

Burkitt's Lymphoma Causing Intussusception in Adults: Report of two Cases and Review of the Literature

Yusuf Yagmur, Serdar Gumus

Yusuf Yagmur, Serdar Gumus, Department of Surgery, Gazi Yaşargil Teaching and Research Hospital, 21070, Diyarbakir, Turkey
Correspondence to: Yusuf Yagmur, MD, Professor of Surgery, Head of Department of Surgery, Gazi Yasargil Teaching And Research Hospital Diyarbakir, Turkey
Email: yusufyagmur@hotmail.com
Telephone: +90-532-7180042
Received: April 16, 2015 Revised: June 39, 2015
Accepted: July 3, 2015
Published online: July 21, 2015

ABSTRACT

BACKGROUND: Burkitt's lymphoma (BL) related intussusception causing intestinal obstruction in adults is very rare. Two cases of BL related ileocecal intussusception were operated in our clinic and treatment options were explained with previous literature.

PATIENTS AND METHOD: The English medical literature in the PubMed and Google Scholar databases was reviewed for adult related ileocecal intussusception, and 10 reports concerning 10 cases of intussusception due to BL were noticed. Our presented two cases of BL related ileocecal intussusception were 17 and 19 years old and both male. both operated due to acute abdomen.

RESULTS: The patients printed in the literature were aged from 16 to 52 years. According to the localization of lymphoma, 6 patients had ileo-colic intussusception, 2 had ileal, and 2 had colic intussusception. In terms of the diagnosis, 10 patients were diagnosed with computerized tomography (CT). Our patient one was 17 years old male complaining from abdominal pain, distention and not passing gas and flatus, having rebound and tenderness on the abdomen. Bowel sounds were increased and abdomen was distended. Laboratory values were normal. Patient was HIV negative and EBV was negative. CT showed "target"-shaped soft-tissue mass with a layering effect of ileo-colic intussusception. At exploration

ileum was invaginated through ileocecal valve to cecum. Cecum mass about 5 cm in diameter was noticed. Right hemicolectomy and ileocolic anastomosis was performed. Macroscopy showed 6×5.5 cm polypoid tumor formation blocked the lumen. A few lymph node with the largest 2.5×2 cm were dissected in the mucosa. On immunohistochemical studies; CD20 in CD10 staining were observed strong positive staining. TdT, CD23, CD5 and bcl-2 staining were not observed. Ki-67 proliferation index was evaluated as 100%. Tumor involvement was observed diagnosis was BL. Our other patient 19 years male patients with abdominal pain and constipation. There was no history of weight loss or fever. Physical examination showed defans and rebound in the right lower quadrant of abdomen in both patients. Bowel sounds were increased. No evidence of any lymph nodes during systematic examination appeared. Laboratory values were normal with negative HIV. In situ hybridization for EB virus was negative forms of sporadic BL. Intravenous contrast for abdominal tomography was taken and A "sausage"-shaped soft tissue mass with ileo-colic intussusception appeared. 4 cm mass in the terminal ileum was palpated. patient had ileal resection and ileoileal anastomosis. Pathology showed a tumor 4 cm in diameter blocked ileum completely and infiltrated serosa of ileum. immunohistochemical studies CD20, CD10 staining were positive, CD3, CD5, CD23, bcl-6 and TdT staining were negative. Ki-67 proliferation index was 100%. Burkitt's lymphoma was diagnosed in the location of terminal ileum. Both patients was discharged with good bowel movements without any complication and referred to the hematology for chemotherapy treatment. Complete resection is very important and improve survival.

CONCLUSION: BL related intussusception is very rare in adults. Complete resection is required and improve patient survival.

© 2015 ACT. All rights reserved.

Key words: Burkitt's Lymphoma; Intussusception; Adult

Yagmur Y, Gumus S. Burkitt's Lymphoma Causing Intussusception in Adults: Report of two Cases and Review of the Literature. *Journal of Gastroenterology and Hepatology Research* 2015; 4(7): 1702-1689 Available from: URL: <http://www.ghrnet.org/index.php/joghr/article/view/1305>

INTRODUCTION

Burkitt's Lymphoma (BL) is usually noticed in children and young adults, and rarely in middle aged adults. BL is caused by chromosomal translocation in deregulation of the c-MYC oncogene. There are three variants: Endemic which is largely appeared in Africa, sporadic which is non-endemic affecting mainly abdominal viscera subsequently described outside Africa, and third variant, immunodeficient patients. The sporadic form tends to present in the lymphoid tissues of the gut. The disease present as masses in the waldeyer ring or the terminal ileum, or even with involvement of abdominal organs with the most involvement of the distal ileum, cecum or mesentery^[1]. BL is a highly aggressive and fast growing B-cell malignancy presenting in non-endemic BL regions. BL cause intussusception rarely, appears as acute abdomen and diagnosis is difficult due to mislead symptoms^[1].

The disease present itself as abdominal pain, nausea, and intestinal obstruction due to direct compression or result of intussusception of the bowel lumen. While intestinal intussusception is a common pathology in children, it is rare condition in adults and when present, it usually manifests with intestinal obstruction or acute abdomen.

Five % of all cases of intussusception are seen in adults and intussusception is reason for only 1%-5% of intestinal obstructions in adults^[2,3]. Intussusceptions were classified into four categories according to presenting locations: entero-enteric, confined to the small bowel, colo-colic, involving the large bowel only, ileo-colic, defined as the prolapse of the terminal ileum within the ascending colon and ileo-cecal, the ileum invaginates through the ileocecal valve^[2].

In contrast to intussusceptions in children, a demonstrable etiology is found in 70% to 95% of cases in the adult population, and primary or secondary malignant neoplasms is the cause of approximately 40% of intussusceptions. Malignant lesions account for up to 30% of cases of intussusception in the small intestine. Intussusception occurring in the large bowel is more likely to have a malignant etiology and represents 63% to 68% of cases^[3-8]. While adenocarcinoma, particularly metastatic carcinoma is the most frequent cause in the colonic intussusceptions; primary adenocarcinoma, gastrointestinal stromal tumors, lymphoma, and carcinoid tumors are noticed in the small intestine intussusceptions^[3,5].

Intestinal lymphoma constitutes 10% to 20% of all small intestine neoplasms and 20% to 30% of all primary gastrointestinal

lymphomas. The ileum is the most common site affected by small intestine lymphoma, followed by the jejunum and duodenum^[3,9]. While intussusception is a very rare presentation of NHL, the most common lymphoma causing intussusception is diffuse large B-cell NHL^[3,10].

We aimed to present two cases of Burkitt's lymphoma related ileocecal intussusception operated due to acute abdomen and reviewed the literature for adult Burkitt's lymphoma related ileocecal intussusception.

PATIENTS METHODS

The English medical literature in the PubMed and Google Scholar databases was reviewed, and 10 reports concerning 10 cases of intussusception due to BL were included in this review. The patients were aged from 16 to 52 years. According to the localization of lymphoma, 6 patients had ileo-colic intussusception, 2 had ileal, and 2 had colic intussusception. In terms of the diagnosis, 10 patients were diagnosed with computerized tomography (CT). The characteristics of the 10 patients are summarized in table 1.

Our patient one was 17 years old male applied to Diyarbakır Gazi Yasargil Teaching and Research Hospital in 2014 years, department of general surgery, complaining from abdominal pain, distention and not passing gas and flatus. On examination patient was having rebound and tenderness on the abdomen. Bowel sounds were increased and abdomen was distended. Laboratory values were normal. Patient was HIV negative and EBV was negative.

X-ray showed no air fluid level. CT showed" target"-shaped soft-tissue mass with a layering effect of ileo-colic intussusception (Figure 1). Patient was operated and at exploration ileum was invaginated through ileocecal valve to cecum. After invagination being reduced, cecum mass about 5 cm in diameter was noticed (Figure 2). right hemicolectomy and ileocolic anastomosis was performed. Macroscopy showed when bowel opened from antimesenteric side of the intestinal margin 6×5.5 cm polypoid tumor formation was seen next to the ileocecal valve largely have blocked the lumen. When sectioned, tumor was hard and in whitish color infiltrating muscular layer. A few lymph node with the largest 2.5×2 cm were dissected in the mucosa. On immunohistochemical studies; CD20 in CD10 staining were observed strong positive staining. TdT, CD23, CD5 and bcl-2 staining were not observed. Ki-67 proliferation index was evaluated as 100%. Tumor involvement was observed in one of 26 pieces of dissected lymph node. The other 25 were considered reactionary lymph nodes. diagnosis was Burkitt's lymphoma. Patients were discharged with good bowel movements without any complication and referred to the hematology for chemotherapy treatment.

Table 1 Summary of 10 cases of intussusception in adults due to Burkitt's lymphomas.

| Ref. | Year | Age | Sex | HIV | Complaint | Palpable mass | Diag tool | Location | Surgical | Medical |
|------|------|-----|-----|-----|-----------|---------------|-----------|-----------|-----------------|---------|
| 11 | 2009 | 16 | M | NS | AP+V+N | Pos | CT | Ileocolic | R.Hemicol | NS |
| 12 | 2008 | 52 | M | NS | AP+V+N | Pos | CT | Transvers | R.Hemicol | NS |
| 13 | 2003 | 39 | M | NS | AP | Pos | CT | Ileocolic | R.Hemicol | ChT |
| 14 | 2002 | NS | NS | NS | AP | Pos | CT | Colic | R.Hemicol | NS |
| 15 | 1999 | 23 | M | NS | AP+V | Pos | CT | Ileocolic | R.Hemicol | ChT |
| 16 | 1982 | NS | NS | NS | AP+V+N | Pos | CT | Ileal | Ileal resection | NS |
| 17 | 2009 | 16 | M | NS | AP | Pos | CT | Ileal | R.Hemicol | ChT |
| 18 | 2010 | 43 | F | NS | AP+V | Pos | CT | Ileocolic | R.Hemicol | NS |
| 19 | 2009 | 29 | F | NS | AP+V | Pos | CT | ileocolic | R.Hemicol | NS |
| 20 | 2008 | 32 | M | NS | AP+V | Pos | CT | Ileocolic | R.Hemicol | NS |

NS:Nonstated; AP:Abdominal pain; V: vomiting; N: Nausea; CT:Computed tomography; ChT: Chemotherapy; ref: reference number; Compl: complaint; Diag: diagnostig; Pos:positive

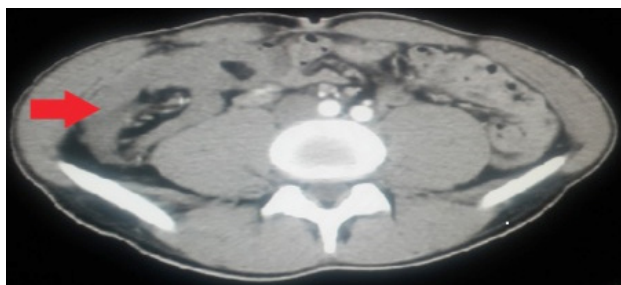


Figure 1 Abdominal computed tomography in adult intussusception: The characteristic “target”-shaped soft-tissue mass with a layering effect of ileo-colic intussusception

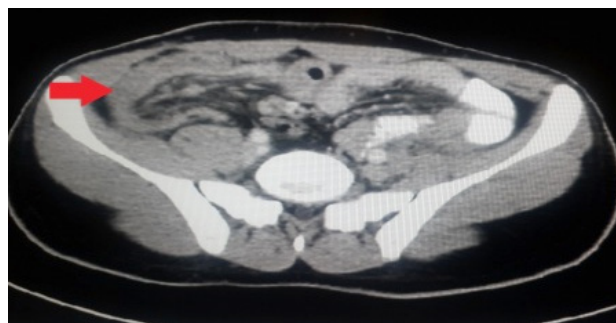


Figure 3 Abdominal computed tomography in adult intussusception A “sausage”-shaped soft tissue mass in the ileo-colic intussusception.



Figure 2 Ileo-colic intussusception after right colectomy. 6x5.5 cm polypoid tumor formation was seen next to the ileocecal valve largely have blocked the lumen.

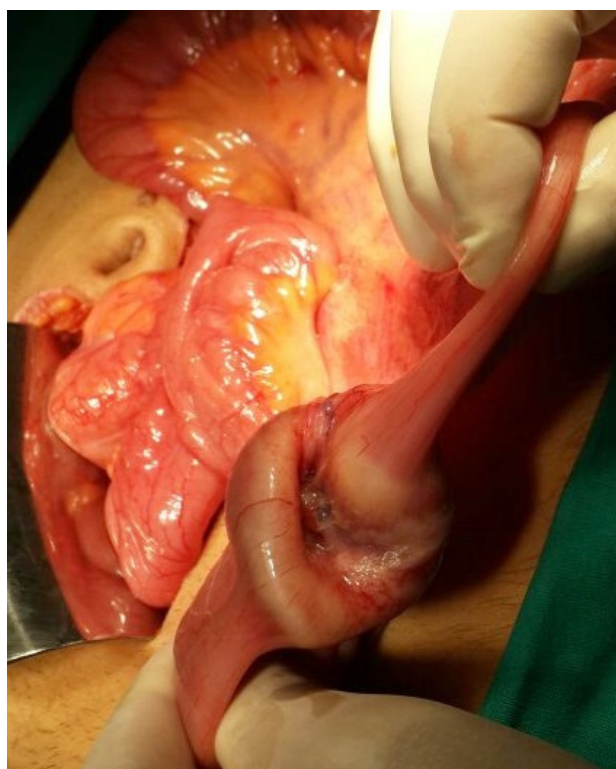


Figure 4 Terminal ileum intussusception caused by Burkitt's lymphoma. patient had ileal resection and ileoileal anastomosis, pathology showed a tumor 4 cm in diameter blocked ileum completely and infiltrated serosa.

19 years male patients applied to Diyarbakır Gazi Yasargil Teaching and Research Hospital in 2014 years, general surgical department with abdominal pain and constipation. There was no history of weight loss or fever. Physical examination showed defans and rebound in the right lower quadrant of abdomen in both patients. Bowel sounds were increased. No evidence of any lymph nodes during systematic examination appeared. Laboratory values were normal with negative HIV. In situ hybridization for EB virus-negative forms of sporadic BL. No evidence of air-fluid levels in direct abdominal graphy while standing. Intravenous contrast for abdominal tomography was taken and A “sausage”-shaped soft tissue mass with ileo-colic intussusception appeared (Figure 3). After interpretation of tomographig view in favor of intussusception, patients undergone laparotomy. Ileum was invaginated thorough the ileocecal valve in both patients. After invagination being reduced 4 cm mass in the terminal ileum was palpated (Figure 4). Patient had ileal resection and ileoileal anastomosis. pathology showed a tumor 4 cm in diameter blocked ileum completely and infiltrated serosa of ileum. immunohistochemical studies CD20, CD10 staining were positive, CD3, CD5, CD23, bcl-6 and TdT staining were negative. Ki-67 proliferation index was 100%.

Burkitt's lymphoma was diagnosed in the location of terminal ileum. Patients was discharged with good bowel movements without any complication and referred to the hematology for chemotherapy treatment.

DISCUSSION

Sporadic Burkitt's is accounting for 1%-2% of adults lymphoma and up to 40% children lymphoma in the United States and Western Europe^[17,21]. Estimated incidence for children under 10 years old 1 per million, for ages 10-20 years old is 0.7 per million, for 20-30

years ages is 0.6 per million and very rare in patients older than 30 years old^[17,22,23].

Burkitt's lymphoma is an aggressive, highly malignant and rapidly growing B-cell neoplasm. The clinical symptoms are various and non-typical. abdominal pain of various character and intensity, vomit, inexplicable weight loss (approximately 39 % of all the patients), torpidity, apathy, permanent fatigue, night perspiration, subfertility, sporadical gastrointestinal bleeding^[24]. The combination of the above mentioned symptoms is reported in 10-40% of the cases. In addition symptoms could change according to complications. in case of erosion of a large vessel the symptoms of acute gastrointestinal hemorrhage, in cases of small bowel perforation symptoms of acute peritonitis, in cases of small bowel lumen obstruction symptoms of acute intestinal obstruction could appear^[24].

Intussusception caused by Burkitt's lymphoma, as a cause of acute abdomen, is rare, with symptoms which often mislead and make diagnosis more difficult^[17,25]. Presenting symptoms in the sporadic

forms are abdominal swelling due to large mesenteric retroperitoneal or pelvic mass, tenderness, pain, ileo-cecal intussusception related symptoms of bowel obstructions^[17,23,26]. Our two patients presenting symptoms were abdominal pain, distention and vomiting with sign of intestinal obstructions. Our two patients were male and in the 10 reported adult form of Burkitt's Lymphoma causing intussusception we found 6 male, 2 female and 2 non stated patients (Table 1). It is clear that BL intussusception is more common in male than female. In the 10 reported case, the mean age of patients was 31 years (16-52 years in 8 patients, 2 NS).

Burkitt's lymphoma diagnosis preoperatively is a real challenge to the clinical practicing. Computerized abdominal tomography (CAT) is necessary in cases of inexplicable abdominal pain, uncertainty about invagination, difficult passage. CAT examination can indicate four types of small bowel lymphoma: multinodular, infiltrative, tumorous and mesenteric. It must be kept in mind that CAT has limited possibilities in diagnostics of small lymphomas <0.5 cm or diffusive infiltration of the intestinal segment. The manifestation is presented by a broad range of signs: multiple intraluminal polypoid formations, broad-base ulcers, aneurismal dilatations, narrowed lumen with mycosis destruction, large excavations^[24]. CAT is currently considered as the most sensitive radiologic method to confirm intussusception, with a reported diagnostic accuracy of 58%-100%^[2]. In our two patients, CT confirmed the diagnosis of intussusception. CAT showed the characteristic "target"-shaped soft-tissue mass with a layering effect of ileo-colic intussusception in one patient and a "sausage"-shaped soft tissue mass in the ileo-colic intussusception in the other patient. Diagnosis of BL was confirmed after surgery which was done to relieve common presenting symptoms of intestinal obstruction, abdominal mass, acute abdomen or intussusception.

BL occurring in adults, involving the terminal ileum with ileal or ileocolic intussusceptions has been reported in a small number of patients^[11-20]. All required emergency surgery and operated for acute abdomen. All treated with small bowel resection and/or right hemicolectomy. Like our two patients, complete resection is very important and improve survival. Surgical resection may be enough if 12 or more lymph nodes are removed and they are negative in cases of intestinal wall affection. It may be supplemented by chemotherapy and irradiation. Surgical resection could be done in cases of affection of local lymph nodes. In cases of impossibility for resection or extensive disease combined chemotherapy and irradiation is used to inhibit the risk of recurrence. In some cases marrow transplantation is performed^[24,27].

Lymph tissue may be found in small bowel in the deep layer of mucosis or submucosis²⁴. In our case a few lymph node with the largest one 2.5 cm was found in the mucosa. The disease may spread lengthwise or crosswise affecting the mucous (tumorous or multinodular type) or may spread all over the intestinal wall (infiltrative type). Its progress into serosa affecting the intestinal meshes and mesenterium constitutes the extralumen form^[24].

The tumor cells exhibit a high mitotic rate and a high degree of apoptosis with diffuse sheets and starry-sky pattern imparted by numerous benign histiocytes with phagocytosis of apoptotic cellular debris. Morphologically, in addition to classical BL, there are 2 cytologic variants—BL with plasmacytoid differentiation and atypical Burkitt/Burkitt-like lymphoma (aBL/BLL), with the latter showing greater pleomorphism in nuclear size and shape than the classical cases. Immunophenotypically, the tumors of all cytologic variants express membranous IgM, CD10, and bcl-6 but not IgD, bcl-2, or terminal deoxynucleotidyl transferase (TdT)^[29]. In one of

the patient, CD10 and CD20 were positive, and bcl-2, CD23, CD5 and TdT were negative. In other patient, CD20, CD10 staining were positive, CD3, CD5, CD23, bcl-6 and TdT staining were negative. Cytogenetically, all cases have a translocation involving the myc gene at 8q24 with the immunoglobulin heavy chain gene (IGH) on 14q32 or less commonly with the κ light chain locus (IGK) at 2q11 or λ light chain locus (IGL) at 22q11. The immunophenotypic prototype of BL is IgM+/CD10+/bcl-2-/bcl-6+ with the Ki-67 proliferation index (PI) nearly at 100%; however, cases with an aberrant immunophenotype such as bcl-2 expression exist^[28,29]. About half of the childhood cancers in equatorial Africa are due to BL (i.e., endemic or African BL), while it occurs at a much lower rate in the rest of the world (i.e., sporadic or American BL). The endemic type is associated with the Epstein-Barr virus (EBV) in almost all cases (DNA virus is present in more than 95% of the cases). Differences between endemic and sporadic types is their different associations with EBV in various geographical regions. In tropical Africa, EBV is present in almost all the cases, whereas, in the sporadic form, in developed countries, it turns up in 15 to 30% of the samples. Also, in developing countries, the association is intermediate between endemic and sporadic types^[30].

The role of surgery in Burkitt's lymphoma Intussusception is resection and anastomosis. When the tumor is localized, total resection results in a good outcome. However, in the presence of extensive intraabdominal diseases instead of resection, the operation should be limited to biopsy only^[31] and ileostomy. We have complete resection in both patients.

BL is a highly aggressive disease, driven by the overexpression of MYC, with a favorable outcome when treated with intensive multiagent chemotherapy and rituximab. Therapy is toxic and results in significant myelosuppression and potentially life-threatening complications^[32].

As a conclusion, Burkitt's Lymphoma related intussusception is very rare in adults. Complete resection is required and improve patient survival.

CONFLICT OF INTERESTS

There are no conflicts of interest with regard to the present study.

REFERENCES

- Hoxha FT, Hashani SI, Krasniqi AS, Kurshumliu FI, Komoni DS, Hasimja SM, Maxhuni Intussusceptions as acute abdomen caused by Burkitt lymphoma: a case report. *M Cases J* 2009; **2**: 9322. doi: 10.1186/1757-1626-2-9322
- Athanasios Marinis, Anneza Yiallourou, Lazaros Samanides, Nikolaos Dafnios, Georgios Anastasopoulos, Ioannis Vassiliou, Theodosios Theodosopoulos Intussusception of the bowel in adults: A review. *World J Gastroenterol*. 2009; **15**(4): 407-411. Published online 2009 January 28. doi: 10.3748/wjg.15.407
- Akbulut S. Unusual cause of adult intussusception: diffuse large B-cell non-Hodgkin's lymphoma: a case report and review. *Eur Rev Med Pharmacol Sci*; **16**(14): 1938-1946
- Erkan N, Hacıyanlı M, Yıldırım M, Sayhan H, Vardar E, Polat AF. Intussusception in adults: an unusual and challenging condition for surgeons. *Int J Colorectal Dis* 2005; **20**: 452-456
- Goh BK, Qu AH HM, Chow PK, Tan KY, Tay KH, EU KW, OOI LL, WONG WK. Predictive factors of malignancy in adults with intussusception. *World J Surg* 2006; **30**: 1300-1304
- Yakan S, Caliskan C, Makay O, Denecli AG, Korkut MA. Intussusception in adults: clinical characteristics, diagnosis and operative strategies. *World J Gastroenterol* 2009; **15**: 1985-1989

- 7 Ahn JH, Choi SC, Lee KJ, Jung YS. A clinical overview of a retrospective study about adult intussusceptions: focusing on discrepancies among previous studies. *Dig Dis Sci* 2009; **54**: 2643-2649
- 8 Hanan B, Diniz TR, DA Luz MM, DA Conceicao SA, DA Silva RG, Lacerda-Filho A. Intussusception in adults: a retrospective study. *Colorectal Dis* 2010; **12**: 574-578
- 9 Ghimire P, WU GY, Zhu L. Primary gastrointestinal lymphoma. *World J Gastroenterol* 2011; **17**: 697-707
- 10 Grin A, Chetty R, Bailey D. Mantle cell lymphoma as a rare cause of intussusception: a report of 2 cases. *Ann Diagn Pathol* 2009; **13**: 398-401
- 11 Batista BN, Maximiano LF Intestinal intussusception in young adults: literature review. *Rev Col Bras Cir* 2009; **36(6)**: 533-536
- 12 Zerwas E, Kemper-Martin A, Comes A case report of adult colonic intussusception. *J La State Med Soc*; **160(2)**: 102-103
- 13 Szabó A, Farkas P, László A, Berczi L, Sperlág M, Sugár I. Magy Seb. Ileocecal intussusception caused by Burkitt lymphoma, cause of mechanical ileus. 2003 Aug; 56(3-4): 116-9. Hungarian.
- 14 Asai S1, Miyachi H, Hara M, Fukagawa S, Shimamura K, Ando Y. Extensive wall thickening in intestinal Burkitt lymphoma. *J Ultrasound Med* 2002; **21(6)**: 657-661
- 15 Chang DK1, Yoo DH, Kim TH, Kim IS, Jun KY, Park MH, Kim SY. Burkitt's lymphoma presenting as ileocecal intussusception in systemic lupus erythematosus. *Clin Rheumatol* 1999; **18(3)**: 253-256
- 16 M M Kemeny, I T Magrath, and M F Brennan The role of surgery in the management of American Burkitt's lymphoma and its treatment. *Ann Surg* 1982; **196(1)**: 82-86
- 17 Hoxha FT1, Hashani SI, Krasniqi AS, Kurshumliu FI, Komoni DS, Hasimja SM, Maxhuni M. Intussusceptions as acute abdomen caused by Burkitt lymphoma: a case report. *Cases J.* 2009; **2**: 9322. doi: 10.1186/1757-1626-2-9322.
- 18 Guillén Paredes MP1, Campillo Soto A, Martín Lorenzo JG, Torralba Martínez JA, Mengual Ballester M, Cases Baldó MJ, Aguayo Albasini JL. Adult intussusception - 14 case reports and their outcomes. *Rev Esp Enferm Dig* 2010; **102(1)**: 32-40
- 19 Marinis A1, Yiallourou A, Samanides L, Dafnios N, Anastasopoulos G, Vassiliou I, Theodosopoulos T. Intussusception of the bowel in adults: a review. *World J Gastroenterol* 2009; **15(4)**: 407-411
- 20 Park IH, Roh JH, Yu JH, Choi JH, Lim DH, Ki SS, Cho YK. Two cases of cecal lymphoma causing intussusception. *Korean J Med* 2008; **74(3)**: 315-320
- 21 Blum KA, Lozanski G and Byrd JC: Adult Burkitt leukemia and lymphoma. *Blood* 2004; **104(10)**: 3009-3020, Epub 2004 Jul 20.
- 22 Levine PH, Kamaraju LS, Connelly RR, Berard CW, Dorfman RF, Magrath I and Easton JM: The American BL Registry: eight years' experience. *Cancer* 1982, **49**: 1016-1022
- 23 McClenathan JH: BL of the Abdomen: The Northern California Kaiser Permanente Experience. *The Internet Journal of Surgery* 2009; **18(2)**
- 24 Koroukov B. Multiple Burkitt's Small Bowel Lymphoma complicated by acute intestinal obstruction (a clinical case report and review of publications). *Open Access Research Journal Medical And Health Science Journal* 2011; **9**: 77-82
- 25 Cossaro M, Noce L, Bonutti A, Pecile P, Di Loreto C, Saro F, Intini S and Terrosu G: An abdominal BL in acute phase. Case report. *Minerva Pediatr* 2006, **58(3)**: 311-318
- 26 Biswas S. Report Of A Case Of Abdominal Burkitt's Lymphoma Presenting As Localized Right Iliac Fossa Pain Mimicking Acute Appendicitis. *The Internet Journal of Surgery* 2007; **9(1)**: 1528-8242
- 27 Levine PH, Kamaraju LS, Connelly RR, Berard CW, Dorfman RF, Magrath I, Easton JM: The American Burkitt's Lymphoma Registry: eight years' experience. *Cancer* 1982; **49(5)**: 1016-1022
- 28 Chuang SS, Ye H, Du MQ, Lu CL, Dogan A, Hsieh PP, Huang WT, Jung YC. Histopathology and immunohistochemistry in distinguishing Burkitt lymphoma from diffuse large B-cell lymphoma with very high proliferation index and with or without a starry-sky pattern: a comparative study with EBER and FISH. *Am J Clin Pathol* 2007; **128(4)**: 558-564
- 29 Nakamura N, Nakamine H, Tamaru J, Nakamura S, Yoshino T, Ohshima K, Abe M. The distinction between Burkitt lymphoma and diffuse large B-Cell lymphoma with c-myc rearrangement. *Mod Pathol* 2002; **15(7)**: 771-776
- 30 Parviz Deyhimi, Mahsa Kalantari Study of Epstein-Barr virus expression in Burkitt's lymphoma by polymerase chain reaction and in situ hybridization: A study in Iran. *Dent Res J (Isfahan)* 2014; **11(3)**: 380-385. doi: 10.4103/1735-3327.135917
- 31 Abbasoğlu L, Gün F, Salman FT, Celik A, Ünüvar A, Görgün O. The role of surgery in intraabdominal Burkitt's lymphoma in children. *Eur J Pediatr Surg* 2003; **13(4)**: 236-239
- 32 Jacobson C, LaCasce A. How I treat Burkitt lymphoma in adults. *Blood* 2014; **124(19)**: 2913-2920

Peer reviewers: Shih-Sung Chuang, M.D., Department of Pathology, Chi-Mei Medical Center, 901, Chung-Hwa Road, Yung-Kang District, Tainan City 710, Taiwan; Somanath Padhi, M.D., Assistant Professor, Department of Pathology, Pondicherry Institute of Medical Sciences (P.I.M.S), Ganapathichettykulam, Kalapet, Puducherry, India.