



Retrospective Study

Safety of endoscopy in patients undergoing treatments with antiangiogenic agents: A 5-year retrospective review

Mohammad Azam, Amit Hudgi, Pearl Princess Uy, Jinal Makhija, John Erikson L Yap

Specialty type: Gastroenterology and hepatology

Provenance and peer review: Unsolicited article; Externally peer reviewed.

Peer-review model: Single blind

Peer-review report's scientific quality classification

Grade A (Excellent): A

Grade B (Very good): 0

Grade C (Good): C

Grade D (Fair): 0

Grade E (Poor): 0

P-Reviewer: Cabezu AS, Spain; Trna J, Czech Republic

Received: February 28, 2022

Peer-review started: February 28, 2022

First decision: April 13, 2022

Revised: May 8, 2022

Accepted: June 15, 2022

Article in press: June 15, 2022

Published online: July 16, 2022



Mohammad Azam, Amit Hudgi, Department of Internal Medicine, Medical College of Georgia/Augusta University, Augusta, GA 30912, United States

Pearl Princess Uy, John Erikson L Yap, Division of Gastroenterology, Medical College of Georgia/Augusta University, Augusta, GA 30912, United States

Jinal Makhija, Department of Internal Medicine, Rush University Medical Center, Chicago, IL 60612, United States

Corresponding author: John Erikson L Yap, MD, Assistant Professor, Division of Gastroenterology, Medical College of Georgia/Augusta University, 1120 15th Street, Augusta, GA 30912, United States. jyap@augusta.edu

Abstract

BACKGROUND

Antiangiogenic agents (AAs) are increasingly used to treat malignant tumors and have been associated with gastrointestinal (GI) bleeding and perforation. Elective surgeries and endoscopy are recommended to be delayed for 31 d until after AAs treatment. Data regarding the safety of endoscopy while on antiangiogenic agents is extremely limited. No guidelines are in place to address the concern about withholding these anti-angiogenic drugs.

AIM

To evaluate the risks of endoscopy in patients on antiangiogenic agents from 2015 to 2020 at our institution.

METHODS

This is a single centered retrospective study approved by the institutional review board statement of the institution. Patients that underwent endoscopy within 28 d of antiangiogenic agents' treatment were included in the study. Primary outcome of interest was death, and secondary outcomes included perforation and GI bleeding. Data were analyzed utilizing descriptive statistics. Fifty-nine patients were included in the final analysis and a total of eighty-five procedures were performed that were characterized as low risk and high risk.

RESULTS

Among the 59 patients a total of 85 endoscopic procedures were performed with 24 (28.2%) categorized as high-risk and 61 (71.8%) procedures as low-risk. Of the

total number of patients, (50%) were on bevacizumab and the rest were on imatinib (11.7%), lenvatinib (6.7%) and, ramucirumab (5%). The average duration between administration of AAs and the performance of endoscopic procedures was 9.9 d. No procedure-related adverse events were noted among our study population. We did observe two deaths with one patient, on lenvatinib for metastatic hepatocellular carcinoma, who had persistent bleeding despite esophageal variceal banding and died 4 d later from hemorrhagic shock. Another patient was diagnosed with acute myeloid leukemia died 24 d after an esophagogastroduodenoscopy with biopsy after transition to comfort care.

CONCLUSION

As per this single center retrospective study, the rate of endoscopic procedure-related adverse events and death within 28 d of AA administration appears to be low.

Key Words: Antiangiogenics; Endoscopy; Bevacizumab; Lmatinib; Lenvatinib; Adverse events

©The Author(s) 2022. Published by Baishideng Publishing Group Inc. All rights reserved.

Core Tip: This single centered study highlights low adverse events of anti-angiogenics after endoscopic procedures. Currently, the consensus recommends holding anti-angiogenics 28 d prior to the procedure. This small sample study sheds light on the need to hold anti-angiogenics prior to endoscopic procedure and affirms to not delay emergent endoscopic procedures.

Citation: Azam M, Hudgi A, Uy PP, Makhija J, Yap JEL. Safety of endoscopy in patients undergoing treatments with antiangiogenic agents: A 5-year retrospective review. *World J Gastrointest Endosc* 2022; 14(7): 416-423

URL: <https://www.wjgnet.com/1948-5190/full/v14/i7/416.htm>

DOI: <https://dx.doi.org/10.4253/wjge.v14.i7.416>

INTRODUCTION

Angiogenesis is a complex process of forming vascular network by endothelial cells proliferation mediated by growth factors like vascular endothelial growth factors (VEGF), insulin like growth factors, fibroblast growth factors and hypoxia inducible factors. It is first initiated during embryogenesis from mesodermal precursor cells, later repeated during process of healing. Similarly, when tumor cells are subjected to hypoxia, they produce growth factor leading to angiogenesis. This not only provide a source of nutrition but also a means for metastasis.

Folkman postulated the idea of antiangiogenic agents (AAs) as an effective cancer therapy in early 1970[1]. Currently, AAs are widely used in the treatment of malignant tumors owing to their effectiveness in increasing survival. Monoclonal antibodies, VEGF decoy receptor, and small molecule tyrosine kinase inhibitors are three major classes of anti-angiogenics currently in clinical practice[2]. However, VEGF also play a crucial role in wound healing and the use of AAs may potentially lead to complications such as bleeding and impaired wound healing[1,3].

Post-procedure adverse events were higher among patients receiving AAs[4]. The potential for increased occurrence of complications such as bleeding among cancer patients on AAs after procedures have led to the postponement of elective surgical procedures and endoscopies for at least 28 d after AA treatment. The mechanism of gastrointestinal (GI) perforation is attributed to splanchnic or mesenteric thrombi, impaired healing and proliferation, decreased blood supply to intestinal wall, and decreased stability secondary to tumor destruction have been postulated[5]. There is limited and inconsistent data in the literature regarding the rate of adverse events during endoscopy among patients on AAs. Imbulgoda *et al*[6] reported two complications of perforation (2/80 patients) in patient receiving bevacizumab while undergoing placement of self-expanding metal stent. More recently Kachaamy *et al* [7] revealed a low adverse event of 1.6% (7/455) in patients receiving AA. The cautious approach of delaying even low risk endoscopic procedures among patients receiving AAs may have resulted from the extrapolation of findings from studies of surgical procedures where increased adverse events like bleeding and impaired wound healing were observed[4]. It is important to note that endoscopic procedures are not as invasive as other surgical procedures and recommendations should not be solely based on data from surgical procedures.

In this single centered study, we reviewed medical records of the patients who underwent GI endoscopy after receiving anti-angiogenics therapy within the past 28 d. Here we aim to investigate 30 d adverse events in patients receiving AA undergoing an endoscopic procedure.

MATERIALS AND METHODS

Study design and patient population

This is a single center retrospective study conducted at a non-National Cancer Institute (NCI) designated hospital specializing in treatment of cancers in the state of Georgia, United States. Inclusion criteria for the study were: (1) Patients receiving treatment with AAs including vascular endothelial growth factor (VEGF), VEGF receptor inhibitors, epidermal growth factor receptor inhibitors, multi-targeted tyrosine kinase inhibitors, and mammalian target of rapamycin inhibitor; and (2) Patients undergoing endoscopic procedures within 28 d of AA administration between from January 1, 2015 - March 31, 2020. Exclusion criteria included: Age less than 18 years old. All patients undergoing endoscopic procedures within 28 d after administration of AAs were included in the study analysis. The Augusta University Investigation Review Boards approved this study.

Patients who met the inclusion and exclusion criteria were identified using I2B2 software, and details regarding the endoscopic procedures and the timing of AA administration were obtained from the electronic medical records. Endoscopic procedures were categorized as either high risk or low risk based on existing literature regarding endoscopic procedural risks associated with antithrombotic agents[8]. Low risk procedures included diagnostic endoscopies or with biopsy. In contrast, high risk procedures consisted of stent placements, gastrostomy tube placements, snare polypectomy, endoscopic retrograde cholangiopancreatography, and endoscopic ultrasound with fine needle aspiration.

Statistical analysis

Statistical analyses were performed utilizing simple descriptive statistics including percentages and frequencies. The demographic data, the mortality rate and the endoscopic adverse events were analyzed using descriptive statistics. The primary outcome measure was mortality rate within 30 d of endoscopy whereas the secondary outcome measures were procedure-related adverse events such as bleeding and perforation within 30 d of endoscopy. The adverse events were labeled according to the common terminology criteria for adverse events version (have version 5.0 now) which defines adverse events (AEs) as an unintended and unfavorable outcome associated with a medical treatment or procedure that may or may not be associated to the medical treatment or procedure. Classification of the severity of AEs were based on a grading system from 1 to 5 wherein 1 is mild, 2 is moderate, 3 is severe, 4 is life-threatening and 5 is death. The mortality rate and incident rate of AEs were determined using the total number of study participants as the denominator.

RESULTS

Patient characteristics

Fifty-nine patients (M/F = 25/34) were included in this study who underwent a total of 85 endoscopic procedures. The mean age of the study population was 64.9 years at the time of endoscopy. Majority of the patients were Caucasians (54.2%) or African Americans (40.7%). The most common malignancy types were colorectal cancer (20.7%), liver (11.9%), ovarian (10.2%) and lung (10.2%); and the majority (59.3%) had stage IV metastatic disease at the time of endoscopy (refer to [Table 1](#)). Thirty patients (50%) were on bevacizumab whereas other patients were on imatinib (11.7%), lenvatinib (6.7%), ramucirumab (5%) as detailed on [Table 2](#). One of the patients with the diagnosis of acute myeloid leukemia (AML) who was being treated with two anti-angiogenic agents bevacizumab and sorafenib.

Procedures

A total of 85 endoscopic procedures were performed with 24 (28.2%) categorized as high-risk and 61 (71.8%) procedures as low-risk. High risk procedures included variceal bleeding control, percutaneous gastrostomy tube placement, pneumatic balloon dilation, and stent placement while low-risk included diagnostic procedures along with mucosal biopsies. The average duration between administration of AAs and the performance of endoscopic procedures was 9.9 d ([Table 3](#)).

Adverse events and mortality

Among the eighty-five endoscopic procedures that were performed, there were no procedure related adverse events that were documented. One patient on lenvatinib therapy for metastatic hepatocellular carcinoma had persistent bleeding despite esophageal variceal banding and died 4 d later from hemorrhagic shock. Another patient on sorafenib therapy for AML died 24 d after an esophago-gastroduodenoscopy with biopsy while on hospice care ([Table 4](#)).

Table 1 Baseline characteristics of patient population on anti-angiogenic agents

Characteristics	Anti-angiogenic agents (n = 59)
Age	64.9
Female	34 (57.62%)
Race	
Caucasian	32 (54.2%)
African American	24 (40.7%)
Hispanic	3 (5.1%)
Malignancy sites	
Colorectal cancer	12 (20.3%)
Hepatocellular cancer	7 (11.9%)
Ovarian cancer	6 (10.2%)
Lung	6 (10.2%)
CML/AML	5 (8.5%)
Renal cell cancer	4 (6.8%)
Oropharyngeal cancer	3 (5.1%)
Uterine	2 (3.4%)
Pancreas	2 (3.4%)
Gastric cancer	2 (3.4%)
Fibrosarcoma	2 (3.4%)
Peritoneal carcinomatosis	2 (3.4%)
Cervical cancer	2 (3.4%)
Fallopian tube	1 (1.7%)
Breast cancer	1 (1.7%)
Other	2 (3.4%)
HHT/Hereditary eosinophilia	
Stage of malignancy	
Unstageable	9 (13.6%)
Stage I	1 (1.7%)
Stage II	3 (5.1%)
Stage III	11 (18.6%)
Stage IV	35 (59.3%)

AML: Acute myeloid leukemia.

DISCUSSION

There is limited data on the safety of endoscopy in patients undergoing treatment with AA for oncological malignancies. Most recently, in a retrospective multi-center study by Kachaamy *et al*[7], the safety of endoscopy was investigated to identify adverse events and mortality in cancer patients being treated with AAs and undergoing endoscopy within 31 d of administration of AAs. It was concluded that endoscopy is well tolerated in patients on AAs and the incidence of adverse events was 0.7%, while the 30 d mortality was estimated at 6.5[7]. In our study, no procedural adverse events were observed, and the mortality rate was 2.35%. One of the two patient succumbed to persistent variceal bleeding, and the other patient died after transition to comfort care.

The first AA to be approved for use was bevacizumab for treatment of breast cancer and since then, AAs have played an integral role in the treatment of many oncological conditions[9]. Various AAs have shown a survival benefit for patients undergoing treatment of colorectal, liver, renal-cell, ovarian,

Table 2 Indication for endoscopic procedures

Indication for endoscopy (n = 86)	
GI bleed	29 (33.7%)
Symptomatic (weight loss, abdominal pain, diarrhea, nausea, vomiting, obstruction)	22 (25.6%)
Anemia	5 (5.8%)
Elective diagnostic + follow-up	16 (18.6%)
Dysphagia	9 (10.5%)
Enteral access	5 (5.8%)

GI: Gastrointestinal.

Table 3 Total endoscopic procedures performed and complications

Endoscopic procedures (n = 85)	
1 Esophagogastroduodenoscopy	56
(A) With biopsy	17
(B) With variceal banding	10
(C) With stent	2
(D) With pneumatic dilation	1
(E) With percutaneous gastrostomy tube placement	8
(F) Enteroscopy	1
2 Flexible sigmoidoscopy	6
(A) With biopsy	2
3 Colonoscopy	23
(A) With biopsy	7
(B) With snare	3
(C) With control of bleeding	2
(D) With stent placement	1
Complications	
1 Perforation	0
2 Bleeding	2 (2.35%)
Mortality	2 (2.35%)

endometrial, cervical, breast, and gliomas[10-14]. Bevacizumab and other AAs have been associated with poor wound-healing and increases the risk of complications if undergoing surgical and endoscopic procedures. Current literature suggest that the use of bevacizumab and other VEGF inhibitors can impair wound healing and potentially lead to severe wound healing complications[3]. It is therefore recommended to delay elective surgeries for at least 28 d from the time of AA administration[15,16]. At present, there is no recommendation regarding the timing of endoscopic procedures among patients on AAs. Our study indicates that there were no procedure related AEs when AAs were administered within 28 d of an endoscopic procedure including high-risk ones.

Use of AAs have also been associated with an increased bleeding risk. This was demonstrated in a meta-analysis of 38 randomized controlled trials evaluating safety and efficacy of bevacizumab, which revealed a dose-dependent increased risk of bleeding (RR: 1.36 *vs* 2.87)[17]. Another meta-analysis evaluating 22 studies identified an incidence of high-risk bleeding of 2.8% (95% CI 2.1%-3.8%) among patients receiving bevacizumab[18]. In comparison to the findings of the previously mentioned meta-analysis, our study did not identify any patients with post-procedure bleeding. However, one patient had persistent variceal hemorrhage despite attempts for endoscopic control with variceal ligation.

Table 4 List of antiangiogenic agents

Anti-angiogenic agents (n = 60)	
Vascular-endothelial growth factor inhibitors	
1 Bevacizumab	30
2 Ramucirumab	3
3 Lenvatinib	4
4 Sorafenib	2
Epidermal-growth factor receptor inhibitors	
1 Cetuximab	3
2 Osimertinib	1
Tyrosine-kinase inhibitors	
1 Lapatinib	1
2 Pazopanib	2
3 Imatinib	7
4 Dasatinib	1
5 Sunitinib	2
Mammalian target of rapamycin inhibitor	
1 Everolimus	2
2 Temsirolimus	2

AAs have also been linked with increased gastrointestinal perforation especially if endoscopic interventions like colonic self-expanding stents (SEMS) are attempted. The rate of perforation ranges between 2%-12% among patients undergoing SEMS placement[19,20]. A meta-analysis evaluating effectiveness and safety of monoclonal antibodies including bevacizumab, cetuximab and panitumumab concluded that the use of these agents have serious adverse events including gastrointestinal perforation[20]. This risk of gastrointestinal perforation, even with the performance of high-risk endoscopic procedures, was not seen in our study which supports the findings of the multicenter outcome study by Kachaamy *et al*[7] regarding the safety of endoscopy among patients on AAs.

Strengths of our study include the removal of any potential selection bias with the inclusion of all patients who underwent endoscopic procedures while on AAs. Given that our facility is not an NCI-designated cancer center, the findings of our study are generalizable and applicable to the general practice. Nonetheless, this study is limited by its retrospective nature and small sample size.

CONCLUSION

In this single center retrospective study, the rate of endoscopic procedure-related adverse events and death within 28 d of AA administration are low. Our study results further support the findings of Kachaamy *et al*[7] on the safety of endoscopy among patients on AAs. While it is recommended to hold AAs 28 d prior to the performance of an elective endoscopic procedure, this should not delay the performance of an emergent or urgent endoscopic procedure given its good safety profile. Our study reiterates the safety data of low-risk endoscopic procedures in this sub-group of patients. This also raises further questions about whether there is a need to hold anti-angiogenics in patients on anti-angiogenics prior to high-risk endoscopic procedures. Awareness of newer medication and its implication on our current practice of gastroenterology are crucial for delivering optimal patient care. Future prospective studies should be evaluated in a multicentric larger population groups while keeping in mind that the GI cancers have an inherent increased risk of bleeding and perforation.

ARTICLE HIGHLIGHTS

Research background

High-grade bleeding and perforation are some of the side effects of antiangiogenic agents. The safety of

endoscopy in patients receiving this therapy is unknown. Here we attempt to explore the incidence of bleeding, perforation, and mortality in our single centered study.

Research motivation

With the increased survival rate of cancer patients with newer chemotherapy, more patients would require endoscopic procedures for further surveillance and screening. It is important to assess the safety of endoscopic procedures among patients receiving therapy such as antiangiogenic agents who are at higher risk for bleeding and perforation.

Research objectives

To understand the risk of endoscopy in patients on antiangiogenic agents.

Research methods

We performed a retrospective analysis of patients, on antiangiogenic agents, who were admitted to the hospital at our institute. We used simple descriptive statistics to primarily assess mortality within 30 d of the procedure along with the incidence of bleeding and perforation.

Research results

We found no procedure-related adverse events in our small population study among the patients receiving antiangiogenic agents. These results need to be further confirmed in a multicentric larger population group.

Research conclusions

Our study reveals that endoscopic procedures are safe in patients receiving antiangiogenic agents. It affirms to not delay emergent or urgent endoscopic procedures among this population.

Research perspectives

Future research should be carried out in a multicentric and larger group of the population than the one in this study to further assess the safety of the endoscopic procedure among this population group.

FOOTNOTES

Author contributions: Azam MU and Hudgi AR performed the research, collected the data, wrote the paper, contributed to analysis and reviewed the article; Uy P collected the data and reviewed the article; Makhija J performed the formal analysis; Yap JE conceptualized, supervised the report and approved the final draft submitted.

Institutional review board statement: This study was reviewed and approved by the Ethics Committee of the Augusta University Medical Centre.

Informed consent statement: Patients were not required to give informed consent to the study because the analysis used anonymous clinical data that were obtained after each patient agreed to treatment by written consent.

Conflict-of-interest statement: All authors declare that they have no conflict of interest.

Data sharing statement: The technical appendix, statistical code, and dataset are available from the corresponding author at jyap@augusta.edu. Consent was not obtained as this was a retrospective study. No additional data are available.

Open-Access: This article is an open-access article that was selected by an in-house editor and fully peer-reviewed by external reviewers. It is distributed in accordance with the Creative Commons Attribution Noncommercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: <https://creativecommons.org/licenses/by-nc/4.0/>

Country/Territory of origin: United States

ORCID number: Mohammad Azam 0000-0002-3847-5285; Amit Hudgi 0000-0002-3062-7694; Pearl Princess Uy 0000-0002-0884-3104; Jinal Makhija 0000-0002-6931-5188; John Erikson L Yap 0000-0002-0441-3211.

S-Editor: Wang LL

L-Editor: A

P-Editor: Wang LL

REFERENCES

- 1 **Folkman J.** Role of angiogenesis in tumor growth and metastasis. *Semin Oncol* 2002; **29**: 15-18 [PMID: [12516034](#) DOI: [10.1053/sonc.2002.37263](#)]
- 2 **Al-Husein B, Abdalla M, Trepte M, Deremer DL, Somanath PR.** Antiangiogenic therapy for cancer: an update. *Pharmacotherapy* 2012; **32**: 1095-1111 [PMID: [23208836](#) DOI: [10.1002/phar.1147](#)]
- 3 **Sharma K, Marcus JR.** Bevacizumab and wound-healing complications: mechanisms of action, clinical evidence, and management recommendations for the plastic surgeon. *Ann Plast Surg* 2013; **71**: 434-440 [PMID: [22868316](#) DOI: [10.1097/SAP.0b013e31824e5e57](#)]
- 4 **Tol J, Cats A, Mol L, Koopman M, Bos MM, van der Hoeven JJ, Antonini NF, van Krieken JH, Punt CJ.** Gastrointestinal ulceration as a possible side effect of bevacizumab which may herald perforation. *Invest New Drugs* 2008; **26**: 393-397 [PMID: [18335169](#) DOI: [10.1007/s10637-008-9125-4](#)]
- 5 **Sliesoraitis S, Tawfik B.** Bevacizumab-induced bowel perforation. *J Am Osteopath Assoc* 2011; **111**: 437-441 [PMID: [21803880](#)]
- 6 **Imbulgoda A, MacLean A, Heine J, Drolet S, Vickers MM.** Colonic perforation with intraluminal stents and bevacizumab in advanced colorectal cancer: retrospective case series and literature review. *Can J Surg* 2015; **58**: 167-171 [PMID: [25799132](#) DOI: [10.1503/cjs.013014](#)]
- 7 **Kachaamy T, Gupta D, Edwin P, Vashi P.** Safety of endoscopy in cancer patients on antiangiogenic agents: A retrospective multicenter outcomes study. *PLoS One* 2017; **12**: e0176899 [PMID: [28472195](#) DOI: [10.1371/journal.pone.0176899](#)]
- 8 **ASGE Standards of Practice Committee, Acosta RD, Abraham NS, Chandrasekhara V, Chathadi KV, Early DS, Eloubeidi MA, Evans JA, Faulx AL, Fisher DA, Fonkalsrud L, Hwang JH, Khashab MA, Lightdale JR, Muthusamy VR, Pasha SF, Saltzman JR, Shaikat A, Shergill AK, Wang A, Cash BD, DeWitt JM.** The management of antithrombotic agents for patients undergoing GI endoscopy. *Gastrointest Endosc* 2016; **83**: 3-16 [PMID: [26621548](#) DOI: [10.1016/j.gie.2015.09.035](#)]
- 9 **Gerriets V, Kasi A.** Bevacizumab. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing, 2022 [PMID: [29489161](#)]
- 10 **Shojaei F, Ferrara N.** Antiangiogenic therapy for cancer: an update. *Cancer J* 2007; **13**: 345-348 [PMID: [18032969](#) DOI: [10.1097/PPO.0b013e31815a7b69](#)]
- 11 **Rini BI, Halabi S, Rosenberg JE, Stadler WM, Vaena DA, Archer L, Atkins JN, Picus J, Czaykowski P, Dutcher J, Small EJ.** Phase III trial of bevacizumab plus interferon alfa vs interferon alfa monotherapy in patients with metastatic renal cell carcinoma: final results of CALGB 90206. *J Clin Oncol* 2010; **28**: 2137-2143 [PMID: [20368558](#) DOI: [10.1200/JCO.2009.26.5561](#)]
- 12 **Pal SK, McDermott DF, Atkins MB, Escudier B, Rini BI, Motzer RJ, Fong L, Joseph RW, Oudard S, Ravaud A, Bracarda S, Suárez C, Lam ET, Choueiri TK, Ding B, Quach C, Hashimoto K, Schiff C, Piau-Louis E, Powles T.** Patient-reported outcomes in a phase 2 study comparing atezolizumab alone or with bevacizumab vs sunitinib in previously untreated metastatic renal cell carcinoma. *BJU Int* 2020; **126**: 73-82 [PMID: [32233107](#) DOI: [10.1038/s41591-018-0053-3](#)]
- 13 **Chellappan DK, Leng KH, Jia LJ, Aziz NABA, Hoong WC, Qian YC, Ling FY, Wei GS, Ying T, Chellian J, Gupta G, Dua K.** The role of bevacizumab on tumour angiogenesis and in the management of gynaecological cancers: A review. *Biomed Pharmacother* 2018; **102**: 1127-1144 [PMID: [29710531](#) DOI: [10.1016/j.biopha.2018.03.061](#)]
- 14 **Bose D, Meric-Bernstam F, Hofstetter W, Reardon DA, Flaherty KT, Ellis LM.** Vascular endothelial growth factor targeted therapy in the perioperative setting: implications for patient care. *Lancet Oncol* 2010; **11**: 373-382 [PMID: [20171141](#) DOI: [10.1016/S1470-2045\(09\)70341-9](#)]
- 15 **Gordon CR, Rojavin Y, Patel M, Zins JE, Grana G, Kann B, Simons R, Atabek U.** A review on bevacizumab and surgical wound healing: an important warning to all surgeons. *Ann Plast Surg* 2009; **62**: 707-709 [PMID: [19461291](#) DOI: [10.1097/SAP.0b013e3181828141](#)]
- 16 **Ahmadizar F, Onland-Moret NC, de Boer A, Liu G, Maitland-van der Zee AH.** Efficacy and Safety Assessment of the Addition of Bevacizumab to Adjuvant Therapy Agents in Cancer Patients: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. *PLoS One* 2015; **10**: e0136324 [PMID: [26331473](#) DOI: [10.1371/journal.pone.0136324](#)]
- 17 **Hang XF, Xu WS, Wang JX, Wang L, Xin HG, Zhang RQ, Ni W.** Risk of high-grade bleeding in patients with cancer treated with bevacizumab: a meta-analysis of randomized controlled trials. *Eur J Clin Pharmacol* 2011; **67**: 613-623 [PMID: [21243343](#) DOI: [10.1007/s00228-010-0988-x](#)]
- 18 **Yan FH, Zhang Y, Bian CL, Liu XS, Chen BC, Wang Z, Wang H, Ji-Fu E, Yu ED.** Self-expanding metal stent insertion by colorectal surgeons using a two-person approach colonoscopy without fluoroscopic monitoring in the management of acute colorectal obstruction: a 14-year experience. *World J Surg Oncol* 2021; **19**: 194 [PMID: [34215276](#) DOI: [10.1016/j.clcc.2019.05.009](#)]
- 19 **Lee JH, Emelogu I, Kukreja K, Ali FS, Noguera-Gonzalez G, Lum P, Coronel E, Ross W, Raju GS, Lynch P, Thirumurthi S, Stroehlein J, Wang Y, You YN, Weston B.** Safety and efficacy of metal stents for malignant colonic obstruction in patients treated with bevacizumab. *Gastrointest Endosc* 2019; **90**: 116-124 [PMID: [30797835](#) DOI: [10.1016/j.gie.2019.02.016](#)]
- 20 **da Silva WC, de Araujo VE, Lima EMEA, Dos Santos JBR, Silva MRRD, Almeida PHRF, de Assis Acurecio F, Godman B, Kurdi A, Cherchiglia ML, Andrade EIG.** Comparative Effectiveness and Safety of Monoclonal Antibodies (Bevacizumab, Cetuximab, and Panitumumab) in Combination with Chemotherapy for Metastatic Colorectal Cancer: A Systematic Review and Meta-Analysis. *BioDrugs* 2018; **32**: 585-606 [PMID: [30499082](#) DOI: [10.1007/s40259-018-0322-1](#)]



Published by **Baishideng Publishing Group Inc**
7041 Koll Center Parkway, Suite 160, Pleasanton, CA 94566, USA

Telephone: +1-925-3991568

E-mail: bpgoffice@wjgnet.com

Help Desk: <https://www.f6publishing.com/helpdesk>

<https://www.wjgnet.com>

