

Running head: MATHEW CLINICAL CASE STUDY

Comprehensive Clinical Case Study: Acute Cholecystitis

Roshini Mathew, RN, BSN

Wright State University-Miami Valley College of Nursing and Health

NUR 7201

July 11, 2013

MATHEW CLINICAL CASE STUDY

Comprehensive Clinical Case Study: Acute Cholecystitis

History and Physical

Source of Information

Information was obtained from the patient, who is a reliable source of information.

Primary language is English.

Chief Complaint

“I have sharp pain along the right upper and middle part of my belly.”

History of Present Illness

This is a 66-year old Caucasian male presenting to the emergency department (ER) with right upper quadrant pain that started earlier this afternoon. The pain started abruptly after lunch at McDonald's today, approximately at 1:00PM. The pain rating is a ten out of ten (on a pain scale of zero to ten), described as “tender,” and it radiates to the right shoulder area. The intensity of the pain is steady and does not fluctuate. The pain has been present for six hours now and that is why the patient sought to seek medical advice. The patient took tramadol 50 mg PO after the pain started in an attempt to relieve pain, but the intervention was not effective. The pain is not aggravated by walking, lying, or coughing. “Nothing” seems to improve the pain. The patient denies any trauma to the abdomen or a recent fall. He states the same type of pain occurred about eight months ago, but the pain resolved spontaneously and he did not follow-up with his physician. He believes the previous pain also occurred after eating a meal. The patient states he felt “funny during the day” yesterday and had no appetite and was nauseous. He also had one episode of vomiting earlier this morning, around 10:00 AM. He did not eat dinner yesterday and breakfast today due to nausea. No other pain or discomfort is reported. He denies recent illnesses or any changes to his medical regimen. Denies history of jaundice.

MATHEW CLINICAL CASE STUDY

Medications

Metoprolol 25 mg PO BID, trimterene-hydrochlorothiazide 37.5-25 mg PO daily, simvastatin 40mg PO daily, glipizide 5 mg PO daily, omeprazole 20 mg PO daily, daily multivitamin one tab PO, tramadol 50 mg PO every six hours PRN pain. Uses meditation and music for relaxation. No other use of alternative or complementary therapies reported.

Medical History

Childhood illnesses. None

Adult illnesses. Hypertension diagnosed at age 40; diabetes diagnosed at age 43; peptic ulcer disease diagnosed at age 42

Surgeries/Procedures. Tonsillectomy and adenoidectomy at age of 10; umbilical hernia repair in 2008; bilateral knee arthroscopy in 2010

Allergies. No known food or drug allergies

Immunizations. Up-to-date on immunizations. Last tetanus-diphtheria booster received 2005. Flu and pneumonia vaccine received in January 2013.

Personal/Social History

The patient has been “happily” married for 45 years and has one son. He is a retired paramedic, but currently works as a fire inspector on a part-time basis. No concern of financial or work-related stress is shared. Denies use of alcohol, illicit drugs, or smoking. The patient is fairly active and independent, although he is limited by his bilateral knee pain at times. He frequently prefers to climb stairs rather than using the elevator and enjoys playing golf on the weekends. Other leisure time activities include jogging, gardening, and reading self-improvement books. He lives with his wife in a split-style two story home.

Family History

MATHEW CLINICAL CASE STUDY

The patient's mother passed away at the age of 68 from congestive heart failure complications. She had a history of hypertension, hyperlipidemia, diabetes, and cholelithiasis. The father died of lung cancer at age of 74. Father's medical history consists of hypertension, cirrhosis, and renal failure. The patient has one brother who died from end-stage renal disease at the age of 70. The patient does not know the cause of death of his grandparents.

Review of Symptoms

General. The patient states he is in good health and blood pressure is well controlled with home medication. He checks his blood pressure daily. Independent with medication management. States he had chills over night, but no fever. He does have a loss of appetite for the past two days with nausea and vomiting. No recent weight loss or weight gain.

Neurological. Denies confusion, dizziness, tremors, numbness/tingling, or falls.

HEENT. Head: Denies headache or trauma to the head and face. Eyes/Ears: Denies visual or hearing deficits, tinnitus, discharge, and pain. Nose: Having mild nasal congestion due to sinus pain. Throat: Denies sore throat and difficulty swallowing.

Neck. Denies pain, stiffness, or swollen lymph nodes.

Respiratory. Denies dyspnea, orthopnea, shortness of breath, coughing, or pain during inspiration/expiration.

Cardiovascular. No chest discomfort/pain, diaphoresis, palpitations, dizziness, lightheadedness or swelling.

Gastrointestinal/Abdominal. States has poor appetite, usual flatulence. Nausea past two days, one episode of vomiting today. Mild heartburn at times after eating. Having right upper abdomen pain that started abruptly this afternoon at 1:00 PM, after having lunch at McDonald's. Rating the pain ten out of ten, and describing it as "tender" and "sharp." Denies hiccoughs,

MATHEW CLINICAL CASE STUDY

diarrhea, constipation, abdominal tenderness, jaundice, dark urine, light stools, or rectal bleeding. Last bowel movement yesterday which was soft and formed brown stool.

Genitourinary. No urinary urgency, frequency, hesitancy, or burning. No history of urinary tract infections. Denies bladder spasms, stress/night incontinence, flank pain. States urine appearance is clear, straw colored, without odor.

Genitalia. Circumcised male. Sexually active with his wife. Denies any scrotal or penile lumps, lesions, edema, or drainage. Performs self-testicular frequently.

Musculoskeletal. Reports having right shoulder pain that is radiating from his right upper abdomen area which also started abruptly this afternoon at the time of right upper abdomen pain. The pain in the right shoulder is “dull” with a pain rating of five out of ten. The pain is not affected by activity or with movement. Denies history of trauma with or without falls, fractures, or any other muscle or joint pain.

Integumentary. Denies itching, burning, open lesions, blistering, or thinning of skin or nails.

Psychosocial. Denies depression, mood alteration, outbursts of anger, impulsive behavior, anxiety, and social withdrawal.

Hematologic. No active bleeding issues. Denies history of anemia.

Endocrine. Denies confusion, weakness, diaphoresis, increased thirst or urination, irritability, weight loss/gain, or thinning of hair.

Physical Examination

General. The patient is alert, appropriate, and pleasant. Patient is slightly anxious due to pain in right upper quadrant (RUQ) of the abdomen. Height is five feet seven inches, weight is 210 pounds, Body Mass Index (BMI) is 32.9 kg/m².

MATHEW CLINICAL CASE STUDY

Vital signs. Blood pressure is 158/84 mmHg, right arm sitting; apical pulse is 78 beats per minute and regular; respiratory rate is 18 breaths per minute with normal depth and effort; temperature is 99.5°F oral; oxygen level of 98% on room air.

Neurological. Alert and oriented to name, place, person, and time. following commands appropriately. Cranial nerves II – XII intact. Face is symmetrical. Speech is clear, concise, without aphasia or dysarthria. Bilateral pupils are equal (3mm), round, normal, reactive to light. Corneal reflex present and vision intact. Short and long term memory intact.

HEENT. Head is normocephalic, no tenderness on palpation or trauma. Frontal and maxillary sinuses are tender to palpation. Temporomandibular joint intact. No periorbital edema, with clear conjunctiva. Extraocular movements intact. Ears in normal position, tympanic membrane is gray. Nares with mild congestion and inflammation. Clear drainage noted. Lips and mucosa pink and moist without lesions. Uvula and tongue midline, upper dentures in place.

Neck. No pain, distended veins, pulsations, or bruits. No thyromegaly or palpable adenopathy. Neck supple, trachea midline. Bilateral +2 carotid pulses.

Chest. Non-tender on palpation. No masses, lesions, crepitus.

Respiratory. Symmetrical chest expansion with anteroposterior-to-transverse diameter of 1:2. Normal, effortless, regular, even breathing. Resonant lung fields, tactile fremitus present bilateral lobes. Clear lungs upon auscultation without rhonci, wheezing, crackles, or rales. No respiratory distress.

Cardiovascular. Bilateral +2 radial, brachial, posterior tibial, and dorsalis pedis pulses with capillary refill of less than three seconds. Regular rate and rhythm, normal S1/S2, S3/S4 absent. No murmurs, clicks, snaps, or rubs. No peripheral edema in bilateral upper and lower extremities.

MATHEW CLINICAL CASE STUDY

Abdomen. Umbilicus midline. No protrusion, pulsation, rigidity, or ascites.

Hepatomegaly and splenomegaly absent. Abdomen is round, non-distended, normal bowel sounds in all four quadrants without bruits. Abdomen tender in right hypochondrium and epigastrium regions with percussion and palpation. Positive Murphy's sign without rebound tenderness. No pain sensitivity at McBurney's point. Guarding present with deep palpation. Negative for tenderness at the costovertebral angle.

Musculoskeletal. Equal arm and leg lengths. No erythema, crepitation, spinal tenderness, or edema. No kyphosis or scoliosis. Gross and fine sensory and motor strength intact in bilateral upper and lower extremities. Full range of motion and 5/5 strength in bilateral upper extremities, lower extremities, hip, and spine. Deep tendon reflexes intact. Negative Psoas sign, negative obturator sign.

Integumentary. Skin warm and dry, pink skin tone. Intact without lesions, ecchymosis, cyanosis or discoloration. Nail beds pink, no clubbing, no Lindsey's nails.

Laboratory and Radiography Findings

To distinguish between the differential diagnoses of acute cholecystitis (AC), acute pancreatitis, and acute appendicitis, laboratory tests of comprehensive metabolic panel (CMP), complete blood count (CBC) with differential, pancreatic enzymes, and total and direct bilirubin levels were obtained. Since the patient has a history of coronary artery disease, troponin levels, B-type natriuretic peptide (BNP), chest x-ray, and an electrocardiogram (EKG) were attained to eliminate atypical signs and symptoms of a cardiology etiology. A chest x-ray can also assist in excluding non-biliary causes of right upper quadrant pain, such as right lower lobe pneumonia (Watkins & Lemonovich, 2011). An abdominal ultrasound was acquired to assess pain in the right hypochondrium and epigastrium regions. Ultrasonography is usually the initial imaging test

MATHEW CLINICAL CASE STUDY

of choice to investigate the right upper quadrant organs (e.g. gallbladder, liver, and pancreas). An ultrasound can detect the presence of gallstones, but is not a sensitive test for AC (sensitivity of 67%, specificity of 82%) (Papadakis, McPhee, & Rabow, 2013; Tonolin, Ravelli, Villa, & Bianco, 2012). A hepatobiliary imino-diacetic acid (HIDA) scan (sensitivity of 98%, specificity of 81% if bilirubin less than 5 mg/dL) was obtained after reviewing equivocal abdominal ultrasound results to confirm the suspicion of acute cholecystitis (Tonolini et al., 2012). A radioactive dye, technetium-99m, is injected intravenously and is circulated in the liver and the biliary tract. The test is negative if the gallbladder is visualized within one hour of dye injection. A positive test for AC and the obstruction of the cystic duct illustrates the lack of gallbladder visualization within four hours of the injection. The HIDA scan also allows the detection of the severity of gallbladder dyskinesia by measuring the percentage of dye that is ejected from the gallbladder. An ejection fraction (EF) of $\geq 50\%$ is considered normal, whereas an EF of $\leq 30\%$ illustrates severe obstruction and/or dyskinesia (an EF between 30-50% is considered mild/moderate obstruction) (Kessenich, 2011).

To eliminate the diagnosis of complications such as perforated peptic ulcer, cholangitis, and gangrene cholecystitis, a computed tomography (CT) scan was also ordered. Since the increased laboratory values of serum aminotransferases (ALT and AST) and ultrasound results suggested the possibility of dilatation of the common bile ducts, a magnetic resonance cholangiopancreatography (MRCP) (sensitivity of 100%, specificity of 94%) was obtained to examine the diagnosis of coexistent choledocholithiasis and cholangitis (Barak et al., 2009). The MRCP explores the cystic, hepatic, and pancreatic ducts and assists in determining the cause, location, and severity of obstruction. Furthermore, a MRCP allows detection of cholecystitis-related complications of gangrene, pericholecystic abscess, perforation, and intrahepatic

MATHEW CLINICAL CASE STUDY

fistulization (Tonolini et al., 2012). The following are the results from laboratory and imaging studies:

Table 1. Comprehensive Metabolic Panel (CMP) with Creatinine Clearance, Magnesium, and Phosphorus

Lab	Results	Normal Values	Lab	Results	Normal values
<i>Sodium</i>	137 mEq/L	135-148 mEq/L	<i>Globulin</i>	2.2 g/dL	1.9-3.6 g/dL
<i>Potassium</i>	4.3 mEq/L	3.4-5.3 mEq/L	<i>A/G Ratio</i>	1.9	0.8-2.6
<i>Chloride</i>	102 mEq/L	96-110 mEq/L	<i>Total Bilirubin</i>	4.2 mg/dL	0.2-1.9 mg/dL
<i>Carbon Dioxide</i>	26 mEq/L	23-29 mEq/L	<i>AST (SGOT)</i>	229 U/L	0-45 U/L
<i>Glucose</i>	123 mg/dL	70-100 mg/dL	<i>ALT (SGPT)</i>	326 U/L	0-40 U/L
<i>BUN</i>	17 mg/dL	7-20 mg/dL	<i>Alkaline Phosphatase (ALP)</i>	150 U/L	23-150 U/L
<i>Creatinine</i>	1.0 mg/dL	0.8-1.4 mg/dL	<i>Anion Gap</i>	16	10-20
<i>BUN/Creat Ratio</i>	17.4:1	10:1-20:1	<i>Magnesium</i>	2.1 mEq/L	1.6-2.4 mEq/L
<i>Calcium</i>	9.6 mg/dL	8.5-10.5 mg/dL	<i>Phosphorus</i>	3.9 mEq/L	2.5-5.2 mEq/L
<i>Total Protein</i>	6.3 g/dL	6.0-8.3 g/dL	<i>Creatinine Clearance</i>	51.6 mL/min	97-137 mL/min (male)
<i>Albumin</i>	4.0 g/dL	3.5-5.2 g/dL			

(Normal values from Pagana & Pagana, 2010)

Table 2. Complete Blood Count (CBC) with Differential

Lab	Results	Normal Values	Lab	Results	Normal Values
<i>WBC</i>	16.9 k/mm ³	4.5-10.5 k/mm ³	<i>Band Neutrophils</i>	2.7%	2-5%
<i>RBC</i>	4.8 m/mm ³	4.7-6.1 m/mm ³ (male)	<i>Lymphocytes</i>	14.0%	14.0-51.0%
<i>Hemoglobin</i>	12.8 g/dL	14.0-17.5 g/dL (male)	<i>Monocytes</i>	2.0%	2-8%
<i>Hematocrit</i>	38.0 %	40.7-50.3% (male)	<i>Eosinophils</i>	1.0%	1-3%
<i>MCV</i>	93.4 fL	80.0-100.0 fL	<i>Basophils</i>	0.1%	0.0-1%
<i>MCH</i>	31.4 pG	27.0-31.0 pG	<i>Absolute Segmented Neutrophil</i>	14 k/mm ³	1.5-8.0 k/mm ³
<i>MCHC</i>	33.7 g/dL	32.0-36.0 g/dL	<i>Absolute Lymphocyte</i>	1.8 k/mm ³	0.9-4.1 k/mm ³

MATHEW CLINICAL CASE STUDY

<i>RDW</i>	13.4%	9.0-15.0%	<i>Absolute Monocyte</i>	0.8 k/mm ³	0.2-1.1 k/mm ³
<i>Platelets</i>	215,000 k/mm ³	150,000-400,000 k/mm ³	<i>Absolute Eosinophil</i>	0.5 k/mm ³	0.0-0.6 k/mm ³
<i>Segmented Neutrophils</i>	80.2%	40.0-76.0%	<i>Absolute Basophil</i>	0.2 k/mm ³	0.0-0.3 k/mm ³

(Normal values from Pagana & Pagana, 2010)

Table 3. Additional Laboratory Findings: Pancreatic Enzymes, Total and Direct Bilirubin, Troponin, Serum Creatinine Kinase-MB (CK-MB), B-type natriuretic peptide (BNP)

Lab	Results	Normal Values	Lab	Results	Normal Values
<i>Amylase</i>	35 U/L	13.0-53.0 U/L	<i>Troponin</i>	<0.01 ng/mL	<0.01 ng/mL
<i>Lipase</i>	39 U/L	15.0-65.0 U/L	<i>CK-MB</i>	1.1 mcg/L	0-3 mcg/L
<i>Direct Bilirubin</i>	1.8 mg/dL	0.0-0.4 mg/dL	<i>BNP</i>	86 pg/mL	<100 pg/mL
<i>Total Bilirubin</i>	3.1 mg/dL	0.0-1.0 mg/dL			

(Normal values from Pagana & Pagana, 2010)

Table 4. EKG Findings

<i>EKG</i> : Normal EKG. Normal sinus rhythm, heart rate: 92 beats per minute

Table 5. Radiography Findings

<i>X-ray of Chest</i>	Normal chest x-ray without infiltrates or atelectasis. No cardiomegaly.
<i>Ultrasonography of Abdomen</i>	Gallbladder dilatation and wall thickening of 7mm, presence of pericholecystic fluid. Positive Murphy's sign. Dilatation of common bile duct of 4mm. Limited study for detection of stones and visualization of the pancreas. No liver enlargement.
<i>CT scan of Abdomen with Contrast</i>	Gallbladder distention, mural thickening with mucosal hyperenhancement. Presence of pericholecystic fluid. No free air identified. Hepatomegaly not present.

MATHEW CLINICAL CASE STUDY

<i>HIDA Scan</i>	Gallbladder not visualized, EF of 20%.
<i>MRCP</i>	Presence of intraluminal sludge and 4.5mm cystic duct stone. Transverse diameter of gallbladder 8mm, mural thickening of 7mm. Presence of moderate amount of pericholecystic fluid. Dilatation of common bile duct of approximately 3mm, but no stones identified. No abscess detected. Normal appearing pancreas.

Diagnosis

Acute cholecystitis secondary to cystic duct stone, or acute calculous cholecystitis, is the primary diagnosis for this patient. The majority of stones consist of cholesterol as a result of supersaturation, accelerated cholesterol crystal nucleation, and impaired gallbladder motility (Bellows, Berger, & Crass, 2005; Gaby, 2009). The clinical presentation of AC is severe, abrupt, steady sharp pain that has been present for six or more hours in the right hypochondrium and epigastrium regions and that is accompanied with nausea and vomiting. The pain occurs usually after a high-caloric meal when the gallbladder attempts to contract to release stored bile in order to assist in digestion of food (Frossard, Steer, & Pastor, 2008). However, the obstruction in the cystic duct prevents this process from occurring, leading to dilatation and inflammation of the gallbladder and subsequent right upper quadrant pain. The pain may radiate to the right scapula and/or back. A positive Murphy's sign (cessation of inspiration during palpation of the gallbladder) in AC has good sensitivity (86%), but low specificity (35%) (Summers et al., 2010). Strong risk factors of cholelithiasis are obesity (BMI \geq 30 kg/m²) (OR 3.7 [95% CI 2.3-5.3]) and a family history of first-degree relatives with cholecystectomy (OR 2.22 [95% CI 1.5-3.0]) (Nakeeb et al., 2002).

MATHEW CLINICAL CASE STUDY

Leukocytosis results from inflammation of the gallbladder. Cystic duct obstruction causes bile stasis and release of inflammatory enzymes (e.g. phospholipase-A) (Zaliekas & Munson, 2008). Increased levels of total bilirubin (>1 mg/dL), direct bilirubin (>0.4 mg/dL), ALT (>40 U/L), AST (>45 U/L), and ALP (>150 U/L) are associated with AC even in the absence of common bile duct obstruction or liver injury, indicating inflammatory mediators (rather than mechanical obstruction) affecting the liver. Serum aminotransferases (ALT and AST) values can be as high as 300 U/L in AC, but can also indicate bile duct obstruction (Papadakis, McPhee, & Rabow, 2013). All radiography findings suggest the diagnosis of AC with gallbladder dilatation, mural thickening, and presence of pericholecystic fluid, sludge, and cystic duct stone. The inflammatory process in AC damages mucosa resulting in wall thickening, sludge, and development of exudate of pericholecystic fluid (Strasberg, 2008).

Differential Diagnosis

Acute pancreatitis, acute appendicitis, perforated peptic ulcer, and acute hepatitis are all differential diagnoses (listed in order of highest to lowest probability) in the clinical scenario of right upper quadrant pain. The clinical presentation of acute pancreatitis includes sudden mid-epigastric pain that radiates to the back and is accompanied by severe nausea and vomiting, weakness, diaphoresis, and anxiety. Usually, the pain is not associated with guarding, rigidity, or rebound tenderness. The pancreatic pain is usually aggravated by walking and lying and improves with sitting and leaning forward (Brisinda et al., 2011). The pathogenesis of acute pancreatitis consists of choledocholithiasis (gallstone located in the biliary tree), reflux of bile into the pancreatic duct due to a flawed sphincter of Oddi, or premature activation of pancreatic enzymes (Penny, 2012). Serum amylase and lipase (pancreatic enzymes) are elevated by two to three folds the normal value in acute pancreatitis (Frossard, Steer, & Pastor, 2008). Acute

MATHEW CLINICAL CASE STUDY

pancreatitis can be eliminated in this case scenario because the pancreatic enzymes are within the normal range. Furthermore, the MRCP detected a normal-appearing pancreas without inflammation.

The established frequency (10% of the population) and myriad presentation, appendicitis is considered as a differential diagnosis in all patients with abdominal pain. Acute appendicitis is an obstruction of the appendix caused by a fecalith, inflammation, or neoplasm (Vissers & Lennarz, 2010). The peri-umbilical/right lower quadrant pain is the result of increased intraluminal pressure, venous congestion, and thrombosis of intramural vessels. Maximum sensitivity of the pain is over the McBurney's point (located 2/3 the distance from the umbilicus to the right anterior superior iliac spine). Nausea and vomiting is almost always present after the onset of pain (Virmani et al., 2012). On physical examination, signs of peritoneal irritation of abdominal guarding and rebound tenderness are present. A positive psoas sign (pain when right hip is extended) and the obturator sign (pain when right hip is passively flexed and internally rotated) can signify adjacent inflammation in appendicitis (Garst et al., 2013). Laboratory findings illustrate moderate leukocytosis with neutrophilia. Although a CT is fairly accurate in diagnosis of appendicitis (sensitivity of 94%, specificity of 95%), a diagnostic laparotomy or laparoscopy is indicated in some cases. Acute appendicitis is a surgical emergency and required prompt treatment to prevent perforation and gangrene (Papadakis, McPhee, & Rabow, 2013). The diagnosis of acute appendicitis is ruled out in this scenario because of the absence of peritoneal inflammation (negative psoas and obturator sign, no pain indicated at the McBurney's point on physical examination). In addition, the pain associated with acute appendicitis is located usually in the right lower quadrant of the abdomen.

MATHEW CLINICAL CASE STUDY

Since the patient has a history of peptic ulcer disease, perforated peptic ulcer is another differential diagnosis in this scenario. Perforations occur on the anterior wall of the stomach or duodenum and result in chemical peritonitis, causing severe abrupt generalized right abdominal or mid-epigastric pain and tenderness. Ascites, nausea, vomiting, and chills may be present (Tang & Chan, 2012). The incidence of perforations increases with non-steroidal anti-inflammatory drugs (NSAIDs) or cocaine use. The diagnosis of perforated peptic ulcer is eliminated from the results of the CT scan which revealed no free air (Koskensalo & Leppäniemi, 2010).

Liver, located in the right upper quadrant region, also requires assessment to determine the cause of the presenting symptom of pain. Acute viral hepatitis and drug-induced hepatitis are two appropriate differential diagnoses for acute abdominal pain. Many hepatotoxic drugs exist, but the most common include acetaminophen and certain antibiotics (e.g. amoxicillin-clavulanic acid, azithromycin, isoniazid, nitrofurantoin) (Papadakis, McPhee, & Rabow, 2013). Since the patient denied any recent illnesses or new medications, the diagnosis of drug-induced hepatitis in this situation is unlikely. Clinical findings in hepatitis include mild, but constant right upper quadrant or epigastric pain that is exacerbated by exertion. General malaise, arthralgia, upper respiratory symptoms, nausea, and vomiting are usually present in the first phase (prodromal phase). Jaundice usually occurs in the icteric phase, after 5-10 days of initial symptoms (Hawley, 2012). Hepatomegaly and splenomegaly is present in 50% and 15% of hepatitis cases, respectively (Papadakis, McPhee, & Rabow, 2013). Although leukocytosis is not present in the early stage of hepatitis, elevation of liver enzymes (ALT and AST) is strikingly as high as 1000 U/L due to hepatocellular necrosis and inflammation. Total bilirubinemia (>4 mg/dL) and direct (conjugated) hyperbilirubinemia (>0.04 mg/dL) occurs as a resultant of impaired excretion of

MATHEW CLINICAL CASE STUDY

bilirubin from the liver due to hepatocellular dysfunction from epithelial damage or intrahepatic cholestasis (caused by certain drugs or sepsis) (Mahboobi, Porter, Karayiannis, & Alavian, 2012). Lack of hepatomegaly on physical examination and imaging studies do not indicate a diagnosis of hepatitis in this case scenario. The liver enzymes on laboratory findings are slightly elevated and are not as high as 1000 U/L as usually seen in cases of hepatitis. If a high suspicion of hepatitis is present, serum antibodies and/or antigens to specific viruses (i.e. hepatitis A, B, C, D, E and G) may be obtained (Leung, 2010).

Plan

Pharmacological Treatment of AC

Treatment Goals. Treatment goals in AC consist of pain control, prevention of infection and gallbladder perforation, and gastric decompression and intravenous alimentation.

Priority One: Pain Control. Managing acute pain is priority for patient well-being and comfort. Meperidine (Demerol®) is the preferable choice for pain medication because of less spasm of the sphincter of Oddi. The dysfunction of the sphincter of Oddi prevents pancreatic enzymes and bile to enter the small intestine to assist with digestion. The accumulation of bile and pancreatic enzymes can lead to further complications, such as acute pancreatitis and cholangitis (Papadakis, McPhee, & Rabow, 2013).

Only one randomized, double-blind, placebo-controlled trial has been done to evaluate the effect of opioid meperidine with another opioid (i.e. morphine). The small study with 36 patients (seven men, 29 women, mean age 50 with similar demographics), who were diagnosed with acute cholecystitis with biliary pain, assessed the motility of sphincter of Oddi with cumulative doses up to 10 mg of morphine or 100 mg of meperidine. Morphine resulted in increased frequency of sphincter of Oddi contractions from an average of 2.4 to 7.9 ($p < 0.001$).

MATHEW CLINICAL CASE STUDY

However, meperidine inhibited the frequency of contractions from an average of 1.5 to 0.8 ($p < 0.05$) (Thune et al., 1990). The American Pain Society (2012) recommends limiting the treatment with meperidine to 48 hours and doses should be restricted to 600 mg daily. Adult dosing of meperidine ranges from 50-150 mg intravenous every four hours as needed for pain (Lexi-Comp, 2013).

Another effective pain control adjunctive treatment option in AC consists of administration of non-steroidal anti-inflammatory drugs (NSAIDs). A recent meta-analysis of 11 randomized controlled trials (RCTs) with 1076 participants assessing the use of NSAIDs with biliary colic pain was conducted. The study supported that NSAIDs (e.g. diclofenac, tenoxicam, flurbiprofen, ketorolac, ketoprofen) resulted in a higher analgesic effect than placebo and spasmolytic drugs (i.e. hyoscine, scopolamine) in the treatment of cholelithiasis-related complications (odds ratio [OR] 3.77 [95% CI 1.65-8.61], $p = 0.002$ and OR 1.47 [95% CI 1.03-2.10], $p = 0.03$, respectively). However, NSAIDs did not illustrate higher efficacy in controlling pain than opioids (i.e. meperidine and pentazocine) (OR 1.05 [95% CI 0.82-1.33], $p = 0.71$). The analysis demonstrated significantly lower rate of complications and adverse effects such as drowsiness, nausea, vomiting, dizziness, and hypotension with NSAIDs use than with all of other pain medications studied (OR 0.53 [95% CI 0.31-0.89], $p < 0.0001$) (Colli et al., 2012). Due to the inhibition of prostaglandins, NSAIDs favorably modify the progression of inflammation (Qandil, 2012). The NSAID, diclofenac 75 mg PO two times a day, was the drug of choice for effective pain control in six out of the 11 RCTs (Colli et al., 2012). Therefore, this medication was prescribed as an adjunctive therapy to meperidine.

In the state of Ohio, an advanced practice nurse (APN) with a Certificate to Prescribe (CTP) or with a Certificate to Prescribe Externship (CTP-E) and a drug enforcement

MATHEW CLINICAL CASE STUDY

administration (DEA) number is eligible to prescribe schedule II medications within APN standards and scope of practice as an initial treatment for seven days. A physician consultation or a physician initiation is mandated after the seven day period. An APN is able to prescribe NSAIDs in the state of Ohio. Institutional policies should be followed if the medication is prescribed in an institutional setting (Ohio Board of Nursing [OBN], 2013).

Priority Two: Reduce Inflammation. The inflammation in cholecystitis is initially sterile, but secondary infection may occur with microorganisms from the Enterobacteriaceae family. Complications such as necrosis and gangrene of the gallbladder can occur. Without appropriate antibiotic treatment to treat inflammation, perforation of the gallbladder and development of an abscess is possible (Mazeh et al., 2012). The Infectious Diseases Society of America (IDSA) (2010) guidelines recommend initiating antimicrobial therapy if WBC is greater than 12.5 k/mm³ or if the temperature is more than 101°F. Radiography findings of air in the gallbladder also qualify for the antimicrobial treatment. Routine use of antibiotics is also suggested for diabetic or immune-compromised patients and for prophylaxis treatment in patients scheduled for cholecystectomy. The prophylactic antibiotic (cefazolin 1 g IV) is initiated one hour prior to surgery, and continued every eight hours for 24 hours (IDSA, 2010).

According to the IDSA (2010) guidelines, anti-microbial therapy for acute cholecystitis consists of coverage against Enterobacteriaceae organisms. Since this patient is considered a high-risk for complications due to advanced age and a history of diabetes, a combination therapy of ceftriaxone (Rocephin®) 1 g IV daily and metronidazole (Flagyl®) 500 mg IV every eight hours is prescribed for seven days (IDSA, 2010). In a double-blind, randomized, placebo-controlled study of 279 patients (93 men, 186 women, mean age 50, with similar demographics) high-risk patients with symptomatic AC, a combination treatment with a second or third

MATHEW CLINICAL CASE STUDY

generation (e.g. ceftriaxone 1 g IV daily) and metronidazole 500 mg IV every eight hours resulted in lower incidence of bacterial growth in bile cultures (23% vs. 6%) and gallbladder wall cultures (30% vs. 17%) than those who were not given prophylaxis ($p = 0.003$ and $p = 0.02$ respectively). High-risk patients in the study were defined as individuals who were at an increased risk of infective complications and included those over the age of 65 with a history of diabetes. Symptomatic AC included patients with severe pain, nausea/vomiting, and/or leukocytosis (Al-Abassi et al., 2001).

During surgery, culture of the bile and the gallbladder is recommended to guide the selection of antibiotics in the setting of post-operative complications (IDSA, 2010). In the state of Ohio, an APN with a CTP or with a CTP-E is eligible to prescribe antibiotics within APN standards and scope of practice (OBN, 2013).

Priority Three: Treat Nausea and Vomiting/Intravenous Hydration. Gastric decompression by a nasogastric tube is essential to prevent gallbladder stimulation and cease nausea and vomiting. The patient should also refrain from eating and drinking by mouth. Evacuation of gastric contents will also assist with surgery preparation (Strasberg, 2008). The medication ondansetron (Zofran®) 4 mg IV every four to six hours will be added to the medication regimen to alleviate nausea and vomiting. A double-blind, randomized controlled trial with 110 participants (with AC and with similar demographics) compared the efficacy of intravenous ondansetron (4 mg every six hours) with oral disintegrating ondansetron (8 mg every six hours) and placebo. There was no statistically significant difference between the intravenous and oral disintegrating ondansetron groups. However, administration of oral or intravenous ondansetron resulted in less frequent nausea/vomiting episodes zero to 24 hours post

MATHEW CLINICAL CASE STUDY

administration period than the placebo group ($p= 0.001$ and $p= 0.002$ respectively) (Grover, Mathew, & Hegde, 2009).

To prevent dehydration and maintain electrolyte balance, a crystalloid solution is ordered (Ker, Perel, & Roberts, 2013). Based on the patient's history of diabetes, the appropriate crystalloid is 0.9% sodium chloride (versus a dextrose solution). Lactated Ringer's solution is usually indicated for severe, rapid blood loss, dehydration, burns, and loss of fluid in the lower gastrointestinal tract (Ker, Perel, & Roberts, 2013). In the state of Ohio, an APN with a CTP or with a CTP-E is eligible to prescribe crystalloid solutions and ondansetron within APN standards and scope of practice (OBN, 2013).

Non- Pharmacological Therapy

Patient Education. The patient will be educated on a combination of verbal, written, and teach-back methods. Providing sufficient disease-related education leads to increased adherence to the treatment plan and improved patient outcomes (Mayoux-Benhamou et al., 2008). Education material on AC and the potential risk factors associated with reoccurrences of stones in the biliary tract will be provided. Maintaining a healthy body weight ($BMI < 25 \text{ kg/m}^2$) and eating a diet low in cholesterol may help prevent the formation of recurrent calculi. Increased intakes of saturated and trans-fatty acids are dietary factors that provoke cholelithiasis (Gaby, 2009). Exercising for at least 30 minutes a day five times a week and eating a balanced meal with low in fat and calories will assist in a steady weight loss. Rapid weight loss (more than three pounds a week) can lead to the development of gallstones by increasing bile cholesterol saturation and bile stasis (Gaby, 2009; Ruhl & Everhart, 2011). The patient will be encouraged to use the previous complimentary therapies of meditation and music to assist with pain alleviation.

MATHEW CLINICAL CASE STUDY

Surgical Therapy

Gastroenterology surgery team was consulted on the case and the patient underwent laparoscopic cholecystectomy on hospital admission day three. Laparoscopic cholecystectomy is the preferred treatment of choice in AC because 25% of patients develop recurrent gallstones within five years with nonsurgical treatment with bile acid therapy (Barak et al., 2009).

Laparoscopic, rather than laparotomic (open), is the preferred treatment for cholecystectomy because the procedure results in less tissue damage and post-operative pain, reduces the risk of wound infection, and decreases overall mortality (Riall et al., 2010). However, some laparoscopic procedures are converted to open cholecystectomy if biliary injury is detected or if anatomical difficulty prevents successful completion of the procedure (Strasberg, 2008). Early surgery (within five days) is preferred because local inflammation increases after 72 hours of the initial onset of symptoms, inhibiting gallbladder exposure, prohibiting dissection, and increasing the risk of developing surgical complications (i.e. bile leakage). Furthermore, delayed surgery can lead to gangrenous cholecystitis and increases the likelihood of requiring an open cholecystectomy and a longer hospitalization stay (Nikfarjam et al., 2011; Riall et al., 2010). A Jackson-Pratt (JP) drain or a T-tube is inserted to drain excess fluid or bile, respectively, around the surgical site (Cherng et al., 2012).

A large cohort study with 29, 818 Medicare patients (>65 years of age) supported the benefit of performing laparoscopic cholecystectomy in the initial hospitalization. Gallstone or surgery-related readmission rates were low in patients who underwent early laparoscopic cholecystectomy (less than five days) than in patients who either did not receive the definitive treatment or received late laparoscopic cholecystectomy (4.4% versus 38% ($p < 0.0001$)). Furthermore, the rate of performing open cholecystectomies increased by 8% for patients

MATHEW CLINICAL CASE STUDY

requiring readmission ($p < 0.0001$). The mortality rate was 56% higher in patients who were not initially treated with laparoscopic cholecystectomy, even after controlling for patient demographics and comorbidities (OR 1.56 [95% CI 1.47-1.65], $p < 0.0001$) (Riall et al., 2010).

Although cholecystectomy is the treatment of choice in AC, patients with severe chronic illnesses, including cardiovascular or pulmonary disease, advanced malignancy, or sepsis have a moderate to high surgical mortality rate (5-27%) (Ruhl & Everhart, 2011). Conservative management for these patients includes a combination treatment of antibiotics and gallbladder drainage by percutaneous cholecystostomy. The drainage allows removal of purulent material from the obstructed gallbladder, resolution of edema, and unobstructed cystic duct. Surgical cholecystectomy should be sought when the patient is medically stable, even in the setting of resolved AC. If gangrenous cholecystitis has been suspected, hemodynamically unstable patients may benefit from an open cholecystectomy. Another nonsurgical treatment consists of percutaneous calculous extraction with or without mechanical lithotripsy (Cherng et al., 2012).

Follow-Up and Monitoring Parameters

Follow-up monitoring of AC consists of maintaining adequate pain control and hydration, monitoring for infection, and assessing for post-procedure complications. Usually, the patient is discharged within 24 hours of the laparoscopic cholecystectomy in the absence of complications and if the procedure was not converted into an open cholecystectomy. Elderly patients (> 65 years of age) with comorbidities are observed overnight. A follow-up appointment is scheduled after two weeks of hospital discharge (Shuja, Bashir, & Rashid, 2011). The following monitoring parameters are ordered based on patient's medical history of hypertension and diabetes and in order to monitor for possible post-procedure complications (Cherng et al., 2012; Girometti, 2010; Strasberg, 2008):

Call clinician if:

Systolic Blood Pressure > 170 mmHg or < 90 mmHg
Diastolic Blood Pressure > 95 mmHg or < 50 mmHg
Heart Rate > 110 beats per minute or < 50 beats per minute
Temperature > 101.5°F or < 95°F
Respiratory Rate > 30 breaths per minute or < 8 breaths per minute
Oxygen Saturation < 90%
Urine Output > 300 mL/hr or < 30 mL/hr for two hours
Blood Glucose > 150 mg/dL or < 70 mg/dL
JP drainage > 50 mL for three hours

Inadequate pain control negatively affects quality of life standards, psychosocial well-being, and economic costs. Benefits of effective pain relieve includes earlier mobilization, leading to fewer deep vein thrombosis and other pulmonary and cardiovascular complications (Nworah, 2012). An interdisciplinary approach to adequate pain control can reduce costs for the patient and facility, decrease hospital length of stay, and increased patient satisfaction. Poor pain control can lead to physiological complications such as increased heart rate, blood pressure, and respiratory rate (Filligim et al., 2009). A clinician should assess pain control by consistent and comprehensive screening, and documenting the evaluation of treatment modalities used (The Joint Commission [TJC], 2009).

Complications of laparoscopic cholecystectomy include gallbladder perforation with infection, vascular injury resulting in active bleeding, bowel injury leading to ischemia or perforation, and bile duct injuries. If these complications arise during procedure, an open cholecystectomy is warranted (Nawaiseh & Ajarma, 2010). Usually severe biliary leakage of cystic and hepatic ducts develops two to ten days post-cholecystectomy. Clinical presentations to monitor for a major bile injury includes a fever (>101°F), abdominal pain, bilious ascites, and jaundice (e.g. dark urine, pale stools, yellowing of skin). Laboratory findings such as increased

MATHEW CLINICAL CASE STUDY

WBC, decreased hemoglobin/hematocrit, elevated liver function tests (ALT, AST, ALP), and increased total and direct bilirubin are monitored post-cholecystectomy (Papadakis, McPhee, & Rabow, 2013). Fever accompanied by leukocytosis should prompt the clinician to adjust antibiotics according to the culture results of the bile and the gallbladder that was obtained intraoperatively (Strasberg, 2008). If clinical suspicion of biliary leak is present, a transabdominal ultrasonography or an abdominal CT with contrast is performed to evaluate the extent of the possible leak. Positive results indicate the need for an endoscopic retrograde cholangiopancreatography (ERCP) to determine the location of the leak and to directly treat the complication (Tonolini et al., 2012). An endoprosthesis (i.e. a stent) or sphincterotomy with insertion of percutaneous drains are the treatment of choice to decrease pressure in the biliary system and to allow for bile drainage into the intestinal tract (Hsieh et al., 2012; Maekawa et al., 2013). At two to four week follow-up, a HIDA scan and liver function tests are ordered. If the scan reveals absence of bile leak and if the laboratory work-up is normal, the stent is removed with a repeat ERCP (Maekawa et al., 2013).

Acute hemodynamic instability with hypotension and tachycardia are associated with active bleeding, usually from arterial sources or the liver. Meticulous cardiovascular assessments and frequent monitoring of vital signs (every 15 minutes for two hours, then hourly) are critical in the post-operative period (Masood et al., 2012). The patients can also present with sepsis and cardiovascular collapse from possible bowel injury/perforation during the procedure. Abdominal pain or distention, constipation, peritonitis, and absent or hypoactive bowel sounds are related clinical findings. A CT of the abdomen and pelvis with contrast is ordered for further evaluation. In both of the above mentioned situations, an emergent open cholecystectomy may be indicated for intervention (Nawaiseh & Ajarma, 2010).

MATHEW CLINICAL CASE STUDY

Another complication that may arise months to years after cholecystectomy is the Post-cholecystectomy Syndrome (PCS). Persistence of symptoms of right upper quadrant pain, flatulence, and dyspepsia after meals can be due to recurrent biliary stones, bile duct strictures, gallbladder remnant, inflamed cystic duct, or biliary dyskinesia from dysfunction of sphincter of Oddi (Papadakis, McPhee, & Rabow, 2013). Elevated liver function tests, fever, chills, or jaundice suggest biliary tract disease. Extrabiliary causes of PCS include differential diagnoses such as pancreatitis, hepatitis, peptic ulcer disease, diverticulitis, irritable bowel syndrome, or esophagitis. Treatment is based on the underlying cause of the symptoms (Janes, Berry, & Dijkstra, 2005). A CT of abdomen with contrast or a MRCP are noninvasive tests for evaluation of biliary tract disease (Girometti et al., 2010).

Establishing monitoring parameters for the prescribed medications is also necessary. When prescribing meperidine, clinician should observe the patient for respiratory depression, hypotension, bradycardia, confusion, increased intracranial pressures, seizures, constipation, nausea/vomiting, abdominal cramps and anaphylaxis (Lexi-Comp, 2013). Use of NSAIDs is associated with renal insufficiency and increased risk of bleeding (Katzung, Masters, & Trevor, 2012). With NSAID, diclofenac, monitoring of CBC, CMP, liver enzymes, BUN/creatinine, and urine output is essential (Lexi-Comp, 2013).

A possible complication that can arise with the use of antibiotics is *Clostridium difficile*, presenting with leukocytosis and severe diarrhea (Howerton, Patra, & Abel-Santos, 2013). Side effects of ceftriaxone include anaphylaxis, Stevens-Johnson syndrome, agranulocytosis, thrombocytopenia or thrombocytosis, hemolytic anemia, and increased BUN and serum transaminases. Adverse effects of metronidazole consist of T-wave flattening on an EKG, syncope, flushing, confusion, Stevens-Johnson syndrome, aseptic meningitis, neutropenia, and

MATHEW CLINICAL CASE STUDY

thrombocytopenia. Routine follow-up with lab work (i.e. CBC with differential, CMP) and an EKG may be required (Lexi-Comp, 2013).

Adverse effects of ondansetron consist of headache, malaise, fatigue, drowsiness, and urinary retention. Less common side effects include hepatic failure and second-degree heart block and ST-segment depression on an EKG (Lexi-Comp, 2013). Routine monitoring of liver enzymes and cardiac tracing is suggested. Monitoring of electrolytes, vital signs, and signs and symptoms of fluid retention is essential when administering intravenous crystalloid fluids (Ker, Perel, & Roberts, 2013).

Discharge Planning/Health Promotion

The patient will be instructed to advance diet as tolerated, starting with a clear liquid diet. Early ambulation and aggressive pulmonary toileting will be encouraged the post-operative period to prevent cardiopulmonary and vascular complications (Drolet et al., 2013). If a large umbilical incision was performed, the patient will be educated to limit heavy lifting for two weeks (Strasberg, 2008). Due to the possible risk of infection after the surgical procedure, the patient will be educated on signs and symptoms of infection, including increased temperature greater than 101.5°F and purulent drainage, redness, warmth, or inflammation from the surgical site, and instructed to promptly call the clinician if the signs and symptoms are present (Shuja, Bashir, & Rashid, 2011). Other clinical symptoms to monitor and report are: dark urine, pale stools, yellowing of skin, chills, dizziness, syncope, abdominal distention or severe sharp pain, constipation or diarrhea, difficulty breathing, severe bleeding, and chest pain (Papadakis, McPhee, & Rabow, 2013). The patient will be instructed on the importance of attending the follow-up appointment scheduled in two weeks with the clinician in order to assess the patient's condition and obtain lab work (i.e. CBC, CMP) if necessary. Instructions on how to care for the

MATHEW CLINICAL CASE STUDY

JP and T-tube drains will be provided. Keeping the insertion site clean and dry is essential to prevent infection. The patient will be instructed to wash the wound site with soap and water daily (Cherng et al., 2012). Care must be taken to avoid accidental pulling or clamping of the drains.

The patient will be educated on medications' signs and symptoms prescribed at discharge and the importance of medication adherence. Common drug-to-drug interactions will be verbalized in order to avoid possible concerning complications. The patient will continue current home medications at discharge in addition to diclofenac (Zipsor®) 75 mg PO two times a day for mild to moderate abdominal pain that may continue for up to a week after discharge (Riall et al., 2012). If severe pain develops, the patient will be instructed to contact the clinician immediately. The NSAID use will be restricted to one to two weeks due to the patient's history of PUD. The patient will be encouraged to use the medication only if pain present to avoid bleeding complications (Katzung, Masters, & Trevor, 2012). If pain is not adequately relieved with diclofenac, the patient will be asked to contact the clinician.

General health promotion strategies will be discussed with the patient. Since diabetes and obesity are related factors in the development of recurrent biliary lithiasis, the patient will be instructed on losing weight gradually and controlling blood glucose levels. The patient will be encouraged to lose weight gradually to a BMI of < 25 kg/m² with eating healthy, balanced meals and exercising 30 minutes daily five days a week. Monitoring blood glucose before meals and at bedtime is essential to avoid symptomatic hypoglycemia or hyperglycemia. Taking the hypoglycemic medication as recommended and restricting foods that are high in glucose assists in maintaining serum glucose levels in the target goal range between 70-110 mg/dL. Controlling blood pressure (SBP < 120 mmHg, DBP < 80 mmHg) by limiting sodium intake and taking medications as prescribed can prevent life-threatening complications such as heart attack and

MATHEW CLINICAL CASE STUDY

stroke (American College of Cardiology Foundation [ACCF]/American Heart Association [AHA], 2009). Although the patient is currently up-to-date on immunizations, reiteration will be provided on obtaining a flu vaccination yearly and a pneumonia vaccination every five years. An annual physical health check with a primary care physician is essential to assess patient's condition and identify complications related to comorbidities early (Tsuboi, Hayakawa, Kanda, & Fukushima, 2011).

MATHEW CLINICAL CASE STUDY

References

- Al-Abassi, A. A., Farghaly, M. M., Ahmed, H. L., Mobasher, L. A., & Al-Manee, M. S. (2001). Infection after laparoscopic cholecystectomy: Effect of infected bile and infected gallbladder wall. *European Journal of Surgery*, *167*(4), 268-273. doi:10.1080/110241501300091426
- American Pain Society. (2012). *Types of Treatments*. Retrieved from www.americanpainsociety.org/uploads/pdfs/npc/section_3.pdf
- Barak, O., Elazary, R., Appelbaum, L., Rivkind, A., & Almogy, G. (2009). Conservative treatment for acute cholecystitis: Clinical and radiographic predictors of failure. *The Israel Medical Association Journal*, *11*(1), 739-743.
- Bellows, C., Berger, D., & Crass, R. (2005). Management of gallstones. *American Family Physician*, *72*(4), 637-637-42, 567-9, 711 passim.
- Brisinda, G., Vanella, S., Crocco, A., Mazzari, A., Tomaiuolo, P., Santullo, F., & ... Crucitti, A. (2011). Severe acute pancreatitis: Advances and insights in assessment of severity and management. *European Journal of Gastroenterology & Hepatology*, *23*(7), 541-551. doi:10.1097/MEG.0b013e328346e21e
- Cherng, N., Witkowski, E. T., Sneider, E. B., Wiseman, J. T., Lewis, J., Litwin, D. M., & ... Shah, S. A. (2012). Use of cholecystostomy tubes in the management of patients with primary diagnosis of acute cholecystitis. *Journal of The American College of Surgeons*, *214*(2), 196-201. doi:10.1016/j.jamcollsurg.2011.11.005
- Colli, A. A., Conte, D. D., Valle, S., Sciola, V. V., & Fraquelli, M. M. (2012). Meta-analysis: Nonsteroidal anti-inflammatory drugs in biliary colic. *Alimentary Pharmacology & Therapeutics*, *35*(12), 1370-1378. doi:10.1111/j.1365-2036.2012.05115.x

MATHEW CLINICAL CASE STUDY

- Drolet, A., Dejuilio, P., Harkless, S., Henricks, S., Kamin, E., Leddy, E. A., & ... Williams, S. (2013). Move to improve: The feasibility of using an early mobility protocol to increase ambulation in the intensive and intermediate care settings. *Physical Therapy, 93*(2), 197-207. doi:10.2522/ptj.20110400
- Fillingim, R. B., King, C., Ribeiro-Dasilva, M., Rahim-Williams, B., Joseph, L., & Riley, L. J. (2009). Sex, gender, and pain: A review of recent clinical and experimental findings. *Journal of Pain, 10*(5), 447-485.
- Frossard, J., Steer, M., & Pastor, C. (2008). Acute pancreatitis. *Lancet, 371*(9607), 143-152.
- Gaby, A. R. (2009). Nutritional approaches to prevention and treatment of gallstones. *Alternative Medicine Review, 14*(3), 258-267.
- Garst, G., Moore, E., Banerjee, M., Leopold, D., Burlew, C., Bensard, D., & ... Sauaia, A. (2013). Acute appendicitis: A disease severity score for the acute care surgeon. *Journal of Trauma & Acute Care Surgery, 74*(1), 32-36. doi:10.1097/TA.0b013e318278934a
- Girometti, R. R., Brondani, G. G., Cereser, L. L., Como, G. G., del Pin, M. M., Bazzocchi, M. M., & Zuiani, C. C. (2010). Post-cholecystectomy syndrome: Spectrum of biliary findings at magnetic resonance cholangiopancreatography. *British Journal of Radiology, 83*(988), 351-361. doi:10.1259/bjr/99865290
- Grover, V. K., Mathew, P. J., & Hegde, H. H. (2009). Efficacy of orally disintegrating ondansetron in preventing postoperative nausea and vomiting after laparoscopic cholecystectomy: A randomized, double-blind placebo controlled study. *Anaesthesia, 64*(6), 595-600. doi:10.1111/j.1365-2044.2008.05860.x
- Hawley, C. (2012). Understanding viral hepatitis: As easy as A, B, C. *British Journal of Primary Care Nursing: Cardiovascular Disease, Diabetes & Kidney Care, 16*-21.

MATHEW CLINICAL CASE STUDY

- Howerton, A., Patra, M., & Abel-Santos, E. (2013). A new strategy for the prevention of clostridium difficile infection. *Journal of Infectious Diseases*, 207(10), 1498-1504.
- Hsieh, Y., Chen, C., Su, C., Chan, C., Huo, T., Liu, C., & ... Lin, H. (2012). Outcome after percutaneous cholecystostomy for acute cholecystitis: A single-center experience. *Journal of Gastrointestinal Surgery*, 16(10), 1860-1868. doi:10.1007/s11605-012-1965-8
- Janes, S., Berry, L. L., & Dijkstra, B. B. (2005). Management of post cholecystectomy mirizzi's syndrome. *Journal of Minimal Access Surgery*, 1(1), 34-36.
- Jessup, M., Abraham, W., Casey, D., Feldman, A., Francis, G., Ganiats, T., & ... Yancy, C. (2009). 2009 focused update: ACCF/AHA Guidelines for the diagnosis and management of heart failure in adults. A report of the American College of Cardiology Foundation/American Heart Association task force on practice guidelines. *Circulation*, 119(14), 1977-2016.
- Katzung, B.G., Masters, S.B., & Trevor, A.J. (2012). *Basic and clinical pharmacology*. New York, NY: McGraw Hill Medical.
- Ker, K., Perel, P., & Roberts, I. (2013). Colloids versus crystalloids for fluid resuscitation in critically ill patients. *Cochrane Library*, 3, 1-73. doi:10.1002/14651858.CD000567.pub6
- Kessenich, C. R. (2011). Cholecystitis and HIDA scan. *Nurse Practitioner*, 36(9), 11-12. doi:10.1097/01.NPR.0000403295.82092.20
- Koskensalo, S., & Leppäniemi, A. (2010). Perforated duodenal ulcer: Has anything changed?. *European Journal of Trauma & Emergency Surgery*, 36(2), 145-150. doi:10.1007/s00068-010-9128-7
- Leung, N. (2010). Viral hepatitis lab testing. *Advance For Administrators Of The Laboratory*, 19(2), 42.

MATHEW CLINICAL CASE STUDY

Lexi-Comp, Inc. (2013). Lexi-Drugs™: [Smart-phone application]. Accessed July 14, 2013.

Maekawa, S., Nomura, R., Murase, T., Ann, Y., Oeholm, M., & Harada, M. (2013). Endoscopic gallbladder stenting for acute cholecystitis: A retrospective study of 46 elderly patients aged 65 years or older. *BMC Gastroenterology*, *13*(1), 1-7. doi:10.1186/1471-230X-13-65

Mahboobi, N., Porter, S., Karayiannis, P., & Alavian, S. (2012). Oral fluid and hepatitis A, B and C: A literature review. *Journal Of Oral Pathology & Medicine*, *41*(7), 505-516. doi:10.1111/j.1600-0714.2011.01123.x

Masood, R., Samillah, Afridi, Z., Masood, K., Khan, B., & Khurshied, F. (2012). Laparoscopic cholecystectomy in acute gallbladder. *JPMI: Journal of Postgraduate Medical Institute*, *26*(2), 212-217.

Mayoux-Benhamou, A., Giraudet-Le Quintrec, J., Ravaud, P., Champion, K., Dernis, E., Zerkak, D., & ... Dougados, M. (2008). Influence of patient education on exercise compliance in rheumatoid arthritis: A prospective 12-month randomized controlled trial. *Journal of Rheumatology*, *35*(2), 216-223.

Mazeh, H., Mizrahi, I., Dior, U., Simanovsky, N., Shapiro, M., Freund, H., & Eid, A. (2012). Role of antibiotic therapy in mild acute calculus cholecystitis: A prospective randomized controlled trial. *World Journal of Surgery*, *36*(8), 1750-1759. doi:10.1007/s00268-012-1572-6

Nakeeb, A., Comuzzie, A.G., Martin, L., Sonnenberg, G.E., Swartz-Basile, D., & Kissebah A.H. (2002). Gallstones: Genetics versus environment. *Annals of Surgery*, *235*(12), 842-849.

Nawaiseh, K., & Ajarma, K. (2010). Laparoscopic versus open cholecystectomy in the treatment of acute cholecystitis. *Middle East Journal of Internal Medicine*, *3*(1), 38-41.

MATHEW CLINICAL CASE STUDY

Nikfarjam, M., Niumsawatt, V., Sethu, A., Fink, M. A., Muralidharan, V., Starkey, G., & ...

Christophi, C. (2011). Outcomes of contemporary management of gangrenous and non-gangrenous acute cholecystitis. *HPB: The Official Journal of The International Hepato-Pancreato-Biliary Association*, 13(8), 551-558. doi:10.1111/j.1477-2574.2011.00327.x

Nworah, U. (2012). From documentation to the problem: Controlling postoperative pain.

Nursing Forum, 47(2), 91-99. doi:10.1111/j.1744-6198.2012.00262.x

Ohio Board of Nursing (OBN). (2013). *The formulary developed by the Committee on*

Prescriptive Governance. Retrieved from

http://www.nursing.ohio.gov/PDFS/AdvPractice/1-20-13_Formulary.pdf

Pagana, K. D. & Pagana, T. J. (2010). *Mosby's manual of diagnostic and laboratory tests*. St.

Louis, MI: Elsevier, Inc.

Papadakis, M., McPhee, S. J., & Rabow, M.W. (2013). *Current medical diagnosis and*

treatment. New York, NY: McGraw-Hill Companies, Inc.

Penny, S. M. (2012). Clinical signs of pancreatitis. *Radiologic Technology*, 83(6), 561-581.

Qandil, A. M. (2012). Prodrugs of nonsteroidal anti-inflammatory drugs (NSAIDs), more than

meets the eye: A critical review. *International Journal of Molecular Sciences*, 13(12),

17244-17274. doi:10.3390/ijms131217244

Riall, T. S., Zhang, D., Townsend, C. M., Kuo, Y., & Goodwin, J. S. (2010). Failure to perform

cholecystectomy for acute cholecystitis in elderly patients is associated with increased

morbidity, mortality, and cost. *Journal of The American College of Surgeons*, 210(5),

668-677. doi:10.1016/j.jamcollsurg.2009.12.031

Ruhl, C.E. & Everhart, J.E. (2011). Gallstone disease is associated with increased mortality in

the United States. *Gastroenterology*, 140(12), 508-516.

MATHEW CLINICAL CASE STUDY

Shuja, A., Bashir, A., & Rashid, A. (2011). Optimal timing for surgery in acute gallstone disease.

Professional Medical Journal, 18(2), 237-242.

Solomkin, J. S., Mazuski, J. E., Bradley, J. S., Rodvold, K. A., Goldstein, E. C., Baron, E. J., &

... Bartlett, J. G. (2010). Diagnosis and management of complicated intra-abdominal infection in adults and children: Guidelines by the Surgical Infection Society and the Infectious Diseases Society of America. *Clinical Infectious Diseases, 50(2), 133-164.*

doi:10.1086/649554

Strasberg, S. (2008). Clinical practice. Acute calculous cholecystitis. *New England Journal of*

Medicine, 358(26), 2804-2811.

Summers, S., Scruggs, W., Menchine, M., Lahham, S., Anderson, C., Amr, O., & ... Fox, J.

(2010). A prospective evaluation of emergency department bedside ultrasonography for the detection of acute cholecystitis. *Annals of Emergency Medicine, 56(2), 114-122.*

doi:10.1016/j.annemergmed.2010.01.014

Tang, R. S., & Chan, F. K. (2012). Therapeutic management of recurrent peptic ulcer disease.

Drugs, 72(12), 1605-1616. doi:10.2165/11634850

The Joint Commission (TJC). (2012). *TJC Standards for Pain Management. Comprehensive Accreditation Manual for Critical Access Hospitals (CAMCAH): The official handbook.*

Retrieved from

http://www.jointcommission.org/standards_information/cah_requirements.aspx

Thune, A., Baker, A., Saccone, G.T., Owen, H., & Toouli, J. (1990). Differing effects of

pethidine and morphine on human sphincter of oddi motility. *British Journal of Surgery, 77(9), 992-995.*

MATHEW CLINICAL CASE STUDY

- Tonolini, M., Ravelli, A., Villa, C., & Bianco, R. (2012). Urgent MRI with MR cholangiopancreatography (MRCP) of acute cholecystitis and related complications: Diagnostic role and spectrum of imaging findings. *Emergency Radiology, 19*(4), 341-348. doi:10.1007/s10140-012-1038-z
- Tsuboi, S., Hayakawa, T., Kanda, H., & Fukushima, T. (2011). Physical activity in the context of clustering patterns of health-promoting behaviors. *American Journal of Health Promotion, 25*(6), 410-416.
- Virmani, V., Papadatos, D., Fasih, N., Kielar, A., Gulati, A., & Sethi, V. (2012). Rule out appendicitis: "To be or not to be". *Canadian Association of Radiologists Journal, 63*(1), 47-60. doi:10.1016/j.carj.2010.06.001
- Vissers, R., & Lennarz, W. (2010). Pitfalls in appendicitis. *Emergency Medicine Clinics of North America, 28*(1), 103. doi:10.1016/j.emc.2009.09.003
- Watkins, R., & Lemonovich, T. (2011). Diagnosis and management of community-acquired pneumonia in adults. *American Family Physician, 83*(11), 1299-1306.
- Zaliekas, J., & Munson, L. (2008). Complications of gallstones: The Mirizzi syndrome, gallstone ileus, gallstone pancreatitis, complications of "lost" gallstones. *Surgical Clinics of North America, 88*(6), 1345-1368.