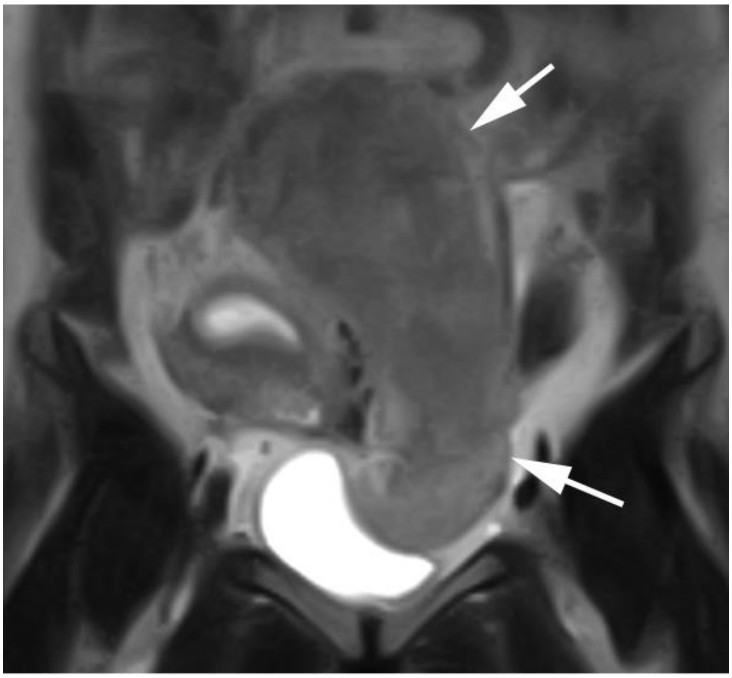
In this institutional review board-approved retrospective study, we included 469 consecutive gynaecological MRIs performed and first interpreted at an outside institution between 1st January 2008 and 1st August 2013, which were submitted for second-opinion reporting at Memorial Sloan-Kettering Cancer Center (MSKCC). The second-opinion interpretation was performed by one of four sub-specialized gynaecological oncologic radiologists. Two radiologists who did not take part in the second-opinion interpretations (with five and six years of experience in diagnostic radiology) compared these interpretations to the outside reports submitted with the images and divided the studies into two groups – a group with no disagreement and a second group with disagreement/s between initial reports and second-opinion interpretations. Two board-certified gynaecological oncologic surgeons each having 20 years of experience, were blinded to the origin of each report and independently reviewed all MRI reports which had any disagreements. For every pair of MRI reports, each gynaecological surgeon logged whether discrepancies between the reports were clinically important, i.e. would have resulted in a change in patient management, including treatment approach, patient counselling, or patient referral. Histopathology reports or a minimum 6-month imaging follow-up were used as a reference standard to establish the diagnosis (33).

MRI report review: Review for discrepancies by two radiologists

In the first part of the study, review of outside and second-interpretation reports by two radiologists in consensus found 288/469 (61.4%; 95% CI: 56.8 - 65.8) studies without difference and 181/469 (38.6%; 95% CI: 34.2 - 43.2) studies with disagreements between initial reports and second-opinion review. The discrepancies were due to differences in lesion detection (for example, the presence of pelvic lymphadenopathy or peritoneal carcinomatosis) in 37/469 (7.9%), interpretation of findings (for example, in determining adnexal mass origin) in 124/469 (26.4%) (Figure 1), or both in 20/469 (4.2%) patients (33).



a.



b.

Figure 1. Axial T2-weighted (a) and coronal T2-weighted (b) images from an outside MRI obtained in a 38-year-old woman with a pelvic mass seen on ultrasound. The initial MRI report described a large left pelvic mass (arrows) suspicious for an adnexal neoplastic process of indeterminate malignant potential. Second-opinion interpretation by a gynaecological oncologic radiologist correctly characterized this pelvic mass as a subserosal leiomyoma. *Source: Lakhman, D'Anastasi et al. Eur Radiol. 2016 Jul;26(7):2089-98*

Review of discrepant reports by gynaecological oncologic surgeons

Among 181 MRI examinations with disagreements between initial reports and second-opinion reviews, 57/181 (31.5%; 95% CI: 24.9 - 38.9) discrepancies were considered clinically unimportant while 124/181 (68.5%; 95% CI: 61.1 - 75.1) differences were considered clinically significant by a minimum of one of the gynaecological oncologic surgeons. Thus, discrepancies between initial reports and second-opinion reviews would have theoretically affected patient care in 124/469 (26.4%; 95% CI: 22.6 - 30.7) of women. Second-opinion reinterpretation refuted the suspicion for gynaecologic malignancy communicated in the initial report in 46/124 (37%) of patients, suggested a new diagnosis of cancer (not included in the initial report) in 12/124 (10%) of women, upstaged or downstaged disease in 18/124 (14%) of patients, and provided a more specific diagnosis in 48/124 (39%) of women (e.g. epithelial ovarian neoplasm versus ovarian mass) (33).

A detailed summary of the results for the two surgeons is provided in Tables 1-3.

Table 1. Change in patient management for each surgeon (number of patients, percentages, 95% confidence intervals) based on second-opinion interpretations of gynaecological MR examinations by sub-specialized radiologists. *Source: Lakhman, D'Anastasi et al. Eur Radiol. 2016 Jul;26(7):2089-98*

Surgeon	Change in Management	Change in Treatment Approach	Change in Patient Counselling	Change in Patient Referral
Surgeon 1	94/469 (20.0%) (95%CI: 16.6-24.0)	71/469 (15.1%) (95%CI: 12.1-18.8)	92/469 (19.6%) (95%CI: 16.2-23.6)	50/469 (10.7%) (95%CI: 8.1-13.9)
Surgeon 2	101/469 (21.5%) (95%CI: 18.0-25.6)	60/469 (12.8%) (95%CI: 10.0-16.2)	101/469 (21.5%) (95%CI: 18.0-25.6)	53/469 (11.3%) (95%CI: 8.6-14.6)

Second-opinion reinterpretations of gynaecological MRIs would have theoretically affected patient care in 94/469 (20%; 95% CI: 16.5 - 24.0) of patients for surgeon 1 and 101/469 (21.5%; 95% CI: 17.9 - 25.6) of patients for surgeon 2. The treatment strategy would have been changed in 71/469 (15.1%) and 61/469 (13.0%) of women for surgeon 1 and surgeon 2, respectively. This included a change from a surgical to a non-surgical approach in 35/469 (7.5%) and 31/469 (6.6%) of patients and a change in type of surgical procedure in 19/469 (4.1%) and 12/469 (2.5%) of patients for each surgeon, respectively. Moreover, patient counselling would have been modified in

92/469 (19.6%) of patients for surgeon 1 and 101/469 (21.5%) of patients for surgeon 2 (33).

Table 2. Change in treatment approach based on second-opinion interpretations of gynaecological MR examinations by sub-specialized radiologists – **Surgeon 1**. *Source: Lakhman, D'Anastasi et al. Eur Radiol. 2016 Jul;26(7):2089-98*

Change in Treatment Approach (Outside reports → 2nd-opinion interpretation)	Number of patients	%
SURGEON 1		
Surgical → Non-surgical approach	35/469	7.5% (95%CI:5.3-10.3)
Switch in surgical procedure	19/469	4.1% (95%CI:2.5-6.4)
Non-surgical → Surgical approach	11/469	2.3% (95%CI:1.2-4.3)
Biopsy → Observation or follow-up with imaging	4/469	0.85% (95%CI:0.3-2.3)
Follow-up with imaging → Colonoscopy	1/469	0.2% (95%CI:5.3-10.3)
Observation → Follow-up with imaging	1/469	0.2% (95%CI:0.01-1.37)

Table 3. Change in treatment approach based on second-opinion interpretations of gynaecological MR examinations by sub-specialized radiologists – **Surgeon 2.** *Source: Lakhman, D'Anastasi et al. Eur Radiol. 2016 Jul;26(7):2089-98*

Change in Treatment Approach (Outside reports → 2nd-opinion interpretation)	Number of patients	%
SURGEON 2		
Surgical → Non-surgical approach	31/469	6.6% (95%CI:4.6-9.4)
Switch in surgical procedure	12/469	2.5% (95%CI:1.4-4.6)
Non-surgical → Surgical approach	9/469	1.9 % (95%CI:0.9-3.7)
Biopsy or Dilatation and Curettage → Surgical approach	3/469	0.6% (95%CI:0.2-2.0)
Biopsy → Observation	2/469	0.4% (95%CI:0.07-1.70)
Follow-up with imaging → Hysteroscopy	2/469	0.4% (95%CI:0.07-1.70)
Observation → Follow-up with imaging	1/469	0.2% (95%CI:0.01-1.37)
Biopsy → Medical treatment	1/469	0.2% (95%CI:0.01-1.37)

Precision of second-opinion review

There were 124 cases with clinically significant differences between initial reports and second-opinion interpretations. For these 124 MRIs, histopathology or follow-up imaging were available as a reference standard in 103/124 (83.1%) and 21/124 (16.9%) respectively. Second opinion review was found to be correct in 103/124 (83.1%; 95% CI: 75%, 89%) cases. The second opinion review was incorrect with regard to the discrepant finding in 21/124 (16.9%) of cases. In 13/124 (10.5%) cases both the initial and second-opinion review were incorrect with regard to the discrepant finding, while in 8/124 (6.4%) the discrepant finding in the external report was correct as compared to the gold standard (33).

In conclusion, second-opinion review of gynaecological MRI examinations by experts in gynaecological oncologic imaging in the setting of a specialized oncology centre has a substantial impact on patient care.

5. Operative complications and their interventional radiological management with a focus on urological surgical complications

5.1 CT fluoroscopy-guided percutaneous intervention

CT-guided interventions, e.g. CT-guided biopsies or drain insertions, may be performed either by means of sequential CT monitoring or by means of CT-fluoroscopy (CTF). During sequential CT monitoring, a short CT scan is performed repeatedly over the area of interest while advancing the needle or drain further in between scans until it reaches the target organ or lesion. This has the advantage of no radiation dose to the interventional radiologist (who leaves the room during each scan) but the disadvantage of a comparatively higher dose for the patient. CT-fluoroscopy, on the other hand, enables an almost real-time visualization of the needle or drain during its insertion until it reaches the target lesion or organ of interest. CT images are acquired at a high rate of up to 10 images per second. This simplifies compensation for respiratory motion and angulated access routes. CT-fluoroscopy may be performed continuously or as a quick-check method (repeated fluoroscopic images performed after every alternation of the needle/drain position). The combination of a quick-check technique and a low-milliampere technique (reduction of tube current during CT-fluoroscopy to 10-20 mA) results in a significant reduction in CT-fluoroscopy time and a reduction in radiation dose to the patient and to the interventional radiologist operator (34).

CT-fluoroscopy, particularly quick-check low-milliampere CT-fluoroscopy guidance, is a very useful and advantageous technique which is widely used in various interventional procedures, such as CT-guided biopsies and drain insertions, CT-guided radiofrequency ablation or microwave ablation, CT-guided percutaneous periradicular infiltration and CT-guided vertebroplasty (34).

5.1.1 CT fluoroscopy-guided percutaneous drainage in patients with infected renal and perirenal fluid collections

Publication 2: Trumm CG, Burgard C, Deger C, Stahl R, Forbrig R, **D'Anastasi M**. Diagn Interv Radiol. 2021 May;27(3):378-385.

Renal and perirenal abscesses are a relatively rare complication of urinary tract infections. They may also occur as a complication of renal surgery, such as nephrectomy, partial nephrectomy as well as renal transplantation. Their prognosis has significantly improved over the last 20 years through earlier detection with modern cross-sectional imaging techniques as well as increased and earlier availability of minimally invasive image-guided or surgical treatment (35-40). Infected renal cysts are a particularly rare subgroup of infected renal fluid collections. Small abscesses (< 3 cm in diameter) are usually treated with antibiotics. Larger abscesses and sometimes smaller abscesses are treated with a combination of antibiotics and ultrasound- or CT-guided drainage. CT-fluoroscopy enables an accurate and near real-time targeting and drainage of the affected cyst/abscess/infected fluid collection. Apart from providing immediate drainage of infected fluid with potential nephron-preservation, it enables microbiological sampling and possibly a faster patient recovery (40, 41).

In a retrospective, institutional-board approved study, we evaluated the technical and clinical success and safety of CTF-guided percutaneous pigtail drainage (PPD) in patients with infected renal and perirenal fluid collections. This retrospective analysis included consecutive patients who underwent CTF-guided drainage procedures between August 2005 to November 2016 at Ludwig-Maximilians-University Hospital, Munich (40).

Our patient cohort included 23 males and 21 females, with a mean age of 57.1 years (range: 20.7 to 83.1 years). Infected fluid collections consisted of 9 renal cysts (12.68%), 17 renal and perirenal abscesses due to comorbidities (23.94%), and 45 infected fluid collections following renal surgery or other urological interventions (63.38%). The eligibility of patients for CTF-guided PPD placement was confirmed following discussion by a multidisciplinary team including urologists, abdominal surgeons, and interventional radiologists. The CTF-guided procedure involved low-milliampere settings (10–20 mA) to minimize radiation exposure. Protective measures such as thyroid shields and lead aprons were used by the operators. All patients were monitored clinically for at least 24 hours following the intervention (40). Technical success was defined as PPD insertion within the collection with the obtainment of fluid for microbiological analysis. Clinical success was defined as normalisation or marked improvement of clinical symptoms and inflammatory parameters (leukocyte count, CRP) under combined therapy with antibiotics and PPD within 1 month after intervention. Adverse events were graded according to the CIRSE classification (42).

73 single lumen PPDs with diameters ranging between 7.5 French (F) and 12.5F were used. The mean size of the fluid collections was 7.1±3.0 cm (range: 2.0-15.2 cm). The choice of PPD depended on the size and assumed viscosity of the fluid. CTF-guided PPD placement was performed in 44 patients over 61 sessions and included 73 single lumen PPDs in 71 fluid collections (40).

Primary technical success was achieved in 94.5% of cases (Figure 2). In four cases (4.1%), the PPD could not be inserted into the fluid collection or fluid could not be aspirated due to high viscosity. Clinical success, as defined above, using minimally invasive methods, was achieved in 39 out of 44 patients (88.6%) (Figure 3). Adverse events within 30 days included: PPD failure occurred in 2.3% of patients, secondary dislocation of the catheter (Grade 3) in 11.4% of cases, and one death (2.3%) within 30 days of the procedure (unrelated to the intervention). Five patients required open surgical revision with nephrectomy, partial nephrectomy, or surgical drainage insertion, largely due to late diagnosis or poor residual function of the infected kidney (40).

The mean duration of functioning PPD before removal was 10.9 days and the most commonly isolated microorganisms out of the aspirated fluid were Escherichia coli (17%), Proteus mirabilis (17%) and Candida albicans (11.3%) (40).

With regard to the radiation dose, the mean total dose-length-product (DLP) was 749±385 mGy*cm. This value included mean pre- and post-interventional DLP of 413±245 mGy*cm and 250±185 mGy*cm respectively, and median intra-interventional DLP of 45 mGy*cm (23.5–83 mGy*cm) (40).

The obtained results showed that CTF-guided PPD placement in combination with antibiotics for the management of infected renal and perirenal fluid collections, has high technical and clinical success rates with a low rate of complications. This can lead to a reduction of the need for open surgical incision and drainage in this often severely ill and heterogenous patient population. The possibility to perform microbiological analysis immediately after aspiration enables targeted antibiotic therapy and potentially results in quicker patient recovery (40). The study’s results are in agreement with prior studies which support the efficacy of CTF-guided procedures, thus reinforcing their role in modern interventional radiology and multidisciplinary care (40).

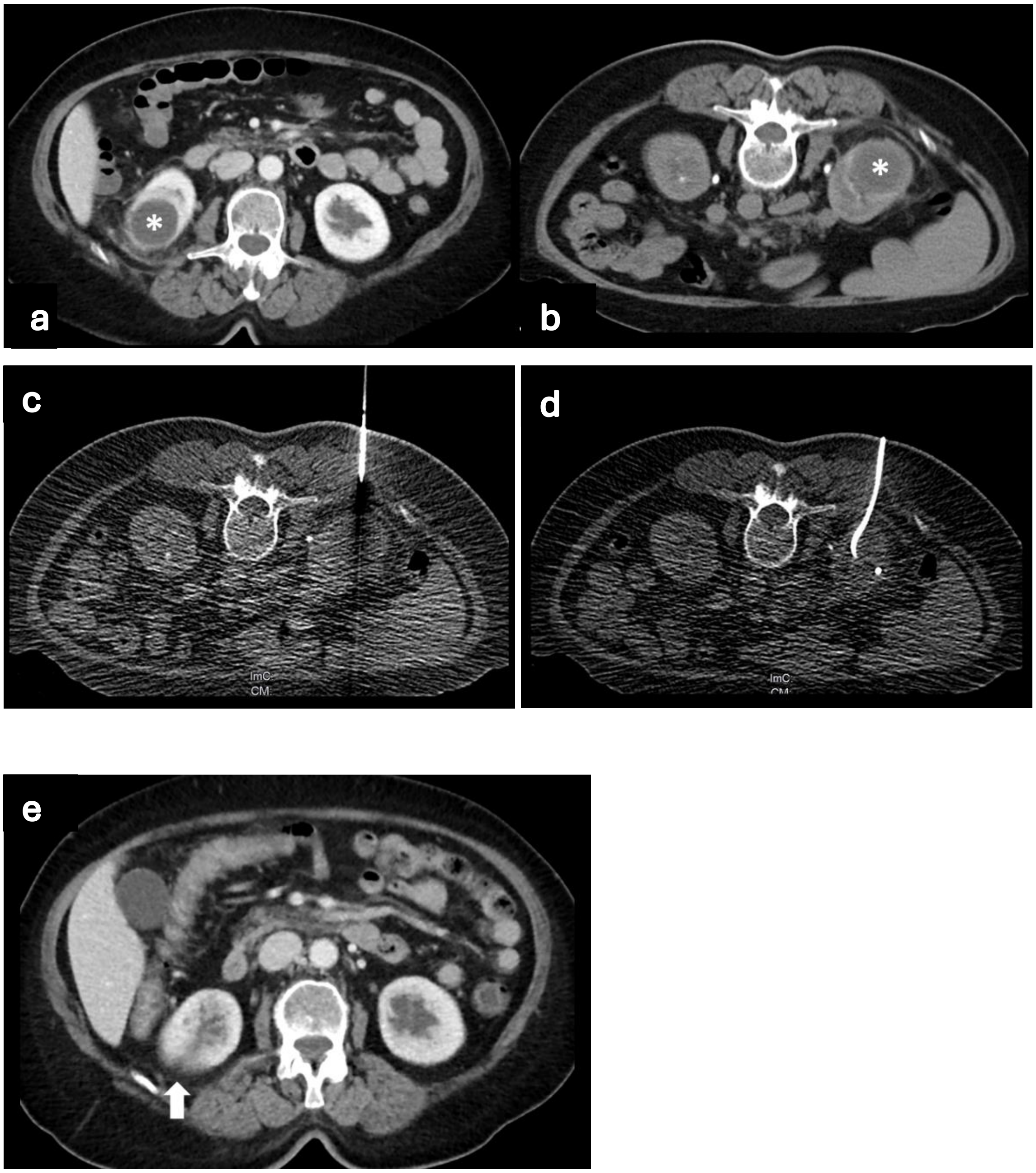


Figure 2

a. 74-year-old woman presenting with fever, right flank pain and elevated inflammatory parameters (Leucocytes 10.6; CRP 11.4) and positive urinalysis but negative urine culture. CE-CT of the abdomen (venous phase) shows a 3.8 cm cyst at the lower pole of the right kidney with a marked rim enhancement.
b. Unenhanced CT in prone position before CT fluoroscopy guided PPD placement showing the infected cyst (asterisk).
c. CT fluoroscopy-guided PPD placement (8F pigtail drainage) under local anaesthesia using posterior access and the trocar technique.

d. CT fluoroscopy image after successful PPD placement. Note the decrease of the cyst size after aspiration of 10 mL slightly haemorrhagic fluid. Microbiological analysis of the cyst content revealed an E. coli infection.
e. CE-CT of the abdomen after 4 weeks after PPD removal. After combined antibiotic and drainage treatment there is only a small residual cortical defect at the posterior lower pole of the right kidney.

Source: Trumm CG, Burgard C, Deger C, Stahl R, Forbrig R, **D'Anastasi M**.
Diagn Interv Radiol. 2021 May;27(3):378-385.

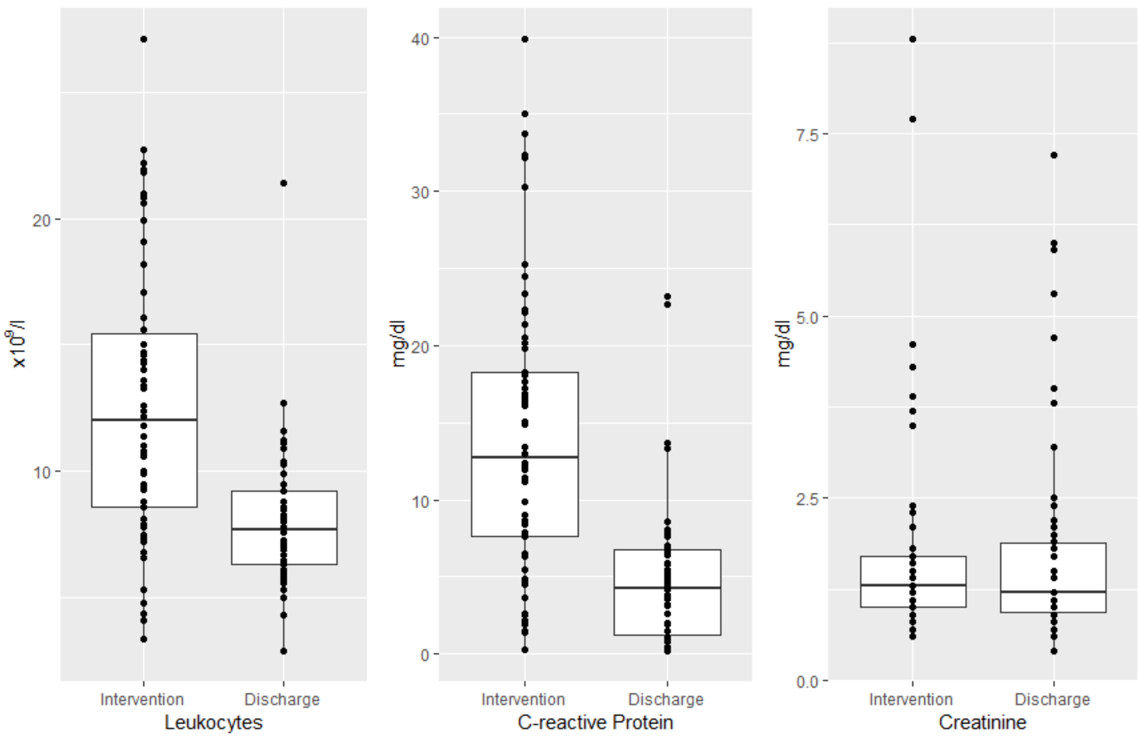


Figure 3 - Box plots show the median values (25th, 75th percentiles) of leukocyte count, C-reactive protein and creatinine at the time of the intervention and at discharge, showing a statistically significant decrease in leukocyte and CRP values ($p < 0.0001$)

Source: Trumm CG, Burgard C, Deger C, Stahl R, Forbrig R, **D'Anastasi M**.
Diagn Interv Radiol. 2021 May;27(3):378-385.

5.1.2 CT fluoroscopy-guided percutaneous drainage of lymphoceles following radical prostatectomy with pelvic lymph node dissection

Publikation 3: **D'Anastasi M**, Ebenberger S, Alghamdi A, Helck A, Herlemann A, Stief C, Khoder W, Trumm C, Stahl R.
Diagnostics (Basel). 2022 Oct 1;12(10):2394

Lymphoceles are lymphatic fluid collections with no distinct epithelial lining (43-45) and are common complications after surgical procedures involving lymph node dissection and disruption of lymphatic vessel networks, such as following axillary lymph node dissections, vascular bypass surgery, renal transplantation, and radical prostatectomy with pelvic lymphadenectomy in the treatment of prostate cancer (43, 46, 47). When large enough, they may cause symptoms due to compression of neighbouring structures and they may occasionally become infected (48).

This retrospective study, approved by the institutional review board, involved consecutive patients who had PD placement in lymphoceles after radical prostatectomy (RP) with pelvic lymph node dissection (LND) performed under low-milliampere CTF guidance at Ludwig-Maximilians-University Hospital. This study aimed to assess the technical outcomes, clinical success, and complications of the procedure in this patient group. Urologists and interventional radiologists confirmed the indication for CTF-guided PD placement during a multidisciplinary discussion. This decision relied on clinical symptoms, laboratory parameters, and imaging results from US or CT examinations. Technical success was defined as PD placement within the lymphocele, accompanied by complete or near-complete fluid aspiration. Clinical success was defined as an improvement in symptoms within the first 48 hours, if symptomatic, and marked improvement of inflammatory parameters (leucocytes, CRP) within 30 days after intervention (49).

In this patient cohort, imaging revealed a total of 89 lymphoceles (see Figure 4). Among these, 50 (56%) were located on the right side, 34 (38%) on the left side, and 5 (6%) were midline lymphoceles. The classification of the detected lymphoceles is detailed in Table 4.

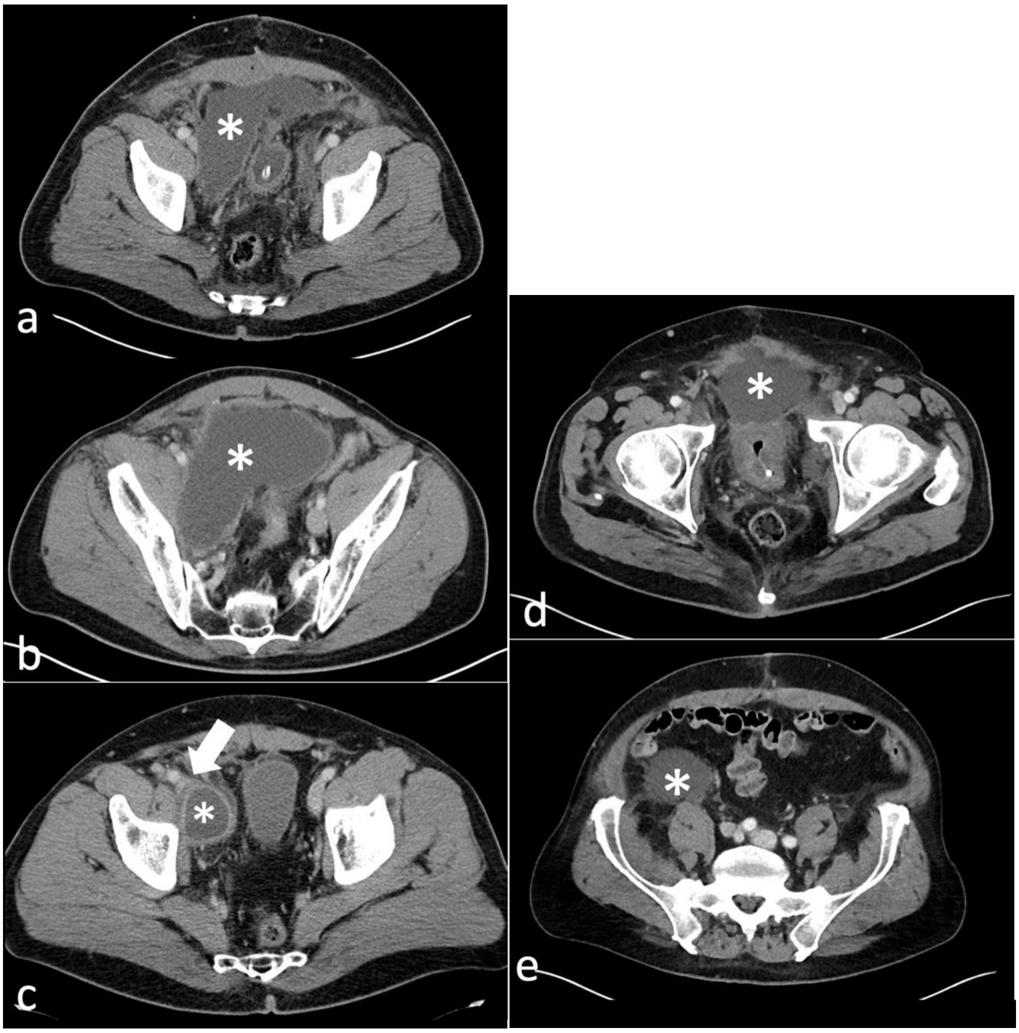


Figure 4. (a) Axial CT image of a patient with a Type 1 lymphocele (*), 9 days after radical prostatectomy with pelvic lymph node dissection. (b) Axial CT image of another patient with a large Type 2A lymphocele (*), 51 days after radical prostatectomy with pelvic lymph node dissection. (c) Axial CT image of a different patient with a right-sided Type 2B lymphocele (*), 4.5 months after radical prostatectomy with pelvic lymph node dissection. The lymphocele is seen to compress the right external iliac vein (arrow) and shows peripheral enhancement with mild surrounding fat-stranding. (d) Axial CT image of another patient with Type 3(*) + 2A lymphocele, 22 days after radical prostatectomy with pelvic lymph node dissection. (e) Axial CT image of a further patient showing a right retroperitoneal component of a Type 4 lymphocele (*), 16 days after radical prostatectomy with pelvic lymph node dissection.

Source: **D'Anastasi** et al. Diagnostics (Basel). 2022 Oct 1;12(10):2394

Table 4 – Classification of lymphoceles in the study cohort according to Khoder et al.

Lymphocele Type	Description	Number	%
Type 1	Paravesical	2	2.2
Type 2A	Lateral pelvic	48	53.9
Type 2B	Deep Pelvic	17	19.1
Type 3	Prevesical	5	5.6
Type 4	Pelvic with retroperitoneal extension	15	16.9
Mixed	Mixed	2	2.2
Total		89	100

A total of 77 CTF-guided interventions were performed in this cohort of 65 patients, with a total of 92 drain insertions (one drain in 81% of sessions, two drains in 19%). Low-milliampere quick-check CTF was used for guidance. 89 drains (97%) were inserted using the curved trocar technique, while 3 drains (3%) were placed using the Seldinger technique (Figure 5). Single lumen drains used included 7.5 F to 12 F drains. Doses were measured using dose-length product (DLP) values for pre-, intra-, and post-interventional scans (49).

The insertion of CTF-guided lymphocele drains was technically successful in all cases, achieving 100% success. 9 out of 65 patients needed a second intervention for lymphocele recurrence, and three of these required a third intervention (49). On follow-up, 33 of 65 patients (50.1%) required a lymphocele fenestration, 32 of whom underwent laparoscopic marsupialization, while one patient underwent an open surgical lymphocele fenestration (49).

100% of patients reported symptom improvement (e.g., pain and neuralgia relief) within 48 hours post-intervention. Statistically significant reductions in C-reactive protein (CRP) and leukocyte levels were observed within 30 days post-procedure in patients who did not undergo further surgical intervention. According to the above definition, clinical success was achieved for CRP in 17 of 18 interventions (94.4%) after 4 days. For leucocytes, success was reached within 1 day in all 13 cases (100%) (49).

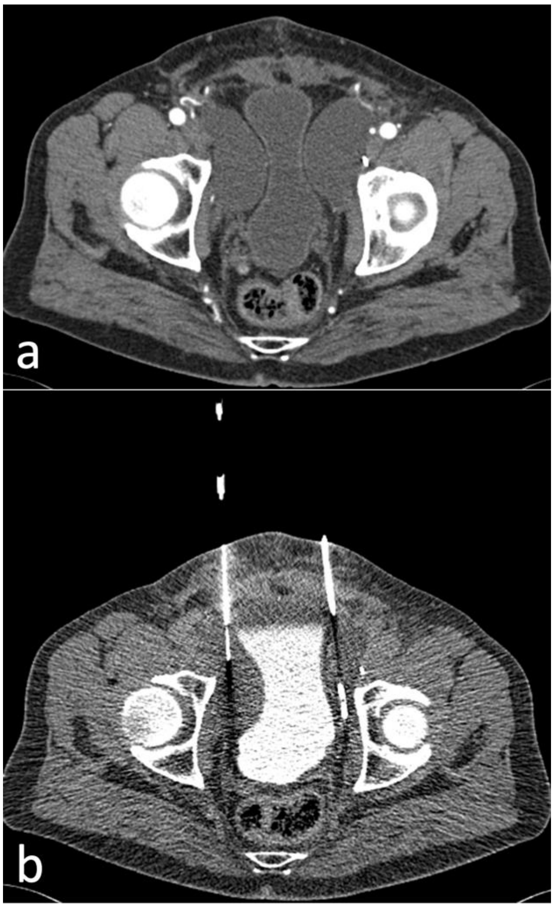


Figure 5. (a) Axial CT image showing a different patient with bilateral Type 2A lymphoceles compressing the urinary bladder, 20 days after radical prostatectomy with pelvic lymph node dissection. (b) Axial CT fluoroscopy image showing drainage insertion with the Seldinger technique in the right-sided Type 2A lymphocele using a tube current-time product of 25 mAs. An 8F pigtail drainage lies within the left-sided lymphocele.

Source: **D'Anastasi** et al. Diagnostics (Basel). 2022 Oct 1;12(10):2394

As regards radiation exposure, the median DLP values were: Pre-interventional scan: 431 mGy*cm; Intra-procedural scan: 45 mGy*cm; Post-procedural scan: 303 mGy*cm, Total: 723 mGy*cm. In this study, a median DLP of the sum of all intra-interventional CT fluoroscopic acquisitions of 45 mGy*cm was achieved (49). This value is lower compared to previously published data for the radiation dose of continuous CT-guided fluoroscopy for abdominal drainage (53 mGy*cm) (50).

A minor complication, a self-resolving hematoma on the bladder dome, occurred, but no major complications were noted. While 50% of patients eventually required surgical lymphocele fenestration, CTF-guided drainage served as an effective initial or bridging therapy, resulting in rapid symptom relief, thus reducing the need for immediate surgery (49).

In conclusion, the results of this study showed that, for patients experiencing postoperative lymphoceles as a complication after radical prostatectomy and pelvic lymph node dissection, low-milliampere CTF-guided drainage is a safe and effective treatment option. It achieves high rates of technical and clinical success, provides quick symptom relief, and may serve as a definitive treatment for some patients or as an interim therapy prior to surgical intervention by means of laparoscopic marsupialisation. An awareness of this technique is essential as it is a very safe and effective alternative to US-guided drainage (49).

5.2 Percutaneous catheter embolisation after oncological surgery

5.2.1 Microcoil embolisation of renal pseudoaneurysms and arteriovenous fistulas as a complication of nephron-sparing partial nephrectomy

Publikation 4: Strobl FF, **D'Anastasi M**, Hinzpeter R et al.
Fortschr Röntgenstr 2016; 188: 188–194

Partial nephrectomy is nowadays a very well-established, safe and effective surgical procedure for the treatment of T1 renal tumours (51, 52). This nephron-sparing technique shows similar oncological outcomes to a radical nephrectomy and is associated with a lower risk of postoperative renal impairment (52-54). However, due to the high vascularity of the renal parenchyma, it carries an increased risk of vascular post-surgical complications such as renal pseudoaneurysms and arteriovenous fistulas (AVFs) (55, 56). These rare, however serious complications can cause severe blood loss and haematuria, which, if untreated, can lead to haemorrhagic shock (56, 57). These arterial lesions can be successfully treated with minimally invasive selective transcatheter embolisation (57-59).

In a retrospective institutional review board-approved study we evaluated the clinical and functional outcomes of patients treated with selective transarterial embolisation of renal pseudoaneurysms or arteriovenous fistulas at Ludwig-Maximilians-University Hospital between January 2003 and September 2013. Out of a total of 1424 patients who underwent partial nephrectomy during this period, 39 (2.7%) were referred for transcatheter embolisation of iatrogenic vascular lesions post-surgery. 32 of these (82.1%) followed an open partial nephrectomy, while the rest followed laparoscopic or robot-assisted partial nephrectomy. In most cases, diagnosis was done through the use of a biphasic contrast-enhanced CT of the abdomen, while in a number of cases with reduced renal function, contrast-enhanced ultrasound (CEUS) was used as an alternate imaging modality. Interventions consisted of a femoral arterial access followed by renal angiography to localise the vascular lesion using a 4F cobra or RDC catheter. Next, a superselective catheterisation of the bleeding vessel was conducted utilizing a coaxial 2.7F microcatheter system. Coil embolisation followed, continuing until the vascular lesion was completely occluded. Technical success was defined as successful primary angiography-guided occlusion of the arterial lesion, while clinical success was defined as the prevention of nephrectomy or additional surgery during the follow-up period (60).

The referred patient cohort consisted of 30 males and 9 females with a mean age of 65.7 years. 26 patients had at least one pseudoaneurysm, 12 patients had AV fistula while 1 patient presented with a pseudoaneurysm and an additional AV-fistula. Patients presented with clinical symptoms of the arterial lesion 15.3 days (mean) after surgery. Diagnosis was done by means of biphasic CT in 92.3% of cases and by CEUS in 7.7% of cases. Occlusion of the vascular lesions was achieved with a mean of 4 pushable 0.018” Cook Tornado® microcoils (60).

Technical success of primary coil embolisation was achieved in all 39 patients (100%) (Figure 6). However, a second intervention involving additional embolisation was necessary for two of these patients. Clinical success was achieved in 35 patients (89.7%) (60).

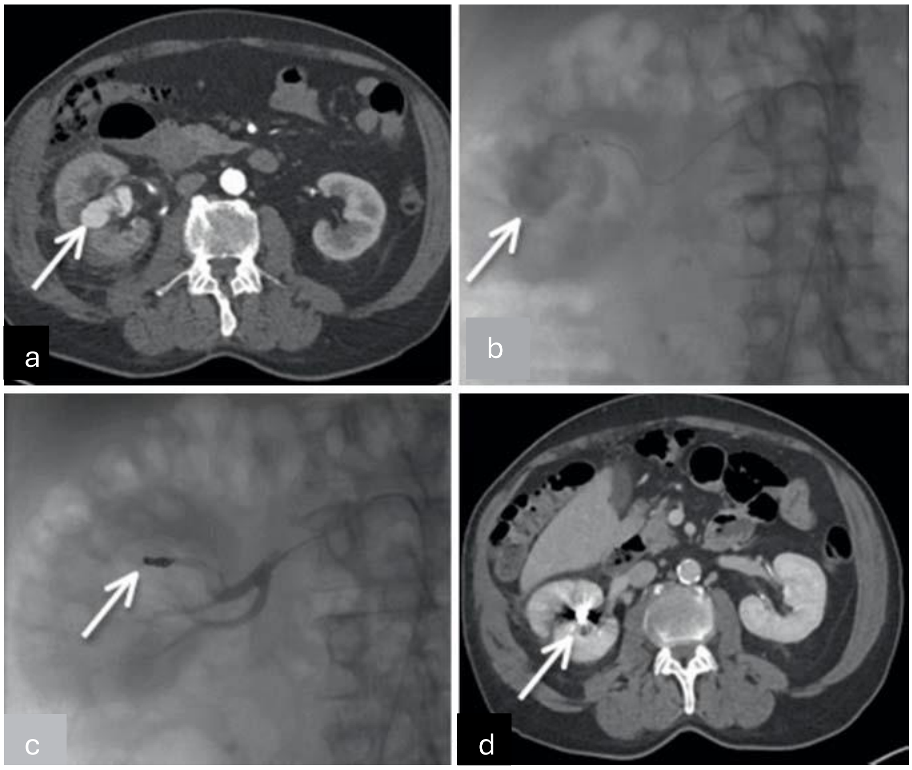


Figure 6. A - Contrast-enhanced CT demonstrating a renal artery pseudoaneurysm (white arrow) of 4.4 × 2.3cm after partial nephrectomy on the right side. B - Angiography confirms the pseudoaneurysm (white arrow) of the upper renal artery. C – Successful embolisation of the feeding vessel of the pseudoaneurysm with six microcoils, which were deployed via a co-axial microcatheter system. D - Postinterventional CT demonstrating complete occlusion of the feeding vessel of the vascular lesion with microcoils.
Source: Strobl FF, **D'Anastasi M** et al. Fortschr Röntgenstr 2016; 188: 188–194

Four patients (10.3%) needed further surgical intervention due to persistent clinical symptoms – in three of these patients they were sufficiently severe to require a total nephrectomy, while in another patient an operative revision involving suturing of the arterial lesion was performed. No complications from invasive angiography, such as dissections, bleeding, or groin hematomas, were noted. No significant reduction in glomerular filtration rate (GFR) between the post-operative pre-embolisation and post-embolisation days was observed. For a subgroup of 10 patients who had an available scan at 100 days post-embolisation, volumetric analysis could be performed. This showed a mean renal parenchymal volume loss of 25.2% of the affected kidney after embolisation. Despite this being considered a significant volume loss, it was not associated with a significant reduction in GFR. The mean-dose area product for the evaluated interventions was 8563 cGy x cm^2 with a wide range of 1287 to 36701 cGy x cm^2. This was likely due to the varying equipment used over the 10-year study period and the variable complexity of the treated arterial lesions. The mean fluoroscopy time was 13 minutes, considered acceptably low. (60).

In conclusion, transcatheter embolisation is an effective method for treating pseudoaneurysms and arteriovenous fistulas following partial nephrectomy. The findings demonstrate a high technical success rate, with no notable decline in renal function during the early post-embolisation phase in this group of patients (Strobl et al). Close interdisciplinary collaboration between urologists and interventional radiologists enables patients with such complications to be treated in a minimally invasive way, avoiding the need for further surgery in most cases.

6. Multidisciplinary tumour boards before and after the COVID-19 pandemic

6.1 Involvement of radiologists in oncologic multidisciplinary team meetings

Publikation 5:
Neri E, Gabelloni M, Bäuerle T, Beets-Tan R, Caruso D, **D'Anastasi M**, Dinkel J, Fournier LS, Gourtsoyianni S, Hoffmann RT, Mayerhöfer ME, Regge D, Schlemmer HP, Laghi A.
Eur Radiol. 2021 Feb;31(2):983-991.

The radiologist, through his/her imaging expertise and as one of core members of the MTB, plays an essential role in the determination of the treatment plan for each patient by the MTB. MTBs have been widely adopted due to their beneficial effects on patient care and benefits related to multidisciplinary collaboration and education. However several challenges arise in practice, which are mainly related to logistics, administrative support, lack of documentation and time management issues (61, 62).

We conducted a survey among radiologists who were members in good standing of the European Society of Oncologic Imaging (ESOI) for the year 2018 to assess the quality and amount of radiologists' involvement in MTBs, the radiologist role and related issues in clinical practice (63). A panel of ESOI experts prepared the online survey. In a first round, the questionnaire was shared among panellists to obtain feedback on the proposed questions, and in a second round, consensus was reached on the final draft (63).

A total of 292 ESOI members participated in the study in 2018. The data obtained were analysed using descriptive statistics. 173/292 (59.2%) of respondents worked at university hospitals, 68 (23.3%) worked in private hospitals, and 51 (17.5%) were employed in public non-academic hospitals. A high proportion (89%) of surveyed radiologists reported attending MTBs regularly. However, only 114 (43.9%) reviewed more than 70% of patient imaging studies before the meetings. The most frequently cited reason for insufficient preparation was lack of time due to a busy clinical schedule. Other reasons included inadequate access to imaging from external facilities and poor quality of some studies. 173 (66.5%) receive the list of patients to be discussed at the MTB, including imaging studies, while 33 (12.7%) receive only the list of patients for discussion at the MTB. 54 (20.8%) do not prepare in advance as they do not receive the list of patients for discussion (63).

Radiologists also emphasized the need for appropriate technology to project high-resolution images (55%), as well as PACS (Picture Archiving and Communication System) workstations to display imaging studies and compare them to previous examinations (32.7%). These are essential for effective image review and presentation during MTBs (63). Radiologists are included in the final multidisciplinary meeting report in 213 cases out of 260 (81.9%). If the MTB radiologist opinion is different from the primary imaging report, a supplementary report is provided during the MTB meeting in only 104 out of 260 cases (40%) (63).

Attendance of MTBs is associated with a number of benefits. Most radiologists (226/260, 86.9%) highlight the importance of feedback from surgeons and pathologists, which helps in enhancing diagnoses and refining diagnostic skills. MTBs lead to better interaction between radiologists and referring clinicians according to 148/260 (56.9%) of respondents. 215/260 radiologists (82.7%) report that the MTBs improve their knowledge of cancer treatment. 56% of surveyed radiologists feel that MTBs facilitate better interaction and communication with clinicians. 35% of respondents find MTBs beneficial by helping them obtain information about ongoing clinical trials and 21.9% in keeping up to date with translational research (63).

The pie chart below (Figure 7) shows the ranges of perceived changes in the diagnostic strategy or therapeutic decisions as a result of radiologists' attendance and contributions at MDTs, according to the respondents.

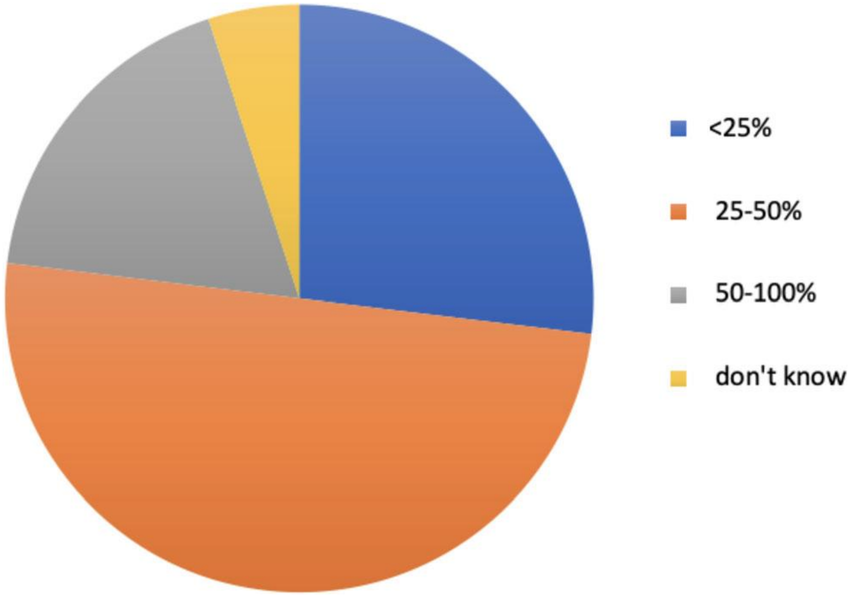


Figure 7 - Percentage of cases in which the diagnostic strategy or therapeutic decision has changed due to the participation of radiologists in MTBs, according to the European radiologists joining the survey. 50–100% of cases, 18.1%; 25–50% of cases, 50%; < 25% of cases, 26.9%; do not know, 5%.
Source: Neri E et al. Eur Radiol. 2021 Feb;31(2):983-991.

Several challenges are faced by radiologists attending MTBs. Almost half (46.6%) of surveyed radiologists indicated that their busy schedule for imaging and reporting severely limited their ability to adequately prepare for MTBs. A significant proportion (71.9%) mentioned that MTBs were scheduled during regular working hours, overlapping with other duties, which created conflicts and limited effective participation. Only 15% of respondents reported that MTBs were accredited for CME in their institutions, despite the time commitment required and the learning opportunities offered by these meetings. The respondents cited the following perceived deficiencies of MTBs: lack of time (156/260, 60%), timing of MTB meetings (83/269, 31.9%), insufficient documentation available (83/260, 31.9%), inadequate IT resources (68/260, 26.1%), lack of clarity with regard to the clinical question (78/260, 30%) and absence of the referring physicians at the MTB (39/260, 15%) (63).

Involvement in MTBs was compulsory for 153/260 (58.8%) of respondents and very useful for the rest (107/260, 41.2%). No one of the respondents thought that MTBs are not useful (63).

The results from this survey, performed among a select group of radiologists with special interest in oncologic imaging, highlight the importance of radiologists' attendance and their expert contributions at MTBs but also demonstrate significant administrative and logistical challenges. A recognition of radiologists' contributions at MDTs with CME accreditation, structured scheduling and administrative and technological support are essential in optimising their impact on patient care. Addressing the deficiencies and challenges highlighted by this study could improve the quality of radiologists' participation at MTBs and the overall effectiveness and efficiency of the MTB as a whole, ensuring that these meetings fulfil their maximum potential in the multidisciplinary management of cancer patients.

6.2 Online oncologic multidisciplinary team meetings during the COVID-19 pandemic

Publikation 6:
Bonanno N, Cioni D, Caruso D, Cyran CC, Dinkel J, Fournier L, Gourtsoyianni S, Hoffmann RT, Laghi A, Martincich L, Mayerhoefer ME, Zamboni GA, Sala E, Schlemmer HP, Neri E, **D'Anastasi M.**
Eur Radiol. 2022 Aug 20:1-11.

The COVID-19 pandemic presented unique challenges to multidisciplinary cancer care. However, with the available teleconferencing software and hardware, a shift of the conventional in-person oncologic multidisciplinary team meeting (MDTM) to an online oncologic MDTM was possible for many institutions worldwide. This was essential to guarantee the continuity of the MDTMs and ensure uninterrupted multidisciplinary cancer care while simultaneously complying with social distancing and quarantine regulations to reduce and control the spread of SARS-CoV-2 (64).

The aims of this study were to explore the transition from face-to-face to online MDTMs and to assess the clinical and technical impacts of online MDTMs during the COVID-19 pandemic. We also aimed to determine the benefits and challenges of online

MDTMs to enhance current practices and derive maximum advantage from the available technologies. The first author prepared the survey questions, which were reviewed and amended by the last author and a facilitator. A panel of four ESOI experts reviewed and approved the final survey questions. ESOI members were then invited to participate in a 24-question survey on online oncologic MDTs (64). The full survey questions are shown in Table 5.

Table 5 - Survey questions:

General information:

1. Which country do you work in?

2. What is your role in the imaging department?
    a. Chair/Director
    b. Consultant
    c. Radiology Fellow/Resident
    d. Board-certified Radiologist

3. On average per week, how many MDTs do you attend and/or participate in?
    a. <1 per week
    b. 1-3 per week
    c. 3-6 per week

4. Is attendance to MDTs mandatory for the Radiologists in your institution?
    a. Yes
    b. No

5. How much time do you spend preparing for and participating at MDTs?
    a. 1-2 hours per week
    b. 2-4 hours per week
    c. > 4 hours per week

6. Have you participated in any online MDT before the COVID-19 pandemic?
    a. Yes
    b. No

Opinion of MDTs during the COVID-19 pandemic:

7. Did your hospital implement online MDTs after the start of the COVID-19 pandemic (February/March 2020)?
    a. Yes
    b. No – online MDTs were not done before or during the pandemic
    c. No – online MDTs were already being done prior to the pandemic

8. What was your initial reaction when your hospital implemented online MDTs following the COVID-19 pandemic?
    a. Approved it
    b. Neutral
    c. Disapproved it

9. In your opinion, has Radiologists' participation at MDTs increased on account of the meeting being held online?
    a. Yes
    b. No
    c. Maybe

10. In your opinion, has Clinicians' participation at MDTs increased on account of the meeting being held online?

a. Yes
b. No
c. Maybe

11. Do you think the shift to an online meeting affected the standard of the MDT?
    a. Yes, significantly better
    b. Yes, slightly better
    c. Yes, slightly lowered standard
    d. Yes, significantly lowered standard
    e. No, remains the same

12. Are you happy with the depth of discussion happening in the online MDTs compared to conventional face-to-face MDTs?
    a. Yes
    b. No

13. Do you think the role of the Radiologist at the online MDT has changed?
    a. Yes
    b. No, remains the same
    If answer to the above is 'Yes', please state how:
    ____

14. Were you able to interact adequately with other Specialists in the online MDT?
    a. Yes
    b. No

15. Were you able to access all relevant patient imaging data in the online MDT?
    a. Yes
    b. No

16. Did you find the viewing of imaging studies to be equal, better, or worse in the online MDT when compared to the physical MDT?
    a. Equal
    b. Better
    c. Worse

17. Which videoconferencing software was used during online MDTs?
    a. Zoom Meetings
    b. Microsoft Teams
    c. GoToMeeting
    d. Google Meet
    e. Other: ______________________

18. Where did you participate at the online MDT from?
    a. Hospital office
    b. Home office
    c. Both hospital and home office

19. In your opinion, which of these do you consider important benefits for Radiologists to having the MDT held online?
    You may select more than one answer:
    a. Safer alternative to face-to-face contact between multiple clinical teams thereby minimizing viral transmission/the risk of infection
    b. Easier access to the meeting
    c. More organised discussion
    d. More organised chairing, reducing the number of people speaking at one time
    e. Room availability and scheduling no longer a problem as no need for a dedicated large room.
    f. Other: ____

20. In your opinion, which of these do you consider important deficiencies of online MDTs that the radiologist may encounter?

    You may select more than one answer:

a. Difficulties with technology and connectivity
b. Lack of technical support
c. Difficulties with review of imaging studies online
d. Ineffective communication between radiologist and the other medical teams
e. Missing non-verbal cues may lead to misunderstandings
f. Difficulty in developing a working relationship with new team members due to sole online interaction at MDT
g. Other: ____

21. Has the number or frequency of meetings changed since the switch to online MDTs?
    a. Yes, more meetings/more frequent
    b. Yes, fewer meetings/less frequent
    c. No change

Future directions:

22. In your opinion do you agree that MDTs should revert to face-to-face group meetings, once it is considered safe to do so?
    a. Yes
    b. No
    c. Combination of physical and online MDTs

23. In your opinion would you support the continued practice of online MDTs following the end of the current pandemic and the ensuing return to normal work?
    a. Yes
    b. No

24. If online MDTs continue in the future, will this increase or decrease the workload of Radiologists?
    a. Increased workload
    b. Decreased workload
    c. Remains the same

Source: Bonanno N, …., **D'Anastasi M.**
Eur Radiol. 2022 Aug 20:1-11.

We received 204 responses from radiologists across 47 countries, all ESOI members in good standing for 2021. Data were analyzed using descriptive statistics.. Most of the respondents were non-consultant board-certified radiologists (89/204, 43.6%) or Consultant Radiologists (24/204, 30.9%). The rest were Departmental Chairs/Directors (28/204, 13.7%) or Fellows/Residents (89/204, 11.8%). 63.2% attended 1-3 MDTMs weekly, 8.8% attended 3-6 weekly MDTMs. MDTM attendance was mandatory in the institutions of 62.3% of the respondents. 1-2 hours weekly were spent preparing for and attending MDTMs by 53.9% of the respondents, while over 4 hours weekly were spent by 16% of the respondents. 74 out of 204 (36.3%) radiologists had participated in online MDTMs before the pandemic (64).

Opinions regarding MTBs during the COVID-19 pandemic:

157 out of 204 respondents (77%) reported a shift to online MDTMs during the COVID-19 pandemic. Twelve out of 204 respondents (5.9%) were already conducting online MDTMs before the pandemic. Conversely, 35 out of 204 respondents (17.2%) stated that online MDTMs were not performed at their institutions before or during the pandemic. Most respondents (141 out of 204, 69.1%) approved of the change to online MDTMs at the beginning of the pandemic, while 57 out of 204 (27.9%) remained neutral, and a small number (6 out of 204, 3%) initially disapproved. Opinions on changes in radiologists' participation in online MDTMs were mixed. Out of 204 respondents, 80 (39.2%) reported increased participation, while another 80 (39.2%) indicated that participation remained the same or decreased. Additionally, 45 respondents (22.3%) were unsure. Furthermore, 82 respondents (40.2%) noted an increase in participation among non-radiologist clinicians at online MDTMs (64).

A considerable number of radiologists (159 out of 204, or 77.9%) felt that the radiologist's role in online MDTMs remains the same, while 45 out of 204 (22.3%) disagreed. The primary reasoning cited by respondents was that radiologists have a strengthened role in online MDTMs because of screen sharing. Radiologists are increasingly taking charge of meetings, having more influence over discussions and increased interactions with fellow MDTM members (64).

Of the 204 respondents, 71 (34.8%) believed that online MDTMs provided a similar standard to face-to-face MDTMs. Meanwhile, 70 (34.3%) believed the quality of online MDTMs was inferior. Conversely, 63 (30.9%) felt that the standard of online MDTMs had improved. Moreover, 129 respondents (63.2%) expressed satisfaction with the depth of discussions in online MDTMs, while 165 participants (80.9%) were content with the specialist interactions in case discussions. Most radiologists (158/204, 77.5%) did not have difficulties accessing patient images during the online MDTMs, and 144 (70.1%) found viewing imaging studies to be equal to or better than in-person MDTMs. However, 60 (29.4%) of respondents reported experiencing problems or suboptimal viewing of imaging examinations during online MDTMs (64).

Various software solutions were used for hosting online MDTMs, with the most commonly used being Zoom (90 out of 204, 44.1%), followed by Microsoft Teams (60 out of 204, 29.4%). Other software solutions included Google Meet and GoToMeeting, as well as institutional solutions. After the widespread introduction of online MDTMs during the pandemic, 15 out of 204 (7.4%) respondents prefer to log on to the meeting from a home office, and 94 out of 204 (46.1%) use both a home and hospital office, while 91 out of 204 (44.6%) use only a hospital office. Interestingly, despite the considerable impact on medical care during the COVID-19 pandemic, our results indicated that for 144 out of 204 (70.6%) surveyed radiologists, online MDTMs were conducted as frequently as before the pandemic. Furthermore, 44 out of 204 (21.6%) respondents even reported an increase in the number and/or frequency of MDTMs, while 16 out of 204 (7.8%) reported a decrease in the number and/or frequency of MDTMs at their hospital (64).

Figure 8 shows the benefits of online MDTMs as reported by respondents, while Figure 9 illustrates the reported deficiencies of online MDTs in this survey.

Opinions on future directions

73 out of 204 (35.8%) participants indicated a preference to return to in-person MDTs once it is safe. In contrast, 7 out of 204 (3.4%) expressed satisfaction with their current arrangements and preferred the continuation of online MDTMs. The majority of surveyed radiologists (124 out of 204, 60.8%) would be pleased to have a combination of physical and online MDTs, either through a ‘hybrid’ meeting setup with concurrent face-to-face and online audiences or alternating between online and face-to-face meetings (64).

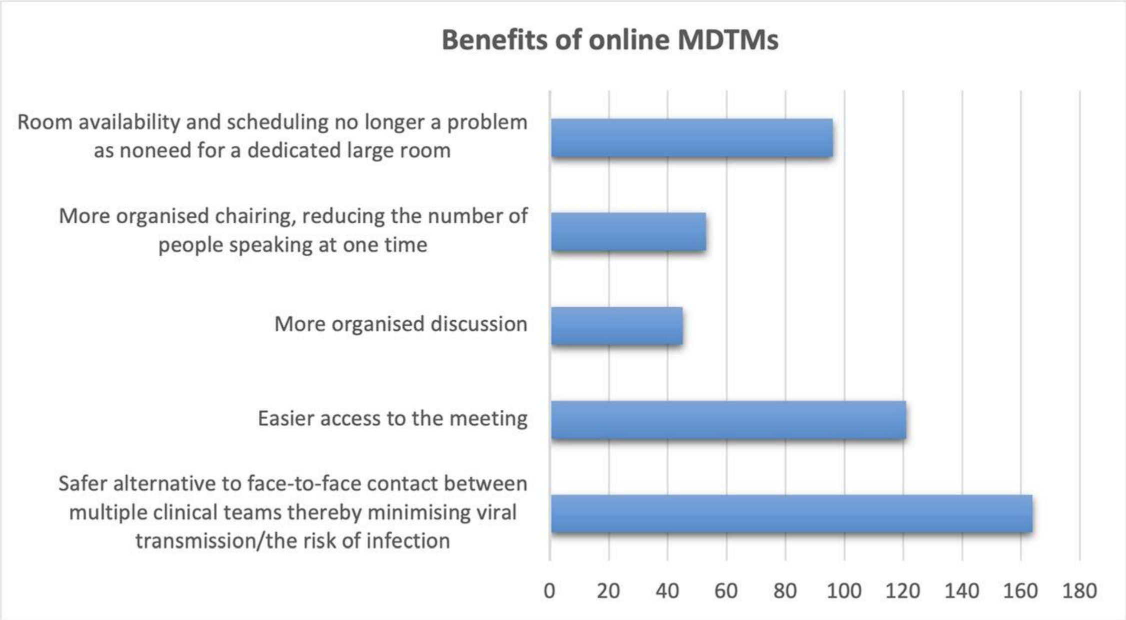


Figure 8 – Benefits of online MDTMs as reported by the respondents.

Source: Bonanno N, …., **D'Anastasi M.**

Eur Radiol. 2022 Aug 20:1-11.

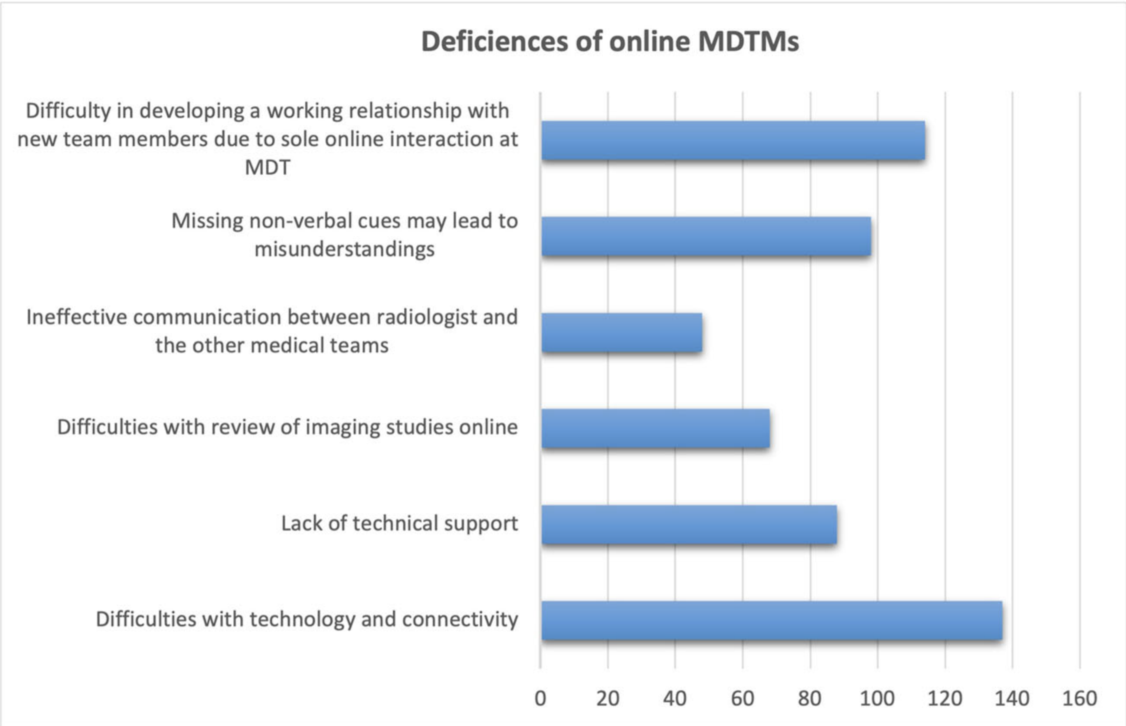


Figure 9 – Deficiencies of online MDTMs as reported by respondents.

Source: Bonanno N, …., **D'Anastasi M.**

Eur Radiol. 2022 Aug 20:1-11.

After the pandemic, a significant portion of respondents (142 out of 204, or 69.6%) favoured maintaining online MDTMs, while a smaller group of 62 out of 204 (30.4%) opposed this practice post-pandemic. Regarding the effects of online MDTs on radiologist workloads, the majority (112 out of 204, or 54.9%) anticipated their workloads would remain stable if online MDTMs continued. In contrast, 77 out of 204 (37.7%) expected an increase in their workload, while 15 out of 204 (7.4%) predicted a decrease (64).

The survey results indicated that having affordable and secure teleconferencing software enabled most health institutions to shift from in-person MDTMs, which were the norm before the pandemic, to online MDTMs. Online MDTMs proved viable and were generally accepted during the pandemic, offering a safe alternative to in-person meetings which enabled a continued provision of high-quality multidisciplinary care of cancer patients. Overcoming a number of technical and communication challenges is essential for broad adoption and effectiveness of online MDTMs. In this respect, training, improved software and IT support services are of utmost importance. Most surveyed radiologists favour a combination of in-person and online MDTMs in future (64), a preference which was replicated in other subsequently published studies (65-69).

7. Abbreviations

AVF – Arteriovenous Fistula

CME – Continuing Medical Education

CRP – C-Reactive Protein

CT – Computed Tomography

CTF – CT Fluoroscopy

DLP – Dose-Length Product

ECCO – European CanCer Organisation

ESOI – European Society of Oncologic Imaging

GFR – Glomerular Filtration Rate

HCC – Hepatocellular Carcinoma

LND – Lymph Node Dissection

MDT – Multidisciplinary Team

MDTM – Multidisciplinary Team Meeting

MRI – Magnetic Resonance Imaging

MTB – Multidisciplinary Tumor Board

NCI – National Cancer Institute

PACS – Picture Archiving and Communication System

PD – Percutaneous Drainage

PET-CT – Positron Emission Tomography-Computed Tomography

PPD – Percutaneous Pigtail Drainage

RFA – Radiofrequency Ablation

RP – Radical Prostatectomy

SARS-CoV-2 – Severe Acute Respiratory Syndrome Coronavirus 2

US – Ultrasound

8. Literature

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9. Publication list for this cumulative Habilitation Thesis

Publication 1:
Second-Opinion Interpretations of Gynecologic Oncologic MRI Examinations by Sub-Specialized Radiologists Influence Patient Care.
Lakhman Y*, **D'Anastasi M***, Miccò M, Scelzo C, Vargas HA, Nougaret S, Sosa RE, Chi DS, Abu-Rustum NR, Hricak H, Sala E.
Eur Radiol. 2016 Jul;26(7):2089-98 **IF (2016) = 3.967**

Publication 2:
Intermittent quick-check CT fluoroscopy-guided percutaneous drainage placement in patients with infected renal and perirenal fluid collections: 11-year experience.
Trumm CG, Burgard C, Deger C, Stahl R, Forbrig R, **D'Anastasi M**.
Diagn Interv Radiol. 2021 May;27(3):378-385. **IF (2021) = 3.346**

Publication 3:
Technical Outcome, Clinical Success, and Complications of Low-Milliampere Computed Tomography fluoroscopy-guided Drainage of Lymphoceles following Radical Prostatectomy with Pelvic Lymph Node Dissection
D'Anastasi M, Ebenberger S, Alghamdi A, Helck A, Herlemann A, Stief C, Khoder W, Trumm C, Stahl R
Diagnostics (Basel). 2022 Oct 1;12(10):2394 **IF (2022) = 3.6**

Publication 4:
Renal Pseudoaneurysms and Arteriovenous Fistulas as a Complication of Nephron-Sparing Partial Nephrectomy: Technical and Functional Outcomes of Patients Treated With Selective Microcoil Embolization During a Ten-Year Period.
Strobl FF, **D'Anastasi M**, Hinzpeter R et al. Renal Pseudoaneurysms and Arteriovenous Fistulas as a Complication of Nephron- Sparing Partial Nephrectomy: Technical and Functional Outcomes of Patients Treated With Selective Microcoil Embolization During a Ten-Year Period. Fortschr Röntgenstr 2016; 188: 188–194 **IF (2015) = 1.554**

Publication 5:
Involvement of radiologists in oncologic multidisciplinary team meetings: an international survey by the European Society of Oncologic Imaging.
Neri E, Gabelloni M, Bäuerle T, Beets-Tan R, Caruso D, **D'Anastasi M**, Dinkel J, Fournier LS,
Gourtsoyianni S, Hoffmann RT, Mayerhöfer ME, Regge D, Schlemmer HP, Laghi A.
Eur Radiol. 2021 Feb;31(2):983-991. **IF (2021) = 7.034**

Publication 6:
Attitudes and perceptions of radiologists towards online (virtual) oncologic multidisciplinary team meetings during the COVID-19 pandemic-a survey of the European Society of Oncologic Imaging (ESOI).
Bonanno N, Cioni D, Caruso D, Cyran CC, Dinkel J, Fournier L, Gourtsoyianni S, Hoffmann RT, Laghi A, Martincich L, Mayerhoefer ME, Zamboni GA, Sala E, Schlemmer HP, Neri E, **D'Anastasi M.**
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