AmeriHealth Caritas Louisiana

National Imaging Associates, Inc.*	
Clinical guidelines **ABDOMEN MRI** **MRCP (Magnetic Resonance Cholangiopancreatography)**	**Original Date: September 1997**
CPT Codes: 74181, 74182, 74183, S8037	**Last Revised Date: April 2021**
Guideline Number: NIA_CG_031	**Implementation Date: January 2022**

IMPORTANT NOTE: A single authorization for CPT code 74181, 74182, 74183, S8037 includes imaging of the biliary tree and liver. Multiple authorizations are not required. When a separate MRCP and MRI abdomen exam is requested, documentation requires a medical reason that clearly indicates why additional MRI imaging of the abdomen is needed.

Note: There is no MRI Abdomen/Pelvis combo (comparable to a CT Abdomen/Pelvis) such that if imaging of both the abdomen and pelvis are indicated, two separate exams (and authorization) are required (i.e., MRI Abdomen and MRI Pelvis)

This study includes MRU (MR urography) and MRE (MR enterography).

INDICATIONS FOR ABDOMEN MRI

Evaluation of suspicious known mass/tumors ~~(unconfirmed diagnosis of cancer)~~ for further evaluation of indeterminate or questionable findings~~:~~

- Initial evaluation of suspicious abdomen masses/tumors found only in the abdomen by physical exam or imaging study, such as ultrasound (US), or CT (ACR, 2019).
- Follow-up of known cancer (Bourgioti, 2016; NCCN, 2019):
  - Follow-up of known cancer of patient undergoing active treatment within the past year
  - ~~-~~**Known cancer with suspected abdominal/pelvic metastasis based on a sign, symptom, (e.g., anorexia, early satiety, intestinal obstruction, night sweats, pelvic pain, weight loss, vaginal bleeding) or an abnormal lab value (alpha-fetoprotein, CEA, CA 19-9, p53 mutation)**
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* National Imaging Associates, Inc. (NIA) is a subsidiary of Magellan Healthcare, Inc.

- For known prostate cancer abdomen MRI can be approved when requested in combination with pelvis MRI when meets GL for pelvis MRI

~~- Known cancer with suspected abdominal metastasis based on a sign, symptom or an abnormal lab value~~

~~- For known prostate cancer abdomen MRI can be approved when requested in combination with pelvis MRI when meets GL for pelvis MRI~~

For evaluation of an organ or abnormality seen on previous imaging~~:~~

ADRENAL

- To locate a pheochromocytoma once there is clear biochemical evidence **(See Background)~~**~~** (Lenders, 2014)
- Suspected adrenal secreting tumor after full clinical and biochemical work~~-~~up (Fassanacht, 2018; Meek, 2013)~~.~~
- Suspected adrenal mass ≥ 1 cm incidentally discovered with no history of malignancy (one follow-up in 6 – 12 months to document stability)
- If adrenal mass ≥ 4 cm and no diagnosis of cancer, can approve for preoperative planning (surgery to rule out adrenal cortical carcinoma)
- For adrenal mass < 4 cm with history of malignancy (if ≥ 4 cm consider biopsy or FDG-PET/CT unless pheochromocytoma is suspected)
- Yearly surveillance for patients with Multiple Endocrine Neoplasia type 1 (MEN1) beginning at age 10 (Kamilaris, 2019)
- For patients with Von Hippel Lindau (VHL) surveillance at least every other year starting at age 16 (a~~A~~bdominal ultrasound starting at age 8) (Varshney, 2017)
- Surveillance MRI (include pelvis) every 2-3 years for patients with Hereditary Paraganglioma syndromes types 1-5 (Benn, 2015)

LIVER

- Indeterminate liver lesion ≥ 1cm seen on prior imaging (ACR, 2020)~~.~~
- Indeterminate liver lesion < 1cm on initial imaging, with known history of extrahepatic malignancy, or known chronic liver disease~~.~~
- Hepatitis/hepatoma screening after ultrasound is abnormal, equivocal, or non-diagnostic (may be limited in patients who are obese, those with underlying hepatic steatosis, as well as nodular livers (ACR, 2017; Bruix, 2011; Lee, 2014; Marquardt, 2016)).~~–~~ **(No literature supports the use of AFP alone in the screening of HCC).**
- **For jaundice or abnormal liver function tests after equivocal or abnormal ultrasound (Vagvala, 2018)~~.~~**
- For surveillance of HCC in patients who have received liver-directed therapy, surgical resection, medical treatment, or transplant (MRI or CT) at one-month post treatment and then every 3 months for up to two years **(See Background)~~*~~** (Arif-Tawari, 2017; **Vagvala, 2018**)
- For follow~~-~~up of suspected adenoma every 6-12 months
- For surveillance of patients with primary sclerosing cholangitis (also CA 19-9), every 6-12 months after the age of 20 (MRI and MRCP preferred over CT) (Bowlus, 2019)

- ~~For jaundice or abnormal liver function tests after equivocal or abnormal ultrasound (Vagvala, 2018)~~
- For follow up of focal nodular hyperplasia (FNH) annually if US is inconclusive (Marrero, 2014)
- For elastography in chronic liver disease to stage hepatic fibrosis (ACR, 2019)
- In patients with Beckwith-Wiedemann syndrome and abnormal ultrasound or rising AFP (Kalish, 2017)~~.~~

Evaluation of iron overload in the following settings

- Initial evaluation of liver iron in Hemochromatosis diagnosed in lieu of liver biopsy (Labranche, 2018)
- Annual evaluation for ~~high~~ **high-**risk patients: transfusion-dependent thalassemia major, sickle cell disease and other congenital anemias (Wood, 2014)

PANCREAS

- Pancreatic cystic lesion found on initial imaging
- For ~~follow~~ **follow-**up of known intraductal papillary mucinous neoplasm (IPMN) and mucinous cystic neoplasm (MCN) (if there are no high-~~-~~risk characteristics, **see Background section**) (Elta, 2018):
    - For incidental and asymptomatic cysts <5 mm, one follow-up at three years (Pandey~~v~~, 2019)
    - For cysts 5mm-1cm image every 2 years for 4 years, and if stable may lengthen intervals~~.~~
    - For cysts 1-2cm image every year for 3 years and if stable every 2 years for 4 years, and if stable may lengthen intervals~~.~~
    - C~~For c~~ysts that are 2-3 cm followed every 6-12 months for 3 years and if stable then yearly for 4 years and if stable may lengthen intervals (can also use EUS-Endoscopic ultrasound)
    - For lesions ≥ 30 mm MRI/CT or EUS every 6 months for 3 years, then imaging alternating with EUS every year for 4 years and consider lengthening interval if stable
- **Annual surveillance** for individuals determined to have an increased lifetime risk of developing pancreatic cancer, based on genetic predisposition or family history
    - Starting at age 50 or 10 years younger than the earliest age of cancer affected ~~first~~ **first-** degree relative (except with Peutz-Jeghers start at age 30-35)~~,~~
    - Von Hippel Lindau starting at age 16 at least every other year (abdominal ultrasound starting at age 8)
    - Hereditary Pancreatitis starting at age 40 or 20 years before first attack** (Hu, 2018; NCCN, 2019; Syngal, 2015)
    - For other approvable genetic syndromes that increase lifetime risks, see **background section**
- Annual surveillance for patients with MEN1 for primary neuroectodermal tumors (pNET) starting at age 10 (EUS also considered)
- For localization of an insulinoma, once diagnosis is confirmed (CT preferred) (Vinik, 2017)

RENAL

- For an indeterminate renal mass on other imaging (ACR, 2014)

- Active surveillance for indeterminate cystic renal mass, not a simple renal cyst (Richard, 2017) (See **Bosniak criteria** in ~~comment~~ **Background** section).
- Follow~~-~~up for solid renal masses under 1 cm at 6 and 12 months, then annually (Herts, 2018)
- Annual surveillance for patient with tuberous sclerosis and known angiomyolipomas (Vos, 2018)
- For surveillance of patients with Von Hippel Lindau at least every other year to assess for clear cell renal cell carcinoma to begin at age 16 (screening with ultrasound starting at around age 8) (Varshney, 2017)~~.~~
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- Active surveillance for renal cell carcinoma in patients with Birt-Hogg syndrome every 36 months (Gupta, 2017)~~.~~
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- MRU (may also approve MR pelvis for MR urography) ~~for~~**when ultrasound is inconclusive and CT (CTU) cannot be done or is inconclusive and MRI is recommended**

- ~~recurrent urinary tract infections in females (≥ 3 infections over 12-month period) (ACR, 2020)~~

SPLEEN

- Incidental findings of the spleen on ultrasound or CT that are indeterminate (Thut, 2017)

Suspected Hernia

- Occult, spigelian, incisional or epiastric hernia when physical exam ~~or~~ **and** prior imaging (ultrasound AND CT) is non-diagnostic or equivocal (Abd~~db~~elmohsen, 2017; Lassandro, 2011; Miller, 2014; Robinson, 2013) and limited to the abdomen
- Suspected incarceration or strangulation based on physical exam or prior imaging (CT preferred) (Halligan, 2018)~~.~~

For evaluation of suspected infection or for follow-up known infection (may approve in conjunction with Pelvis MRI when indicated)

- Persistent abdominal pain not explained by previous imaging/procedure
- Any known infection that is clinically suspected to have created an abscess in the abdomen~~.~~
- Any history of fistula limited to the abdomen that requires re-evaluation or is suspected to have recurred~~.~~
- Abnormal fluid collection limited to the abdomen seen on prior imaging that needs follow-up evaluation~~.~~
- Suspected peritonitis (from any cause)**(would typically need to include MRI Pelvis)** ~~if~~ abdominal pain and tenderness to palpation is present, and **at LEAST one** of the following:
    - Rebound, guarding or rigid abdomen, **OR**
    - Severe tenderness to palpation over the entire abdomen
- Complications of diverticulitis with severe abdominal pain or severe tenderness or mass, not responding to antibiotic treatment (prior imaging study is not required for diverticulitis~~-~~ ~~-~~diagnosis (Cartwright, 2015)

For evaluation of suspected inflammatory bowel disease or follow-up ~~-~~known disease (includes MR enterography and can also approve Pelvis MRI/MRE)

- For suspected inflammatory bowel disease (Crohn's disease or ulcerative colitis) with abdominal pain AND one of the following (ACR, 2019; Arif-Tiwari, 2019; Lichtenstein, 2018):
  - Chronic diarrhea
  - Bloody diarrhea
- High clinical suspicion after complete work up including physical exam, labs, endoscopy with biopsy (ACR, 2019; Arif-Tiwari, 2019; Lichtenstein, 2018; Rubin, 2019)~~For suspected Crohn's disease with abdominal pain, chronic diarrhea, or bloody diarrhea, fatigue, or when there is a high clinical suspicion after complete work up including physical exam, labs, endoscopy with biopsy (ACR, 2019; Arif-Tiwari, 2019; Lichtenstein, 2018).~~
- ~~For ulcerative colitis that is suspected clinically, however abdominal symptoms are not explained by endoscopy (Rubin, 2019)~~
- For MR enterography (MRE) if CT or MRI of the abdomen and pelvis are inconclusive~~.~~
- Known inflammatory bowel disease (Crohn's or ulcerative colitis) with recurrence or worsening signs/symptoms requiring re-evaluation , ~~or~~ for monitoring therapy (ACR, 2019)

Other indications for abdominal MRI (and pelvis where appropriate) when CT is inconclusive or cannot be completed~~)~~

- Persistent abdominal/pelvic pain not explained by previous imaging
- To locate a pheochromocytoma once there is clear biochemical evidence (See Background)
- For B symptoms of fevers more than 101 F, drenching night sweats, and unexplained ~~with~~ weight loss of more than 10% of body weight over 6 months, if CXR labs and an ultrasound of the abdomen and pelvis have been completed (Cheson, 2014)
- Unexplained weight loss of 10% of body weight in two months (patient history is acceptable); with second MD visit documenting further decline in weight (Gaddey, 2014)
- Unexplained weight loss of 5% of body weight in six months confirmed by documentation to include the following (Bosch, 2017; Wong, 2014):
  - Related history and abdominal exam
  - CXR
  - Abdominal ultrasound
  - Lab tests, including TSH
  - Colonoscopy if 50-85 years old
- For fever of unknown origin (temperature of ≥ 101 degrees for a minimum of 3 weeks) after standard diagnostic tests are negative (Brown, 2019)
- For suspected or known retroperitoneal fibrosis after complete workup and ultrasound to determine extent of disease (Runowska, 2016)
- To screen patients with dermatomyositis for occult malignancy (Titulauer, 2011)
- For diffuse, unexplained lower extremity edema with negative or inconclusive ultrasound (Hoshino, 2016)
- For suspected May-Thurner syndrome (CTV/MRV preferred) (Ibrahim, 2012; Wuan~~-Ling~~, 2012)

- For further evaluation of an isolated right varicocele with additional signs and symptoms that suggest malignancy or suspicious prior imaging findings (Gleason, 2019)

Indication for combination studies for the initial pre-therapy staging of cancer, OR active monitoring for recurrence as clinically indicated OR evaluation of suspected metastases

- ≤ 5 concurrent studies to include CT or MRI of any of the following areas as appropriate depending on the cancer: Neck, Abdomen, Pelvis, Chest, Brain, Cervical Spine, Thoracic Spine or Lumbar Spine

INDICATIONS FOR MRCP

(ACR, 2019; Akisik, 2013; Lindor, 2015)

- To confirm choledocholithiasis in patients in the acute setting after ultrasound has been completed (ACR, 2019; Buxbaum, 2019; Williams, 2017)
- Suspected acute pancreatitis with atypical signs and symptoms, including equivocal amylase and lipase and diagnosis other than pancreatitis may be possible. (MRCP and CT may be ordered simultaneously in this setting and may be approved) (ACR 2019; Mathur, 2015).
- Pancreatitis by history (greater than 4 weeks), (including pancreatic pseudocyst) with continued abdominal pain suspicious for worsening, or re-exacerbation. (MRCP and CT may be ordered simultaneously in this setting and may be approved) (ACR 2019; Mathur, 2015).
- Evaluation of suspected congenital anomaly of the pancreaticobiliary tract, e.g., aberrant ducts, pancreas divisum or related complications (Griffin, 2012).
- For confirmation of choledochal cyst, after ultrasound has been done (Katabathina, 2014~~5~~).
- For long--term postoperative surveillance for patients with history of choledochal cyst.
- For post-surgical biliary anatomy and complications when ERCP is not possible or contraindicated.
- For the assessment of benign or malignant biliary strictures.
- Evaluation of persistent symptoms when abnormalities are identified on other imaging (e.g., ultrasound, CT, or MRI).
- Evaluation of abnormality related to the pancreatic or biliary tree based on symptoms or laboratory findings and initial imaging has been performed or is contraindicated (e.g., renal failure prevents contrast CT or body habitus limits US).
- Evaluation of pancreatobiliary disease in pregnant patients after ultrasound has been done

INDICATIONS RELEVANT TO ABDOMEN MRI OR MRCP:

Pre-operative evaluation

- For abdominal surgery or procedure.

Post-operative/procedural evaluation

- Follow-up of known or suspected post-operative complication involving only the abdomen.
- A follow-up study to help evaluate a patient's progress after treatment, procedure, intervention, or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed

If ~~an~~ both Abdomen and ~~/~~Pelvis MRI ~~combo~~ are~~is~~ indicated and the Pelvis MRI has already been approved, then the Abdomen MRI may be approved.

BACKGROUND

***Abdominal Magnetic Resonance Imaging (MRI)** is a proven and useful tool for the diagnosis, evaluation, assessment of severity, and follow-up of diseases of the abdomen and avoids exposing the patient to ionizing radiation. MRI may be the best imaging procedure for patients with allergy to radiographic contrast material or renal failure. It may also be the procedure of choice for suspected lesions that require a technique to detect subtle soft-tissue contrast and provide a three dimensional depiction of a lesion. Abdominal MRI studies are usually targeted for further evaluation of indeterminate or questionable findings, identified on more standard imaging exams such as u~~U~~ltrasound (US) and CT.

Magnetic Resonance E~~e~~nterography is an excellent study for assessing submucosal pathology in inflammatory bowel disease. It generates highly reproducible images of the large and small bowel with excellent sensitivity and specificity. It can determine the presence and extent of transmural inflammation, fibrotic disease, and other intra-abdominal complications. It is also useful in assessment of bowel obstruction, abscess formation, tethering and fistula and is less dependent on bowel distention than CT enterography (Arif-Tiwari, 2019).

Magnetic Resonance Cholangiopancreatography (MRCP) is a non-invasive radiologic technique for imaging the biliary and pancreatic ducts in the clinical setting of cholestatic liver function tests, right upper quadrant pain, recurrent pancreatitis, and assessing postoperative complications. MRCP is reliable for the diagnosis of pancreatic ductal abnormalities, e.g., pancreas divisum. It is also used to diagnose bile duct stones and assess the level of biliary obstruction. MRCP is especially useful as an alternative to ERCP (Endoscopic retrograde cholangiopancreatography) when a noninvasive exam is desired or when there is a very small likelihood that the patient will need therapeutic intervention afforded by ERCP. MRCP is unwarranted in patients with known pathology requiring ~~ERCP~~ **ERCP-** mediated intervention. Due to the variable accuracy of ultrasound in detecting choledocholithiasis, preoperative MRCP prior to cholecystectomy has been advocated particularly in the setting of acute cholecystitis, near normal common bile duct diameter (where ultrasound is less accurate) and elevated liver functions, especially alanine amino transaminase (ALT) (Qiu, 2015). Secretin-enhanced MR Cholangiopancreatography has been recently developed to improve the diagnostic quality of MRCP images (Tirkes, 2013).

In diagnosing acute pancreatitis, MRI and MRCP are not as practical as CT. The latter can be performed more quickly and provide better images due to less motion artifact (if patient cannot cooperate with instructions for MRI) in acutely ill patients (ACR, 2019). In selected patients, however, such as those who cannot receive iodinated contrast for CT, MRI/MRCP may be considered or used in a complementary fashion to CT. Complications of chronic pancreatitis using MRCP are ~~well~~ **well-**imaged in cooperative patients.

Cross--sectional imaging (liver ultrasound with Doppler, CT or MRI) should be completed no more than a month prior to the Transjugular intrahepatic Portosystemic shunt (TIPS) to assess for vascular patency and look for hepatic masses or other problems that could complicate the procedure.

Post procedure, an ultrasound of the liver **is performed** a day after to assess shunt patency. Hepatic encephalopathy (HE) is the most common complication and usually occurs 2-3 weeks after insertion of TIPS. Unique complications may include intravascular hemolysis and infection of the shunt. Other complications**, which may require cross-sectional imaging,** can include capsule puncture, intraperitoneal bleed, hepatic infarction, fistula, hematobilia, thrombosis of stent, occlusion, or stent migration ~~and may require cross sectional imaging~~.

~~Follow~~ **Follow**-up and maintenance imaging, if complications **are** suspected, include Doppler ultrasound to assess shunt velocity. If asymptomatic**, a** sonogram **is** performed at 4 weeks post placement, then every 6 months to a year. The gold standard for shunt patency is portal venography, usually reserved if concern for shunt occlusion.

OVERVIEW

MRI of the liver – The liver is a common site of metastatic spread. Patients with a history of known or suspected malignancy, especially tumors from the colon, lung, pancreas and stomach, are at risk for developing hepatocellular carcinoma. Patients with chronic liver disease are also at risk for developing liver cancer and undergo periodic liver screening for focal liver lesion detection, usually with ultrasonography (US). Extra-cellular gadolinium chelate contrast-enhanced MRI is used for evaluating patients with an abnormal US. Patients with hepatic metastases being considered for metastasectomy undergo contrast-enhanced MRI using tissue-specific contrast agents.

Screening for Hepatocellular carcinoma (HCC): AASLD (American Association for the Study of Liver Diseases) recommends screening for HCC with ultrasound every 6 months for patients with hepatitis C and B (Bruix, 2011). The literature differs on the role of AFP (alpha fetoprotein) in the screening of HCC. Some authors argue against its use altogether due to its lack of sensitivity and specificity in detecting HCC (Bruix, 2011; Marquardt, 2016) and instead recommend ultrasound alone for screening. According to Marquardt, the AASLD and EASLD (European Association for the Study of the Liver) "do not endorse its [AFP] use in clinical routine, neither alone nor in combination with ultrasound". This approach is supported by reports of patients with chronic viral hepatitis and elevated AFP but normal livers on imaging. AFP elevation in these cases is due to hepatic inflammation and viral replication (Patil, 2013), not neoplasm. Others advocate for combined ultrasound and AFP for screening (Tan, 2011; Tzartzeva, 2018) citing increased sensitivity compared to ultrasound alone in detecting early--stage HCC particularly in cirrhotic patients. In a meta--analysis by Tzartzeva, et al of thirty-two studies (13,367 patients with cirrhosis) ultrasound with AFP had a 63% sensitivity of detecting early--stage HCC compared to 45% for ultrasound alone. In the final analysis, no literature supports the use of AFP alone in the screening of HCC.

MRI or MRCP for surveillance of cholangiocarcinoma in patients with PSC, other risk factors: Cholangiocarcinoma**, a cancer with an increase in incidence globally,** is ~~a~~ very aggressive ~~cancer~~ with 95% of patients dying within 5 years ~~and is increasing globally~~. Because of the superior sensitivity of

MRI compared with ultrasound to detect cholangiocarcinoma, it is preferred for imaging surveillance. In a large study of PSC patients, regular surveillance was associated with a higher 5-year survival (Bowlus, 2019).

The strongest risk factors for both intrahepatic (iCCA) and extrahepatic (eCCA) cholangiocarcinoma are choledochal cysts ~~for both iCCA and eCCA~~; cirrhosis is a stronger risk factor for iCCA (i.e., iCCA>eCCA); and choledocholithiasis is a stronger risk factor for eCCA (i.e., eCCA~~cca~~>iCCA) (Clements, 2020).

MRI of the adrenal glands – The adrenal glands are susceptible for metastases from various tumors, especially of lung or breast. Adrenal lesions may also represent primary tumors of the adrenal cortex of medulla, both benign and malignant. MRI may be done to distinguish between benign and malignant lesions. Metastases are predominantly hypointense on T1-weighted images and hyperintense on T2-weighted images. Benign lesions, which have high lipid content, exhibit a drop in signal intensity on opposed phase chemical shift imaging.

In general, masses found < 1 cm do not need to be pursued. If an adrenal mass has diagnostic features of a benign mass, such as a myelolipoma (presence of macroscopic fat), cyst, or hemorrhage (masses without enhancement, defined as change in pre- and postcontrast imaging of <10 HU), no additional workup or follow-up imaging is needed. If the mass has a density of 10 HU on unenhanced CT or signal loss compared with the spleen between in- and opposed-phase images of a chemical-shift MRI (CS-MRI) examination, these features are almost always diagnostic of a lipid-rich adenoma, regardless of size. If no benign imaging features but stable for a year or longer, it is very likely benign and needs no further imaging. The role of adrenal mass biopsy is reserved predominantly to confirm a suspected adrenal metastasis; this procedure has been shown to be safe with a low morbidity.

If there are signs or symptoms of pheochromocytoma, ~~plasma~~ plasma-free metanephrine and normetanephrine levels or urinary fractionated metanephrines should be obtained prior to biopsy. Imaging is recommended with CT (MRI as second option) once biochemical evidence confirmed. Otherwise, endocrine workup of an incidental adrenal mass is controversial. Current guidelines from the American Association of Clinical Endocrinologists and the American Association of Endocrine Surgeons recommend an initial biochemical evaluation of all adrenal incidentalomas to exclude pheochromocytoma, subclinical Cushing's syndrome, and hyperaldosteronism.

Genetic syndromes and adrenal tumors - Adrenal cortical carcinoma (ACC) diagnosed during childhood is known to be commonly associated with hereditary syndromes, including Beckwith-Wiedemann (BWS) and Li-Fraumeni syndrome (LFS). In adults, ACC may be associated with Multiple Endocrine Neoplasia 1 (MEN1), familial adenomatous polyposis coli and neurofibromatosis type 1 (NF1); however, there are currently no surveillance imaging recommendations (Tobias, 2012).

MRI of the pancreas –** Pancreatic cancer is thought to have a familial or hereditary component in approximately 10% of cases. Surveillance of individuals with genetic predisposition for pancreatic adenocarcinoma should include known mutation carriers from hereditary syndromes, such as Peutz-Jeghers (10-30% lifetime risk), hereditary pancreatitis (which is associated with genes *PRSS1* and *SPINK1*), familial atypical multiple melanoma and mole syndrome (10-30% risk) or for members of

familial pancreatic cancer with a first-degree family member with pancreatic cancer. In patients who are mutation carriers in *BRCA2* (5-10% lifetime risk), *PALB2* (5-10% lifetime risk), and Lynch syndrome (5-10%) families. Surveillance for patients with *BRCA1* (2% lifetime risk) and *ATM* serine/threonine kinase (1-5% lifetime risk) is limited to those with first- or second-degree relatives with pancreatic cancer. NCCN also recommends screening for individuals with a known pathogenic/likely pathogenic germline variant in a pancreatic susceptibility gene, including *CDKN2A, MLH1, MLH2, MSH6, PMS2, EPCAM* (mismatch repair genes associated with Lynch syndrome), *ATM, PALB2, STK11, TP-53* and a family history (first- or ~~second~~ **second**-degree relative) from the same side of the family; or a family history of exocrine pancreatic cancer in ≥2 first-degree relatives from the same side of the family or ≥3 first- and second-degree relatives from the same side of the family (and at least one is a first-degree relative) (Daly, 2020; Goggins, 2020; NCCN, 2019).

Patients with a family history of pancreatic cancer affecting two first-degree relatives meet criteria for familial pancreatic cancer and are candidates for genetic testing. It should be noted that 90% of families meeting criteria for familial pancreatic cancer, will not have a pathogenic mutation (Sto~~e~~ffel, 2019).

Surveillance of Pancreatic Cysts: Some pancreatic cysts have the potential for malignant transformation to invasive ductal adenocarcinoma; hence the need for intervention vs surveillance. T~~however t~~he data, **however**, is unclear as to the risk of cancer. Cyst surveillance can be offered to patients with asymptomatic cysts presumed to be IPMN's or MCN's. Pancreatic cystic Neoplasms (PCN) make up about 2-45% of the general population.

High risk characteristics for mucinous pancreatic cysts include all of the following: Symptoms, Jaundice secondary to the cyst, acute pancreatitis secondary to the cyst, elevated serum CA 19-9 and no benign cause present, an enhancing mural nodule or solid component within the cyst or pancreas, main pancreatic duct of > 5mm, change in duct caliber~~re~~ with upstream atrophy, size over 3 cm, high grade dysplasia or cancer on cytology. These patients should undergo EUS + -FNA or be referred to a multidisciplinary group for further recommendations (Elta, 2018).

MRI and insulinoma-Insulinomas are rare pancreatic tumors. Localization of the tumor by ultrasound or CT are the preferred initial options once a diagnosis has been made, followed by endoscopic ultrasound or arterial stimulation with hepatic venous sampling. Whipples triad includes symptoms of hypoglycemia, low blood glucose relieved by ingestion of glucose, and benign 90%. Work-up prior to imaging should include a 72-hour fast with serial glucose and insulin levels over this period until the patient becomes symptomatic. An insulin/glucose ratio of greater than 0.3 has been found in virtually all patients with insulinoma or other islet cell tumors (Vinik, 2017).

~~CT~~ **MRI and elevated Liver Function Tests**: For elevated bilirubin, or serum transaminases with or without bilirubin elevation, US is the initial recommended test to assess for duct dila~~i~~tation which might lead to ERCP or MRCP, vs other causes which might necessitate further lab testing or liver biopsy (Kwo, 2017).

MRI of the kidney – MRI in renal imaging has been used to differentiate benign lesions versus malignant lesions in patients unable to undergo CT scanning with contrast media or in cases where the CT findings were questionable. Initial evaluation of renal lesions is often undertaken with ultrasound. MRI can have additional diagnostic value in the evaluation of lesions with minimal amounts of fat or with intracellular fat. MRI may have a higher accuracy than CT in the evaluation of early lymph node spread. Although MRI of the kidney has not yet found broad clinical application, it may have an increasing role in the management of patients with renal disease.

Recommendations for follow up of a complex cystic renal mass are made using Bosniak criteria (Muglia, 2014):

- Bosniak I (water density 0-20 HU); no further follow--up
- Bosniak II (one or a few thin septations, small or fine calcifications, hyperdense cysts up to 3 cm); no further follow--up
- Bosniak IIF felt to be benign but too complex to be diagnosed with certainty; image at 6 and 12 months, then annually for 5 years if no progression
- Bosniak III thick-walled cystic lesions with wall or septal enhancement; resection favored vs conservative management and RFA in select cases (Richard, 2017)
- Bosniak IV malignant cystic renal mass with enhancing soft tissue components; resection favored; malignant until proven otherwise

MRI of the spleen – Among some radiologists, the spleen is considered a 'forgotten organ' although it is included and demonstrated on every abdominal CT and MRI. Malignant tumors of the spleen are rare; malignant lymphomas are the most common and are usually a manifestation of generalized lymphoma. Splenic metastases are predominantly hypointense on T1-weighted images and hyperintense on T2-weighted images, and MRI is used for the detection of necrotic or hemorrhagic metastases.

MRI for the evaluation of vascular abnormalities such as renal artery stenosis and celiac/superior mesenteric artery stenosis (in chronic mesenteric ischemia) - Doppler Ultrasound, MRA, or CTA should be considered as the preferred imaging modalities.

Imaging of hernias: Most hernias are diagnosed clinically with imaging recommended for the diagnosis of occult hernias or in the evaluation of hernia complications, such as bowel obstruction or strangulation. To detect occult hernias, ultrasound is a ~~first~~ **first**-line study with a sensitivity of 86% and specificity of 77%, compared to 80% sensitivity and 65% specificity for CT (Robinson, 2013). According to Miller, et al "Magnetic resonance imaging is generally not considered a first- or even second-line evaluation modality for hernias…" (Miller, 2014). Based on this analysis, MRI is recommended only when ultrasound and CT have been performed and fail to make a diagnosis.

Ultrasound: Ultrasound is the initial imaging technique used for screening suspected biliary or pancreatic disease, but it has limited ability to characterize abnormalities in the biliary and pancreatic ducts.

Endoscopic retrograde cholangiopancreatography (ERCP): ERCP can combine diagnosis with therapeutic intervention, e.g., removal of stones, but it is an invasive procedure that carries significant risk of complications, e.g., pancreatitis. ERCP is also technically challenging in patients with post-surgical biliary and/or surgical anastomoses.

POLICY HISTORY

Date	Summary
April 2021	Updated for concordance w/CTA abdomen/pelvis
May 2020	**MRCP:** • Added to confirm choledocholithiasis in the acute setting after ultrasound completed • Suspected acute pancreatitis with atypical presentation and other diagnosis possible • To confirm choledochal cyst or long-term post op surveillance • For assessment of suspected biliary strictures • For post op anatomy when ERCP cannot be done **MRI:** • Adrenal-added suspected adrenal secreting tumor after full work up • Surveillance for paraganglioma syndromes • Surveillance primary sclerosing cholangitis • Elastography to stage hepatic fibrosis • Beckwidth Wiedemann after abnormal ultrasound • Revised guidelines for follow up of pancreatic cystic lesions/intraductal papillary mucinous neoplasm • Revised based on NCCN 2019 guidelines for increased lifetime risk of developing pancreatic cancer • Added surveillance for MEN 1 • Added for localization of an insulinoma once dx confirmed • Added surveillance for VHL, renal and Birt-Hogg syndrome • Added MRU for recurrent UTI's in females • Added a separate section on hernias • Improved info on inflammatory bowel disease, MRE • Added imaging for monitoring therapy in IBD • Under other indications added: to locate a pheochromocytoma when clear biochemical evidence; FUO: retroperitoneal fibrosis; added dermatomyositis; added May Thurner; added isolated right varicocele (only with additional signs and symptoms) • Comments with new section on surveillance of cholangiocarcinoma, genetic syndromes and adrenal tumors, Pancreatic cancer risk

	factors, surveillance of panc cysts, Insulioma work up, and CT and elevated LFT's.
May 2019	• Created combo guideline by absorbing MRCP guideline within the Abdomen MRI • Added Note: "A single authorization for CPT code 74181, 74182, 74183, S8037 includes imaging of the biliary tree and liver. Multiple authorizations are not required. When a separate MRCP and MRI abdomen exam is requested, documentation requires a medical reason that clearly indicates why additional MRI imaging of the abdomen is needed". • Added indications for evaluation of an organ or abnormality seen on previous imaging; liver lesions; jaundice or abnormal liver function; follow up of suspected adenoma and focal nodular hyperplasia; surveillance of HCC in patients who have received liver-directed therapy/surgical resection/medical treatment or transplant; pancreatic cystic lesion; intraductal papillary mucinous neoplasm and mucinous cystic neoplasm; pancreatic cancer risk; known necrotizing pancreatitis; renal mass; and spleen • Changed size parameters for adrenal mass: ○ Old: Suspected adrenal mass > 4 cm and there is a history of primary malignancy ○ Revised: Suspected adrenal mass ≥ 1 cm with no history of malignancy; if mass ≥ 4 cm and no diagnosis of cancer, can approve for preoperative planning; for mass < 4 cm with history of malignancy • Added/modified Background information and updated references

~~May 2019~~

- ~~Created combo guideline by absorbing MRCP guideline within the Abdomen MRI~~
- ~~Added Note: "A single authorization for CPT code 74181, 74182, 74183, S8037 includes imaging of the biliary tree and liver. Multiple authorizations are not required. When a separate MRCP and MRI abdomen exam is requested, documentation requires a medical reason that clearly indicates why additional MRI imaging of the abdomen is needed".~~
- ~~Added indications for evaluation of an organ or abnormality seen on previous imaging; liver lesions; jaundice or abnormal liver function; follow up of suspected adenoma and focal nodular hyperplasia; surveillance of HCC in patients who have received liver-directed therapy/surgical resection/medical treatment or transplant; pancreatic cystic lesion; intraductal papillary mucinous neoplasm and mucinous cystic neoplasm; pancreatic cancer risk; known necrotizing pancreatitis; renal mass; and spleen~~

- Changed size parameters for adrenal mass:
    - Old: Suspected adrenal mass > 4 cm and there is a history of primary malignancy
    - Revised: Suspected adrenal mass ≥ 1 cm with no history of malignancy; if mass ≥ 4 cm and no diagnosis of cancer, can approve for preoperative planning; for mass < 4 cm with history of malignancy
- Added/modified Background information and updated references

May 2020

MRCP:

- Added to confirm choledocholithiasis in the acute setting after ultrasound completed
- Suspected acute pancreatitis with atypical presentation and other diagnosis possible
- To confirm choledochal cyst or long-term post op surveillance
- For assessment of suspected biliary strictures
- For post op anatomy when ERCP cannot be done

MRI:

- Adrenal-added suspected adrenal secreting tumor after full work up
- Surveillance for paraganglioma syndromes
- Surveillance primary sclerosing cholangitis
- Elastography to stage hepatic fibrosis
- Beckwidth Wiedemann after abnormal ultrasound
- Revised guidelines for follow-up of pancreatic cystic lesions/intraductal papillary mucinous neoplasm
- Revised based on NCCN 2019 guidelines for increased lifetime risk of developing pancreatic cancer
- Added surveillance for MEN 1
- Added for localization of an insulinoma once dx confirmed
- Added surveillance for VHL, renal and Birt-Hogg syndrome
- Added MRU for recurrent UTI's in females
- Added a separate section on hernias
- Improved info on inflammatory bowel disease, MRE
- Added imaging for monitoring therapy in IBD
- Under other indications added: to locate a pheochromocytoma when clear biochemical evidence; FUO: retroperitoneal fibrosis; added dermatomyositis; added May Thurner; added isolated right varicocele (only with additional signs and symptoms)
- Comments with new section on surveillance of cholangiocarcinoma, genetic syndromes and adrenal tumors, Pancreatic cancer risk factors, surveillance of panc cysts, Insulioma work up, and CT and elevated LFT's.

REFERENCES

Abdelmohsen M, El-sharkawy M. Imaging of Hernias. *Hernia*. August 30, 2017. https://www.intechopen.com/books/hernia/imaging-of-hernias.

Adeyemo D, Hutchinson R. Preoperative staging of rectal cancer: Pelvic MRI plus abdomen and pelvic CT. Does extrahepatic abdomen imaging matter: A case for routine thoracic CT. *Colorectal Dis*. 2009; 11(3):259-263.

Akisik MF, Jennings SJ, Aisen AM, et al. MRCP in patient care: A prospective survey of gastroenterologists. *AJR Am J Roentgenol*. 2013; 201(3):573-577. doi: 10.2214/AJR.12.9900.

American College of Obstetrics and Gynecologists (ACOG) Practice Bulletin; Clinical Management Guidelines for Obstetricians-Gynecologists: Polycystic Ovary Syndrome. June 2018; 194.

American College of Radiology. ACR Appropriateness Criteria®. https://acsearch.acr.org/list. 2019.

American College of Radiology. ACR Appropriateness Criteria®. https://acsearch.acr.org/list. 2020.

American College of Radiology (ACR). ACR Appropriateness Criteria®. https://acsearch.acr.org/list. https://acsearch.acr.org/docs/69468/Narrative/. Published 2017. Retrieved January 28, 2018.

Arif-Tiwari H, Taylor P, Kalb BT, Martin DR. Magnetic resonance enterography in inflammatory bowel disease. *Appl Radiol*. 2019;48(1):9-15.

~~Arif-Tiwari H, Taylor P, Kalb BT, et al. Magnetic resonance enterography in inflammatory bowel disease. *Applied Radiol*. 2019 Jan-Feb; pg8.~~

Benn DE, Robinson BG, et al. Clinical Manifestations of paraganglioma syndrome types 1-5. *Thematic Rev*. 2015; 22(4).

Bilgin M, Balci NC, Momtahen AJ, et al. MRI and MRCP findings of the pancreas in patients with diabetes mellitus: Compared analysis with pancreatic exocrine function determined by fecal elastase 1. *J Clin Gastroenterol*. 2009; 43(2):165-170. doi: 10.1097/MCG.0b013e3181587912.

Bosch X, Monclus E, et al. Unintentional weight loss: Clinical characteristics and otucomes in a prospective cohort of 2677 patients. *PloS One*. 2017 Apr 7; 12(4).

Bourgioti C, Chatoupis K, Moulopoulos LA. Current imaging strategies for the evaluation of uterine cervical cancer. *World J Radiol*. April 28, 2016; 8(4):342-54.

Bowlus CL, Lim JK, et al. AGA Clinical Practice Update on Surveillance for Hepatobiliary Cancers in Patients with Primary Sclerosing Cholangitis; Expert Review. *Clin Gastroenterol Hapatol*. Nov 2019; 17(12):2416-2422.

Brown I, Finnigan NA. Fever of Unknown Origin (FUO). StatPearls (Internet); December 16, 2019.

Bruix J, Sherman M, American Association for the Study of Liver Diseases. Management of hepatocellular carcinoma: An Update. AASLD Practice Guideline. *Hepatology*. 2011; 53(3):1020-1022. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3084991/.

Buxbaum JL, Abbas SM, et al. ASGE guideline on the role of endoscopy in the evaluation and management of choledocholithiasis. *Gastroint Endosc*. 2019; 89(6).

Byrne MF. Management of benign biliary strictures. *Gastroenterol Hepatol*. 2008; 4(10):694-697. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3104180/.

Cao HS, Kellogg B, Lowy A, et al. Cystic neoplasms of the pancreas. *Surg Oncol Clin N Am*. April 2010; 19(2):267-295. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4383087/. Retrieved January 27, 2017.

Cartwright S, Knudson MP. Diagnostic imaging of acute abdominal pain in adults. *Am Fam Physician.* April 1, 2015; 91(7):452-459. https://www.aafp.org/afp/2015/0401/p452.html. February 7, 2018.

Cheson BD, Fisher RI, Barrington SF, et al. Recommendations for initial evaluation, staging, and response assessment of Hodgkin and non-Hodgkin lymphoma: The Lugano classification. *JCO*. 2014;32(27):3059-3067. doi:10.1200/JCO.2013.54.8800.

Clements O, Eliahoo J, et al. Risk Factors for Intrahepatic and Extrahepatic cholangiocarcinoma: A systematic review and meta-analysis. *J Hepatol*. 2020; 72(1).

Ctvrtlik F, Koranda P, Schovanek J, et al. Current diagnostic imaging of pheochromocytomas and implications for therapeutic strategy. *Exp Ther Med.* 2018 Apr; 15(4):3151–60.

Daly MB, Oilarski RP. NCCN Guidelines Insights: Genetic/Familial High-Risk Assessment: Breast, Ovarian and Pancreatic, V1.2020. *J Natl Compre Cancer Netw*.2020; 18(4).

Delaney L, Applegate KE, Karmazyn B, et al. MR cholangiopancreatography in children: Feasibility, safety, and initial experience. *Pediatr Radiol.* 2008; 38(1):64-75. doi: 10.1007/s00247-007-0644-5.

Del Chiaro M, Besselink MG, Scholten L, et al. European evidence-based guidelines on pancreatic cystic neoplasms. *Gut*. 2018 May; 67(5):789-804.

Elta GH, Enestvedt BK, Sauer BG, et al. ACG clinical guideline: Diagnosis and management of pancreatic cysts. *Am J Gastroenterol*. 2018; 1-16.

Fassnacht M, Dekkers O, Else T, et al. European Society of Endocrinology Clinical Practice Guidelines on the management of adrenocortical carcinoma in adults, in collaboration with the European Network for the Study of Adrenal Tumors. *Eur J Endocrinol*. 2018 Oct 1; 179(4):G1-46.

Gaddey HL, Holder K. Unintentional weight loss in older adults. *Am Fam Physician*. 2014;89(9):718-722.

Girometti R, Brondani G, Cereser L, et al. Post-cholecystectomy syndrome: Spectrum of biliary findings at magnetic resonance cholangiopancreatography. *Br J Radiol.* 2010 Apr; 83(988):351-61. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3473449/.

Gleason A, Bishop K, et al. Isolated Right-sided varicocele: Is Further Workup Necessary. *AJR*. 2019; 212(4).

Goggins M, Overbeek KA, et al. Management of patients with increased risk for familial pancreatic cancer: Updated recommendations from the International Cancer of the Pancreas (CAPS) Consortium. *Gut*. 2020; 69:7-17.

Gotthardt D, Chahoud F, Sauer P. Primary sclerosing cholangitis: Diagnostic and therapeutic problems. *Digestive Disorders*. 2011; 29(1):41-45. doi: 10.1159/000331074.

Griffin N, Charles-Edwards G, Grant LA. Magnetic resonance cholangiopancreatography: The ABC of MRCP. *Insights Imaging*. 2012; 3(1):11-21. doi: 10.1007/s13244-011-0129-9.

Gupta S, Hyunseon C, et al. The ABC's of BHD. An In-Depth Review of Birt-Hogg-Syndrome. *AJR*. 2017 Dec; 209(6).

Halligan S, Parker SG, et al. Imaging complex ventral hernias, their surgical repair, and their complications. *Eur Radiol*. 2018; (8):3570-3569.

Han Y, Lee H, Kang JS, et al. Progression of pancreatic branch duct intraductal papillary mucinous neoplasm associates with cyst size. *Gastroenterology*. 2018 Feb; 154(3):576-84.

Herts BR, Silverman SG, Hindman NM, et al. Management of the incidental renal mass on CT: A white paper of the ACR incidental findings committee. *J Am Coll Radiol*. 2018 Feb; 15(2):264-73.

Hoodeshanas S, Yin M, et al. Magnetic Resonance Elastography of Liver-Current Update. *Top Magn Reson Imaging.* 2018 Oct; 27(5):319-333.

Hoshino Y, Machida M, Shimano S, et al. Unilateral Leg Swelling: Differential Diagnostic Issue other than Deep Vein Thrombosis. *J Gen Fam Med*. 2016; 17(4):311-14.

Hu C, Hart SN, Polley EC, et al. Association between inherited germline mutations in cancer predisposition genes and risk of pancreatic cancer. *JAMA*. 2018 Jun; 319(23):2401-09.

Ibrahim W, Zakareya AS, et al. Endovascular Management of May-Thurner Syndrome. *Ann Vasc. Dis*. 2012; 5(2):217-221.

Jiang H, Zheng T, Duan T, et al. Non-invasive *in vivo* imaging grading of liver fibrosis. *J Clin Transl Hepatol.* 2018 Jun 28; 6(2):198-207.

Kalish JM, Doros L, et al. Surveillance Recommendations for Children with Overgrowth Syndromes and Predisposition to Wilms Tumors and Hepatoblastoma. *Clinc Cancer Res*. 2017 Jul 1; 23(13).

Kamilaris CD, Stratakis CA. Multiple Endocrine Neoplasia Type 1 (MEN1): An Update and the Significance of Early Genetic and Clinical Diagnosis. *Front Endocrinol (Lausanne).* 2019; 10:339.

Katabathina VS, Dasyam AK, Dasyam N, et al. Adult bile duct strictures: Role of MR imaging and MR cholangiopan - creatography in characterization. *RadioGraphics.* 2014; 34:565-586. doi: 10.1148/rg.343125211.

Kennedy P, Wagner M, Castera L, et al. Quantitative elastography methods in liver disease: Current evidence and future directions. *Radiology.* 2018 Mar; 286(3):738-63.

Kilcoyne A, Kaplan JL, Gee MS. Inflammatory bowel disease imaging: Current practice and future directions. *World J Gastroenterol*. 2016 Jan 21; 22(3):917-32.

Kwo PY, Cohen SM, et al. ACG Clinical Guideline: Evaluation of Abnormal Liver Chemistries. *Am J Gastroenerol*. 2017; 112:18-35.

Labranche R, Gilbert G, Cerny M, et al. Liver iron quantification with MR imaging: A primer for radiologists. *Radiographics*. 2018 Mar; 38(2).

Lassandro F, Iasiello F, Pizza NL, et al. Abdominal hernias: Radiological features. *World J Gastrointest Endosc*. June 16, 2011; 3(6):110-117. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3158902/. Retrieved February 8, 2018.

Lee SS, Park SH. Radiologic evaluation of nonalcoholic fatty liver disease. *World J Gastroenterol*. 2014 Jun 21; 20(23):7392-7402.

Lenders JW, Duh QY, Eisenhofer G, et al. Pheochromocytoma and paraganglioma: An endocrine society clinical practice guideline. *J Clin Endocrinol Metab*. 2014 Jun; 99(6):1915-42.

Lichtenstein GR, Loftus EV, et al. ACG Clinical Guideline: Management of Crohn's Disease in Adults. *Am J Gastroenterol*. 2018; 113(4).

Lindor K, Kowdley KV, Harrison ME. ACG guidelines. Primary sclerosing cholangitis. [Published online ahead of print April 14, 2015]. Am J Gastroenterol. 2015. https://gi.org/guideline/primary-sclerosing-cholangitis/. Retrieved January 28, 2018.

Marquardt JU, Nguyen-Tat M, Galle PR, et al. Surveillance of hepatocellular carcinoma and diagnostic algorithms in patients with liver cirrhosis. *Visc Med*. April 2016; 32(2):110-115. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4926879/.

Marrero JA, Ahn J, Rajender Reddy K, et al. ACG clinical guideline: The diagnosis and management of focal liver lesions. *Am J Gastroentrol*. 2014 Sep; 109(():1328-47.

Mathur A, Whitaker A, Kolli H, et al. Acute pancreatitis with normal serum lipase and amylase: A rare presentation. *JOP. Journal of the Pancreas*. September 30, 2015. http://pancreas.imedpub.com/acute-pancreatitis-with-normal-serum-lipase-and-amylase-a-rare-presentation.php?aid=7509.

Mayo-Smith WW, Song JH, Boland GL, et al. Management of incidental adrenal masses: A white paper of the ACR incidental findings committee. *J Am Coll Radiol*. 2017 Aug; 14(8):1038-44.

McMahon CJ. The relative roles of magnetic resonance cholangiopancreatography (MRCP) and endoscopic ultrasound in diagnosis of common bile duct calculi: A critically appraised topic. *Abdom Imaging.* 2008; 33(1):6-9. doi: 10.1007/s00261-007-9304-3.

Meek CL, Bravis V, et al. Polycystic ovary syndrome and the differential diagnosis of hyperandrogenism. The Obstetrician and Gynecologist. 2013.

Megibow AJ, Baker ME, Morgan DE, et al. Management of incidental pancreatic cysts: A white paper of the ACR incidental findings committee. *J Am Coll Radiol*. 2017 July; 14(7):911-23.

Menko FH, van Steensel MA, Giraud S, et al. Birt-Hogg Dube syndrome: Diagnosis and management. *Lancet Oncol*. 2009; 10(12):1199–1206.

Miller J, Cho J, Michael MJ, et al. Role of imaging in the diagnosis of occult hernias. *JAMA Surg*. October 2014; 149(10):1077-1080. doi: 10.1001/jamasurg.2014.484. https://jamanetwork.com/journals/jamasurgery/fullarticle/1893806. Retrieved February 15, 2018.

Muglia VF, Westphalen AC. Bosniak classification for complex renal cysts: History and critical analysis. *Radiol Bras*. 2014 Nov-Dec; 47(6):368-73.

Mungai F, Berti V, Colagrande S. Bile leak after elective laparoscopic cholecystectomy: role of MR imaging. *J Radiol Case Rep*. January 2013; 7(1):25-32. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3557131/.

National Comprehensive Cancer Network (NCCN). Basal Cell Skin Cancer. 2018.

National Comprehensive Cancer Network (NCCN). NCCN Imaging Appropriate Use Criteria (NCCN Imaging AUC). 2019. https://www.nccn.org/professionals/imaging/default.aspx.

Pandey P, Pandey A, et al. Follow-Up of Incidentally Detected Pancreatic Cystic Neoplasms: Do Baseline MRI and CT Features Predict Cyst Growth? *Radiol*. 2019; 292(3).

Patil M, Sheth KA, Adarsh CK. Elevated alpha fetoprotein, no hepatocellular carcinoma. *J Clin Exp Hepatol.* June 2013; 3(2):162-164. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3940329/. Retrieved February 6, 2018.

Pena AS, Witchel SF, et al. Adolescent polycystic ovary syndrome according to the international evidence-based guideline. *BMC Med*. 2020; 18:72.

Qiu Y, Yang Z, Li Z. Is preoperative MRCP necessary for patients with gallstones? An analysis of the factors related to missed diagnosis of choledocholithiasis by preoperative ultrasound. *BMC Gastroenterol*. 2015; 15:158. Retrieved 1/27/17 from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4650402/. Retrieved January 27, 2017.

Richard PO, Patrick PD, et al. CUA guideline on the management of cystic renal lesions. *Can Urol Assoc J.* 2017 March-April; 11(3-4).

Robinson A. A systematic review and meta-analysis of the role of radiology in the diagnosis of occult inguinal hernia. *Surg Endosc*. January 2013; 27(1):11-18. https://www.ncbi.nlm.nih.gov/pubmed/22733195. Retrieved February 8, 2018.

Rubin DT, Ananthakrishnan AN, Siegel CA, Sauer BG, Long MD. ACG clinical guideline: Ulcerative colitis in adults. *Am J Gastroenterol*. 2019;114(3):384-413. doi:10.14309/ajg.0000000000000152.

Runowska M, Majewski D, et al. Retroperitoneal fibrosis-the state-of-the-art. *Reumatologia*. 2016; 54(5):256-263.

Shah A, Mourad MM, Bramhall SR. Acute pancreatitis: Current perspectives on diagnosis and management. *J Inflamm Res*. 2018; 11:77-85. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5849938/#.

Singh A, Mann HS, Thukral CL, et al. Diagnostic accuracy of MRCP as compared to Ultrasound/CT in patients with obstructive jaundice. *J Clin Diagn Res*. March 2014; 8(3):103-107. http://pubmedcentralcanada.ca/pmcc/articles/PMC4003596/. Retrieved January 27, 2017.

Stoffel EM, McKernin SE, Brand R, et al. Evaluating susceptibility to pancreatic cancer: ASCO provisional clinical opinion. *J Clin Oncol*. 2019 Jan; 37(2):153-164.

Syngal S, Brand RE, Church JM, et al. ACG clinical guideline: Genetic testing and management of hereditary gastrointestinal cancer syndromes. *Am J Gastroenterol*. 2015 Feb; 110(2):223-62.

Tan CH, Low SC, Thng CH. APASL and AASLD consensus guidelines on imaging diagnosis of hepatocellular carcinoma: A review. [Published online ahead of print April 19, 2011]. Int J

Hepatol. 2011. doi: 10.4061/2011/519783. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3170828/. Retrieved February 14, 2018.

Tenner S, Baillie J, DeWitt J, et al. Management of Acute Pancreatitis. *Am J Gastroenterol*. 2013; 108:1400-1415. doi:10.1038/ajg.2013.218.

Terzolo M, Ali A, Reimondo G, et al. The value of dehydroepiandrosterone sulfate measurement in the differentiation between benign and malignant adrenal masses. *Eur J Endocrinol*. 2000 June; 142:611-617.

~~Tobias E. Association of Adrenocortical Carcinoma with Familial Cancer Susceptibility Syndromes. *Mol Cell Endcrinol*. 2012 March 31; 351(1):66-70.~~

Thut D, Smolinski S, Morrow M, et al. A diagnostic approach to splenic lesions. *Applied Radiol*. 2017 Feb; pp7-22.

Tirkes T, Sandrasegaran K, Sanyal R, et al. Secretin-enhanced MR cholangiopancreatography: Spectrum of findings. *Radiographics.* 2013; 33(7):1889-1906. doi: 10.1148/rg.337125014.

Titulauer MJ, Soffietti, et al. Screening for tumours in paraneoplastic Syndromes: Report of an EFNS task force. *Eur J Neurol*. 2011; 18(19).

Tobias E. Association of Adrenocortical Carcinoma with Familial Cancer Susceptibility Syndromes. *Mol Cell Endcrinol*. 2012 March 31; 351(1):66-70.

Tonolini M, Ippilotio S. Cross sectional imaging of complicated urinary tract infections affecting the lower urinary tract and male genital organs. *Insight Imaging*. 2016; 7(5).

Trotter SC, Sroa N, Winkelmann RR, et al. A global review of melanoma follow-up guidelines. *J Clin Aesthet Dermatol*. September 2013; 6(9):18-26. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3780800/. Retrieved February 7, 2018.

Tzartzeva K, Obi J, Rich NE, et al. Surveillance imaging and alpha fetoprotein for early detection of hepatocellular carcinoma in patients with cirrhosis: A meta-analysis. [Published online ahead of print February 6, 2018]. Gastroenterology. May 2018; 154(6):1706-1718.ei. https://www.ncbi.nlm.nih.gov/pubmed/?term=Tzartzeva%20K%5BAuthor%5D&cauthor=true&cauthor_uid=29425931. Retrieved February 14, 2018.

Vagvala SH, O'Connor SD. Imaging of abnormal liver function tests. *Clinical Liver Disease*. 2018 May; 11(5):128-134.

Varshney N, Kebede AA, et al. A Review of Von Hippel-Lindau Syndrome. *J Kidney Cancer VHL*. 2017; 4(3):20-29.

Vinik A, Feliberti E, et al. Insulinomas. *Endotext (Internet).* July 3, 2017.

Vos N, Oyen R. Renal angiomyolipoma: The good, the bad, and the ugly. *J Belg Soc Radiol*. 2018 Apr 20; 102(1):41.

Wan J, Ouyang Y, Yu C, et al. Comparison of EUS with MRCP in idiopathic acute pancreatitis: A systematic review and meta-analysis. *Gastrointest Endosc.* 2018 May; 87(5):1180-88.

Weber C, Kuhlencordt R, Grotelueschen R, et al. Magnetic resonance cholangiopancreatography in the diagnosis of primary sclerosing cholangitis. *Endoscopy*. 2008; 40(9):739-745. doi: 10.1055/s-2008-1077509.

Williams E, Beckingham I, et al. Updated guideline on the management of common bile duct stones (CBDS). *Gut*. 2017; 66:765-782.

Wong CJ. Involuntary weight loss. *Med Clin North Am*. 2014;98(3):625-643. doi:10.1016/j.mcna.2014.01.012.

Wood JC. Guidelines for quantifying iron overload. [Published online ahead of print November 18, 2014]. Hematol Am Soc Hematol Educ Program. 2014 Dec 5; (1):210-215.

Wu W-LM, Tzeng W-S, Wu R-H, et al. Comprehensive MDCT evaluation of patients with suspected May-Thurner syndrome. *American Journal of Roentgenology*. 2012;199(5):W638-W645. doi:10.2214/AJR.11.8040.

Yu XR, Huang WY, Zhang BY, et al. Differentiation of infiltrative cholangiocarcinoma from benign common bile duct stricture using three dimensional dynamic contrast-enhanced MRI with MRCP. *Clin Radiol*. June 2014; 69(6):567-573. http://www.clinicalradiologyonline.net/article/S0009-9260(14)00023-3/abstract. Retrieved January 27, 2017.

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GENERAL INFORMATION

It is an expectation that all patients receive care/services from a licensed clinician. All appropriate supporting documentation, including recent pertinent office visit notes, laboratory data, and results of any special testing must be provided. If applicable: All prior relevant imaging results and the reason that alternative imaging cannot be performed must be included in the documentation submitted.