Colon Cancer and Gastrointestinal Imaging: A Case Report

Abstract

Colorectal cancer is a primary cause of death in the United States. The colon and rectum form cancerous malignant tumors or polyps on the inner mucosal lining of the bowel that can metastasize and impede proper cell functioning. Various prescreening methods detect colorectal cancer including fecal occult blood test (FOBT), colonoscopy, computed tomography colonography (CTC), and colon capsule endoscopy (CCE). Diagnosis and treatment vary depending on the type and location of colorectal cancer. Innovative therapies are being developed to target colorectal carcinoma. Rare incidents of colorectal cancer have been diagnosed including primary choriocarcinoma. One such incident reports a 36 year old male with the primary complaint of upper abdominal pain. This report includes diagnosis and characteristics found in similar studies.

Introduction

Colorectal cancer is the second leading cause of mortality in the United States.\(^1\) In the year 2013 approximately 50,830 United States Americans have died from colon and rectal cancer.\(^2\) An individual’s lifetime risk of colorectal cancer is nearly 6 percent based on a positive family history of colorectal cancer.\(^3\) Therefore, it is recommended that anyone 40 years of age and above should undergo colorectal cancer screening.

Colorectal cancer originates in the lining of the colon and rectum which are segments of the gastrointestinal tract. The upper portion of this intricate system includes the mouth, esophagus, stomach, and small intestine. The small intestine provides significant nutrients and compounds that are broken down and absorbed by the body. After absorption, the lower digestive system removes any byproduct waste through the colon, rectum, and anus. The colon consists of four regions including the ascending colon, transverse colon, descending colon, and sigmoid colon. The sigmoid colon and rectum are common regions for colorectal cancer formation.\(^1\)

Colon cancers arise from abnormal cell development usually in the form of polyps. Polyps on the inner lining of the large intestine or rectum start as benign and can progress into
malignant tumors. These tumors can metastasize throughout the body into vital organs inhibiting proper function. In rare circumstances, malignant tumors can develop from nongestational primary choriocarcinoma (see Figure 1). These are highly aggressive tumors that develop from trophoblastic cells originating in the colon. 4

**Colorectal Cancer Classifications**

*Type I: Adenomatous Carcinoma*

Adenomatous carcinoma encompass 95% of all colon cancers and adenomatous polyps are considered a precancerous condition. 3 When polyps become malignant they spread from the lining of the colon through blood vessels or lymph vessels, which can metastasize to distal areas such as the liver and lungs.

Patients with adenomatous carcinoma often experience abdominal pain and have a difficult time defecating. Malignant adenomatous cancer cells typically diffuse to adjacent tissues and invade the superficial serosa layers. Adenomatous carcinoma is often found in conjunction with other cancer types such as choriocarcinoma.

Diagnosis of adenomatous carcinoma is dependent on a combination of computed tomography, endoscopy, and ultrasound. Accurate and early diagnosis of adenomatous carcinoma is imperative for effective treatment. 5

*Type II: Gastrointestinal Carcinoma*

Gastrointestinal carcinoid tumors originate from neuroendocrine cells. Neuroendocrine cells are dispersed throughout the intestines to help regulate the release of digestive juices and initiate the peristalsis of food. Neuroendocrine cells also help control the growth of other gastric cells. 1 Abnormal changes in neuroendocrine cells cause them to enlarge and become malignant. Malignant gastrointestinal carcinoid tumors typically spread throughout the body and release abnormal amounts of neuroendocrine hormone. Increased neuroendocrine hormone causes symptoms of tachycardia, diarrhea, wheezing, and flushing of the skin. 1

Treatment for gastrointestinal carcinoma is dependent on the size and location of the tumor, whether it has metastasized to other areas of the body, if the patient has other medical conditions, and if the tumor is inflicting specific symptoms. 1
Type III: Gastrointestinal Stromal Tumors (GIST)

Gastrointestinal stromal tumors (GIST) originate from specific cells found in the GI tract lining called interstitial cells of Cajal (ICCs). ICCs are cells of the autonomic nervous system which regulate food digestion by signaling muscle contraction. They are located primarily in the stomach and the small intestine and are often benign. GISTs are associated with gastrointestinal bleeding. Blood is often found in the stool making it black and tarry in appearance. Vomiting can occur when GISTs are located in the stomach or esophagus.

Causes of GIST are not well known. Evidence shows that mutated genes called c-kit and PDGFRA can be inherited increasing the chances of developing GIST. Individuals suffering from neurofibromatosis type 1 and carney stratakis syndrome are also prone to developing GIST.

Type IV: Lymphomas

Colorectal lymphomas originate in the immune system and are considered abnormal lymphocytes. Lymphomas can be subtyped into aggressive (quickly developed) or indolent (slowly developed) and can be formed by B-cells or T-cells. Lymphocytes assist the body in battling infection. When lymphocytes function abnormally, antibody formation is hindered and resulting infection may occur.

Type V: Sarcomas

Sarcomas are tumors which form in blood vessels, muscles, and connective tissues within the lining of the colon and rectum. They are uncommon and may be caused by inflammation or injury to soft tissue. Unlike malignant tumors, sarcomas are not derived from a singular abnormal cell or extend to nearby tissue.

Diagnostic Imaging of Colorectal Cancer

Although colorectal cancer has a high mortality rate, an early detection is the key to a more successful prognosis. Colorectal cancer may be detected through home based screening and clinical examination. Screening preference may be determined by age, mobility, and previous cancer diagnosis. Frequently used methods for colorectal cancer screening are fecal occult blood test (FBOT), colonoscopy, computed tomography colonography (CTC), and colon capsule
endoscopy (CCE). All methods of screening require patients to prep the day before an examination except FBOT.

**Fecal Occult Blood Testing**

Fecal occult blood testing is used to find and detect blood present in stool. Cancerous polyps have fragile blood vessels which are easily damaged by the passage of stool causing occult blood to be present. Patients receive a kit from their practitioner with instructions and indicator pads to be used at home or in a clinic. After the patient has a bowel movement the indicator pad is placed with the stool. A change in the coloring of the indicator specifies a positive or negative occult blood reading. The test is to be completed three times to exclude any false negative readings.\(^1\) Results are sent to a medical laboratory to be read and reported.

**Colonoscopy**

Colonoscopy entails the use of a scope through the rectum and colon for examination of the lower digestive system. Images from the scope are displayed on a screen for immediate visualization of the colon. The process is completed in a medical facility with a colon specialist, nursing staff, and an anesthesiologist. When sedation is used, patients are often required to stay in the facility afterwards for monitoring. Colonoscopy is a preferred exam because of its precision in diagnosing colorectal cancer earlier. Patients report colonoscopies deliver a more immediate and personal diagnosis with their physician.\(^6\) Due to the ability to remove and biopsy polyps, colonoscopy is the ideal way to treat and screen for colorectal cancer even though it is invasive and has risks.

**Computed Tomography Colonoscopy (CTC)**

Computed tomography colonography (CTC) is a new and less invasive method to prescreen for colorectal cancer. CTC allows high risk patients to prescreen for colorectal cancer without undergoing the unnecessary complications of colonoscopy. CTC is a more comfortable procedure and circumvents the need for patients to be sedated during the colorectal screening making CTC safer and less time consuming. However, both CTC and colonoscopy require additional diagnostic testing to be performed if colorectal cancer is suspected. Current research is
being conducted to determine the effectiveness of CTC as opposed to colonoscopy by comparing the need for additional diagnostic tests until colorectal cancer is diagnosed.\textsuperscript{6}

One such trial randomly recruited patients suspected of colorectal cancer from 21 United Kingdom hospitals. “The most frequently presenting symptoms were change in bowel habit, rectal bleeding, and abdominal pain.” \textsuperscript{6(p.1198)} Patients had to be 55 years of age or older and also have the capability to safely undergo the colonoscopy procedure as stated by a clinician. “Patients were randomly assigned (2:1) to colonoscopy or CTC by computer-generated random numbers, in blocks of six, stratified by trial centre and sex.” \textsuperscript{6(p.1194)} “1610 patients were randomly assigned to receive either colonoscopy (n=1072) or CTC (n=538). Thirty patients withdrew consent, leaving for analysis 1047 assigned to colonoscopy and 533 assigned to CTC; 160 (30.0\%) patients in the CTC group had additional colonic investigation compared with 86 (8.2\%) in the colonoscopy group.” \textsuperscript{6(p.1194)} CTC identified 1 of 29 colorectal cancers and colonoscopy detected 55 out of 55 colorectal cancers.\textsuperscript{6}

CTC provides for a great alternative or pre procedural test to colonoscopy because of its convenience and comfort, but with CT examinations becoming more popular, further research should be made to evaluate radiation dose for colonoscopy in comparison to CT as colonoscopy is often guided by fluoroscopy.

\textit{Colon Capsule Endoscopy (CCE)}

Colon capsule endoscopy (CCE) can ease any discomfort a colon screening may induce. CCE is a way to view the colon without sedation or air insufflation via a video capsule.\textsuperscript{7} The CCE capsule is ingested, along with oral laxative boosters, to help promote progression through the alimentary canal. CCE is the first colorectal imaging test to be performed in an out-of-clinic setting, and it has the ability to view small bowel mucosa. The video capsule has a wide angle of view up to 172 degrees and a capture rate of 35 images per second.\textsuperscript{7} CCE has gained increased popularity and is used in conjunction with other screenings such as colonoscopy.

To test CCE’s efficiency, patients suspected of colonic disease with a mean age of 57 years were recruited to perform the screenings at home with instructions and the necessary supplies.\textsuperscript{7} The day before the CCE screening, participants were placed on a clear liquid diet and given their specific time frames to swallow their endoscopic capsule. Furthermore, patients were given a data recorder (DR3) to provide signals to inform them of the capsules location in their
body. These signals let the participants know when to ingest the oral laxatives if the capsule was not in a specific location at a certain time. In case the screening had not been completed within 30 minutes, a suppository was given to the participants for insertion. When the DR3 stopped receiving a signal, an end of procedure icon would display on the LCD screen. This indicated the capsule had been defecated or the batteries had depleted. The patients were then instructed to drive to the nearest health clinic to get feedback. A follow up colonoscopy exam was recommended if any polyps or lesions were traced.

Overall, CCE was successful at prescreening for polyps and lesions in an out-of-clinic setting. All participants were able to comply with the procedural instructions and follow the DR3 signals. Only 13 out of 41 patients had to take a suppository to help excrete the capsule. CCE has an advantage over other procedures, like computed tomography and colonoscopy, because no medical staff is required and sedation is not needed. CCE is comparable to the fecal colorectal screening test; with the exception that CCE gives more definitive information. The disadvantage of CCE is cost and the need of further testing if polyps or lesions are found.

**Colorectal Cancer Therapy and Treatment**

Treatment for colorectal cancer is nonsystematic because of the wide variety of cell types that differentiate and form cancerous tumors. There are two theories surrounding carcinogenesis. The first contributes tumor progression to successive mutations in oncogenes and tumor suppressor genes. The second encompasses the idea that a small division of cancer stem cells within a carcinoma can commence and sustain tumor growth via mutation, proliferation, and invasivity.

Colon cancer is said to be a “stem cell disease.” It is a “stem cell disease” because neoplastic cells within a carcinoma have regenerative growth capabilities and they produce additional abnormal cells. “Cancer stem cells possess high levels of ATP-binding cassette (ABC) transporters and antiapoptotic molecules, active DNA repair, slow replication capacities and they produce growth factors that confer refractoriness to antineoplastic treatments. The inefficiency of conventional therapies toward the stem cell population might explain cancer chemoresistance and the high frequency of relapse shown by the majority of tumors.”

Cancerous tumors elude destructive signals from therapeutic drugs because most drug therapies, including chemo, target rapidly differentiating cancer cells while overseeing the slowly dividing
ones. This oversight is due to disruption in cellular pathways that control proliferation, differentiation, and apoptosis making cancer stem cells harder to pinpoint and destroy.\(^8\)

Most types of colorectal cancer have been treated singly or in conjunction with surgical removal, radiation, drug therapy, and stem cell transplant. Most conventional therapies have proven to be ineffective in many colorectal cancer cases. Research is being directed toward cellular and molecular immunology due to the fact that cancer cells are less immunogenic than normal cell. This suggests that the body, with adequate stimulation, may be able to produce strategies of increasing antitumor responses on its own.\(^8\) It is imperative that further research be directed toward differentiating cancer cells and the innovative therapies being developed to counteract them.

**Case Study**

Choriocarcinoma is predominantly found in the female genital tract and is sometimes found in the male testes.\(^4,9\) In rare cases, choriocarcinoma can originate in the colon and is called primary non-gestational choriocarcinoma (PCC). It is diagnosed more often in women than in men.\(^8\) Primary non-gestational choriocarcinoma develops from highly malignant tumors of trophoblastic cells inside the colon and is associated with adenocarcinoma. There are only 14 cases of PCC reported with a median age of 52 years ranging from 29-74 years. Of the 14 cases diagnosed there were 6 men and 8 women.\(^4\)

A 36 year old male patient consulted a local hospital concerning upper abdominal pain. The patient was prediagnosed with acute appendicitis and an appendectomy was ordered. A sizable tumor was located in the colon while conducting the appendectomy. The operation was then postponed because of the magnitude and difficulty of removing the tumor. After a few days, a computed tomographic scan (CT) was ordered for the patient’s abdomen. The scan exposed a mass located in the ascending colon and metastases into the surrounding lymph nodes and liver (see Figure 2).

The patient was transferred to another hospital for treatment. Further studies were performed on the tumor resulting in the tumor markers carcinoembryonic antigen, cancer antigen (CA) 19-9, and CA 125 falling within normal range.\(^9\) His serum beta human chorionic growth hormone (β-HCG) however was at the level of 3.38mIU/ml.\(^9\) Upon execution of a colonoscopy,
a yellow tumor was discovered in the colon. Removed biopsies from the colon suggested the tumor was made up of poorly differentiated adenocarcinoma.

A colectomy was performed removing a tumor 4cm x 5cm which was encompassed by serosa, mesocolic fat, and 12 enlarges neighboring lymph nodes. Upon examination, the surrounding serosa in the interstitial wall was determined to be composed of syncytiotrophoblastic, cytotrophoblastic like, and intermediate cytotrophoblastic cells. Necrosis and hemorrhaging of the area was also apparent.

The patient was treated with systemic chemotherapy using bleomycin, with etoposide and platinum implementation. Initial results of the chemotherapy showed increased amounts of the β-HCG hormone rising from 3.38 mIU/ml to 10,000mIU/ml and another tumor in the liver. β-HCG remained high after three more cycles of chemotherapy was utilized. The severity in malignancy of the PCC deterred the patient and his family from undergoing anymore regimens of chemotherapy.

Choriocarcinoma typically follows gestational events like molar pregnancy, normal or ectopic pregnancy, or abortion. When PCC develops it is typically in the stomach. PCC cases in the colon are rare and typically have a poor prognosis. The mean age of detection for PCC of the colon is 51.4 years and the male to female ratio 1.6:1. Of the patient reported, 61.5 percent of patients presented with tumors in the proctosigmoid, the other percentage of patients presented with tumors in the ascending colon.

Theories about the initiation and development of PCC include retained primordial germ cells that migrated abnormally during embryonic development, metastasis from a latent primary lesion of the genitalia, and the retrodifferentiation of preexisting colonic carcinoma. Retrodifferentiation of preexisting colonic adenocarcinoma is the more widely excepted theory given that 69.2 percent of patients with PCC had adenocarcinoma evident in their test results. Patients with widespread metastasis had ineffective outcomes with tumor resection, while patients with low metastasis had higher survival rates with surgical removal and chemotherapy adjoined. Metastatic tumors were evident in distal organs, such as the liver, in 10 out 14 of the diagnosed patients. There is only 1 of the 14 cases that had survived longer than 60 months without relapse after treatment. The association of β-HCG with choriocarcinoma and adenocarcinoma is still not apparent, except that β-HCG can be used as a marker of treatment effectiveness. Another therapeutic indicator is the collagen gel droplet embedded culture drug...
sensitivity test (CD-DST). CD-DST involves culturing PCC outside of the body and treating it with several antitumor drugs, including oxaliplatin (OHP), to test its sensitivity to treatment. The most common chemotherapy treatment for PCC is a mixture of etoposide, methotrexate, dactinomycin, and alternate use of cyclophosphamide and vincristine (EMA-CO).4

In comparison to other choriocarcinoma types, chemotherapy for PCC is less effective and the cause is unknown. A theory is that PCC does not originate from ectopic germ cells; this links treatment effectiveness with the origin of the cancerous cells. The median survival period for PCC is 4mo (range, 0.3-60 mo).4 Though a standard regime of chemotherapy prolongs life expectancy, there is no set schedule of chemotherapy administration for PCC patients.4 With advancement in drug therapies and immunology, treatment is becoming more successful and patients’ prognoses more optimistic.

Conclusion

The origin of colorectal cancer is tentative; it rests somewhere between the ideas of inherited cellular anomalies to highly regenerative stem cells that differentiate from previously developed cancers. What is definitive is that colorectal carcinoma affects many cell types ranging from the adenomatous cells lining the colon to the white blood cells that protect it. Because colorectal cancer is so diverse, it is the third most common cancer type in both men and women.2 It not only affects individuals 40 years of age and above, it affects anyone. Notwithstanding, incident rates of colorectal cancer have diminished due to the increased use of colorectal cancer screening tests. Fecal occult blood test (FBOT), colonoscopy, computed tomography colonography (CTC), and colon capsule endoscopy (CCE) allow individuals to detect and remove polyps before they develop into cancer. With innovations being made to prescreening technologies and drug therapies, incidents rates for all cancer types will continue to subside.
References


Figures and Captions

Figure 2. Images A and B view the thickened wall of the ascending colon, enlarged lymph nodes of the mesentery, and the ring shaped lesion on the liver. Image courtesy of: Jiang L, Wu JT, Peng X. Primary choriocarcinoma of the colon: a case report and review of the literature, WJSO. 2013;11:23.