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Systemic Inflammatory Response Indices in the Clinical Management of Patients Monitored for Tubo-Ovarian Abscess

Tubaovaryan Apse Nedeniyle Takip Edilen Hastaların Klinik Yönetiminde Sistemik İnflamatuar Yanıt İndeksleri

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Abstract

Aim This study aimed to evaluate the potential usefulness of the systemic immune response index (SIRI) and systemic immune inflammation index (SII) as biomarkers for forecasting disease severity and clinical outcomes in patients receiving treatment for tubo-ovarian abscess (TOA).

Materials and Methods The records of 64 patients diagnosed and treated for TOA between January 2021 and December 2023 were retrospectively analyzed. The values of SIRI (neutrophil × monocyte / lymphocyte ratio) and SII (neutrophil × platelet / lymphocyte ratio) were calculated using pre- and post-treatment complete blood count parameters.

Results In this study, in patients receiving only medical treatment, a significant reduction was noted in hemoglobin, neutrophil, leukocyte, monocyte, CRP, SII, and SIRI values after treatment. In contrast, platelet values significantly increased ($p<0.05$). Among patients undergoing combined medical and surgical therapy, significant reductions were observed in hemoglobin, neutrophil, leukocyte, monocyte, CRP, SII, and SIRI values. At the same time, lymphocyte and platelet levels significantly increased after treatment compared to pre-treatment levels ($p<0.05$). When comparing pre- and post-treatment measurements in all patients, significant decreases were observed in hemoglobin, leukocyte, neutrophil, and monocyte levels, and significant increases in lymphocyte and platelet levels were detected ($p<0.05$). CRP, SII, and SIRI values significantly decreased after treatment ($p<0.001$).

Conclusions Systemic inflammatory indices are gaining importance in the clinical follow-up of TOA, A critical disease associated with marked morbidity and mortality. Comprehensive prospective studies are needed to validate their use as inflammatory markers in the management of TOA.

Keywords Tubo-ovarian abscess; systemic immune response index; systemic immune inflammation index

Öz

Amaç *Tubaovaryan apse (TOA) nedeniyle tedavi edilen hastalarda sistemik immün yanıt indeksi (SIRI) ile sistemik immün inflamasyon indeksi (SII) parameterlerinin, hastalığın ciddiyetini ve klinik sonuçları öngörmede potansiyel bir biyobelirteç olarak kullanılabilirliğinin araştırılması amaçlandı.*

Gereç ve Yöntem *TOA tanısıyla Ocak 2021 tarihinden Aralık 2023 tarihin kadar, takip ve tedavi edilen 64 hastanın kayıtları retrospektif olarak analiz edildi. Hastaların tedavi öncesi ve sonrasındaki tam kan sayımı parametreleri temel alınarak SIRI (nötrofil × monosit/ lenfosit oranı) ve SII (nötrofil × platelet/ lenfosit oranı) değerleri hesaplandı.*

Bulgular *Bu çalışmada yalnızca medikal tedavi uygulanan hastalarda, tedavi sonrası dönemde tedavi öncesine kıyasla hemoglobin, nötrofil, lökosit, monosit, CRP, SII ve SIRI düzeylerinde anlamlı bir düşüş gözlemlenirken; platelet düzeylerinde ise anlamlı bir artış saptanmıştır ($p<0.05$). Medikal ve cerrahi tedavi uygulanan hastalarda, tedavi sonrası dönemde hemoglobin, nötrofil, lökosit, monosit, CRP, SII ve SIRI seviyelerinde istatistiksel olarak anlamlı bir azalma; lenfosit ve platelet seviyelerinde ise belirgin bir artış gözlemlenmiştir ($p<0.05$). Tüm hastalarda tedavi öncesi ve sonrası yapılan ölçümlerin karşılaştırılmasında, tedavi sonrasında hemoglobin, nötrofil, lökosit ve monosit düzeylerinde istatistiksel olarak anlamlı bir azalma; lenfosit ve platelet düzeylerinde ise anlamlı bir artış saptandı ($p<0.05$), CRP, SII ve SIRI düzeylerinde ise tedavi sonrası dönemde anlamlı ölçüde bir düşüş gözlemlendi ($p<0.001$).*

Sonuç *Ciddi morbidite ve mortaliteye yol açabilen önemli bir hastalık olan TOA'nın klinik takibinde sistemik inflamatuar indeksler önem kazanmaktadır. TOA yönetiminde bir inflamasyon belirteci olarak kullanılabilmesi için prospektif geniş sayılı çalışmalara ihtiyaç vardır.*

Anahtar Kelimeler *Tubaovaryan apse; sistemik immün yanıt indeksi; sistemik immün inflamasyon indeksi*

INTRODUCTION

Tubo-ovarian abscess (TOA), which accounts for the majority of pelvic masses and intra-abdominal abscesses during the reproductive and premenopausal periods, is an inflammation of the adnexa, including the ovaries and fallopian tubes.[1] It is observed in nearly a third of women hospitalized due to pelvic inflammatory disease (PID). A history of PID, intrauterine device (IUD) use, low socioeconomic status, multiple sexual partners and lack of contraceptive use are significant risk factors. Studies have shown that aerobic, anaerobic, and facultative microorganisms are the microbial agents responsible for TOA.[2] In approximately 70% of patients, TOA is unilaterally located and most commonly presents with lower abdominal pain. Clinical and laboratory findings often include fever and leukocytosis.[2] If left untreated, TOA can become life-threatening.[3] Timely detection and intervention are essential to avoid long-term complications. A safe, effective, minimally invasive approach that preserves fertility as much as possible is preferred in treating TOA. Broad-spectrum antibiotics are typically initiated as first-line treatment. Nevertheless, surgical intervention is needed in up to 25% of patients, as reported.[4]

Inflammatory markers are also used in diagnosing, treating, and following patients with TOA.[3] Recently, various pro-inflammatory cytokines and acute phase proteins involved in inflammation, including YKL-40, osteopontin, and pentraxin, have been investigated for their potential to assess the severity and predict the medical results of PID and TOA.[5] Additionally, commonly used parameters such as levels of C-reactive protein (CRP), white blood cell (WBC) count and neutrophil count have significantly correlated with disease progression. WBC count has demonstrated greater sensitivity and a reduced rate of false negatives when compared to CRP. These markers are biomarkers to estimate disease severity and predict clinical outcomes.[5]

Recently, two new indicators, the Systemic Immune Response Index (SIRI) and the Systemic Immune Inflammation Index (SII), have been introduced to evaluate the body's response to inflammatory processes and to predict patient prognosis. These indices, which combine complete blood count parameters, have a strong potential to reflect inflammation in affected individuals.[6] In the literature, these indices have been used to predict procedure success in patients undergoing cervical cerclage, to estimate recurrence risk in early-stage cervical cancer patients, and predict unfavorable pregnancy outcomes in women with systemic lupus erythematosus.[6-8] However, during our literature review, we did not find any studies that evaluated the association between the inflammatory process in TOA and the clinical utility of the SII and SIRI indices in its management.

This study seeks to analyze the applicability of the SIRI and SII indices, calculated using pre- and post-treatment complete blood count parameters, as biomarkers for estimating the severity of the disease and clinical outcomes in the management of patients undergoing treatment for TOA.

MATERIALS and METHODS

This research was ethically approved by Sakarya University Faculty of Medicine's Clinical Research Ethics Committee (Approval No: 356725; April 30, 2024). The design of this study was based on the principles outlined in the Declaration of Helsinki. Medical records of patients (n=68) who were hospitalized with a preliminary diagnosis of tubo-ovarian abscess in the Department of Obstetrics and Gynecology at Sakarya Training and Research Hospital between January 2021 and December 2023 were retrospectively retrieved from the hospital's patient record system. Two patients were excluded from the study because they declined treatment and left the hospital. Patients who received percutaneous drainage (transabdominal drainage under ultrasound guidance) in addition to medical therapy were excluded from the study, as they could not be clearly classified into either the medical-only group or the combined medical and surgical treatment groups (n=2). The study comprised 64 patients in total (Figure 1). Prior

to the study, written informed consent was secured from all participants in accordance with ethical standards.

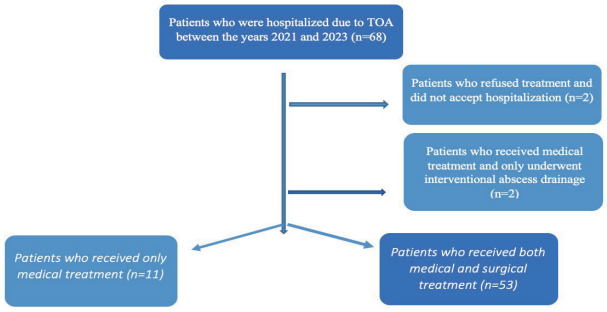

Figure 1. Flow diagram of included patients

Complete blood count parameters (white blood cell, lymphocyte, monocyte, neutrophil, and platelet counts) and CRP values, which were routinely measured upon admission and before discharge, were recorded. Using these pre- and post-treatment complete blood count values, SIRI (neutrophil × monocyte / lymphocyte ratio) and SII (neutrophil × platelet / lymphocyte ratio) indices were calculated. Imaging findings obtained through transvaginal or transabdominal ultrasonography and computed tomography were evaluated to determine the presence, size, and location of the TOA.

All hospitalized patients diagnosed with TOA received intravenous broad-spectrum antibiotic therapy in accordance with the Centers for Disease Control and Prevention guidelines, and individualized treatment approaches were applied. On average, patients were hospitalized for 9.03 ± 4.35 days, and after discharge, they continued antibiotic therapy to complete a 14-day course. Patients with TOA measuring ≥6 cm, those presenting with acute abdomen, or those unresponsive to medical therapy within 48 hours were treated surgically. In this study, patients hospitalized for TOA were categorized into two groups: those who received both medical and surgical treatment (n=53), and those who received only medical treatment (n=11). Complete blood count parameters, CRP, SII, and SIRI values were compared based on the treatment modalities.

Statistical Analysis

Data analysis was performed using SPSS (Statistical Package for the Social Sciences), Version 23. Results with p-values less than 0.05 were considered statistically significant. The distribution of numerical variables was assessed using the Shapiro-Wilk test, and all variables were found to follow a normal distribution. Paired sample t-tests were conducted to evaluate the differences in CRP, SII, SIRI, and complete blood count parameters between pre- and post-treatment values. Numerical variables were presented as mean ± standard deviation. Categorical variables were compared between the medical-only and combined treatment groups using Pearson's chi-square, Fisher's exact, or Yates' corrected chi-square tests, as appropriate. Changes in categorical variables from pre- to post-treatment were examined using the marginal homogeneity test. Categorical variables were presented as counts (n) and percentages (%).

RESULTS

Table 1 presents the clinical and demographic characteristics of all patients diagnosed and treated for TOA. Table 2 presents the pre- and post-treatment values of complete blood count parameters, CRP, SII, and SIRI for each treatment group. Table 3 shows the changes in complete blood count, CRP, SII, and SIRI values before and after treatment for all participants.

Table 1. Clinical and demographic characteristics of the patients		
Variable		**n (%) or Mean ± SD**
Age (mean)		42.39 ± 9.63 years
BMI (mean)		28.54 ± 5.28 kg/m²
Parity	- Multiparous	52 (81.3%)
	- Primiparous	8 (12.5%)
	- Nulliparous	4 (6.3%)
Comorbidities	- None	43 (67.2%)
	- DM	5 (7.8%)
	- HT	6 (9.4%)
	- HT + DM	8 (12.5%)
	- Endometriosis	2 (3.1%)
Presenting Symptoms	- Fever	26 (40.6%)
	- Nausea and vomiting	33 (51.6%)
	- Abdominal pain	64 (100%)
Vaginal Examination Findings	- Leukorrhea	51 (79.7%)
	- Increased vaginal temperature	28 (43.8%)
	- Cervical tenderness	54 (84.4%)
Type of Contraception Used	- None	17 (26.6%)
	- IUD	26 (40.6%)
	- Condom	14 (21.9%)
	- Combined oral contraceptive pills	3 (4.7%)
	- Bilateral tubal ligation	4 (6.3%)
Acute Abdomen		7 (10.9%)
Cyst Size (Mean Diameter, cm)	- <6 cm	11 (17.2%)
	- ≥6 cm	53 (82.8%)
Length of Hospital Stay (days)		9.03 ± 4.35
Type of Treatment	- Medical	11 (17.2%)
	- Medical + Surgical	53 (82.8%)
Surgical Method	- Laparoscopy	42 (79.2%)
	- Laparotomy	11 (20.8%)
Surgical Procedures Performed	- Abscess drainage	10 (18.9%)
	- Salpingectomy	19 (35.8%)
	- Salpingo-oopho-rectomy	20 (37.7%)
	- TAH + BSO	4 (7.5%)
Histopathological Findings	- Tubo-ovarian abscess / Hydro-salpinx	46 (86.8%)
	- Adenocarcinoma / Primary colon CA	1 (1.9%)
	- Borderline ser-omucinous tumor	1 (1.9%)
	- Endometrioma	5 (9.4%)

SD; Standard deviation, BMI; body mass index, TAH + BSO; Total Abdominal Hysterectomy with Bilateral Salpingo-Oophorectomy, IUD: Intrauterine, Device DM: Diabetes Mellitus, HT: Hypertension

Accordingly, among patients who underwent solely medical therapy, post-treatment values showed a statistically significant reduction in hemoglobin, WBC, monocyte, and neutrophil levels, alongside a significant rise in platelet counts compared to pre-treatment levels ($p<0.05$). In addition, comparisons of CRP, SIRI, and SII values revealed a statistically significant decrease after treatment ($p<0.05$). Among patients that received a combination of medical and surgical therapy, hemoglobin, white blood cell, monocyte, and neutrophil values significantly declined, while lymphocyte and platelet levels significantly increased following treatment ($p<0.05$). Furthermore, CRP, SIRI, and SII values showed a statistically significant decrease post-treatment ($p<0.001$) (Table 2).

When all patients were analyzed collectively, post-treatment values showed statistically significant reductions in hemoglobin, white blood cell, monocyte, and neutrophil levels compared to pre-treatment values. In contrast, lymphocyte and platelet counts increased significantly ($p<0.05$). Additionally, CRP, SII, and SIRI values significantly decreased after treatment ($p<0.001$) (Table 3).

Table 2. Comparison of pre- and post-treatment complete blood count, CRP, SII, and SIRI results according to clinical management

Parameter		Medical (n=11)	p-value	Medical + Surgical (n=53)	p-value
Hemoglobin (g/dL)	Pre-treatment	10.57±1.07		11.07±1.73	
	Post-treatment	10.04±1.05		9.8±1.23	
	Difference before and after treatment	0.54±0.65	**0.021**	1.27±1.68	**<0.001**
WBC (×10³/μL)	Pre-treatment	14.1±6.32		14.41±6.46	
	Post-treatment	7.74±2.91		9.12±3.09	
	Difference before and after treatment	6.36±4.47	**<0.001**	5.29±6.2	**<0.001**
Lymphocyte (×10³/μL)	Pre-treatment	1.71±0.89		1.71±0.69	
	Post-treatment	2.11±1.52		1.94±0.7	
	Difference before and after treatment	0.4±0.73	0.101	0.23±0.81	**0.039**
Neutrophil (×10³/μL)	Pre-treatment	11.64±5.33		11.79±6.17	
	Post-treatment	4.84±1.46		6.44±3.03	
	Difference before and after treatment	6.8±4.76	**<0.001**	5.35±6.32	**<0.001**
Platelet (×10³/μL)	Pre-treatment	273.58±79.59		320.92±99.19	
	Post-treatment	359.19±133.47		360.58±137.04	
	Difference before and after treatment	85.61±84.95	**0.007**	39.66±112.87	**0.013**
Monocyte (×10³/μL)	Pre-treatment	0.71±0.39		0.71±0.31	
	Post-treatment	0.47±0.14		0.55±0.2	
	Difference before and after treatment	0.25±0.34	**0.037**	0.16±0.24	**<0.001**
CRP (mg/L)	Pre-treatment	146.51±101.3		159.09±115.15	
	Post-treatment	27.82±28.15		41.15±32.68	
	Difference before and after treatment	118.69±93.56	**0.002**	117.95±108.16	**<0.001**
SII	Pre-treatment	1859.76±767.26		2696.54±2255.69	
	Post-treatment	951.34±485.36		1387.88±1239.21	
	Difference before and after treatment	908.42±649.01	**<0.001**	1308.66±2534.82	**<0.001**
SIRI	Pre-treatment	5.81±4.82		6.1±5.58	
	Post-treatment	1.23±0.54		2.18±1.93	
	Difference before and after treatment	4.58±4.86	**0.011**	3.92±5.48	**<0.001**

WBC; white blood cell, CRP; C-reactive protein SII; Systemic Immune-Inflammation Index, SIRI; Systemic Immune-Response Index

Table 3. Comparison of pre- and post-treatment complete blood count, CRP, SII, and SIRI results in all patients

Parameter		Mean ± SD	p-value
Hemoglobin (g/dL)	Pre-treatment	10.98±1.64	**<0.001**
	Post-treatment	9.84±1.2	
	Difference before and after treatment	1.14±1.58	
WBC (×10³/μL)	Pre-treatment	14.36±6.39	**<0.001**
	Post-treatment	8.88±3.09	
	Difference before and after treatment	5.47±5.92	
Lymphocyte (×10³/μL)	Pre-treatment	1.71±0.72	**0.010**
	Post-treatment	1.97±0.88	
	Difference before and after treatment	0.26±0.79	
Neutrophil (×10³/μL)	Pre-treatment	11.76±6	**<0.001**
	Post-treatment	6.16±2.88	
	Difference before and after treatment	5.6±6.07	
Platelet (×10³/μL)	Pre-treatment	312.79±97.22	**<0.001**
	Post-treatment	360.35±135.38	
	Difference before and after treatment	47.56±109.39	
Monocyte (×10³/μL)	Pre-treatment	0.71±0.33	**<0.001**
	Post-treatment	0.54±0.19	
	Difference before and after treatment	0.18±0.26	
CRP (mg/L)	Pre-treatment	156.93±112.23	**<0.001**
	Post-treatment	38.85±32.14	
	Difference before and after treatment	118.07±105.1	
SII	Pre-treatment	2552.72±2096.28	**<0.001**
	Post-treatment	1312.85±1154.32	
	Difference before and after treatment	1239.87±2322.38	
SIRI	Pre-treatment	6.05±5.42	**<0.001**
	Post-treatment	2.02±1.81	
	Difference before and after treatment	4.03±5.35	

SD; Standard deviation, WBC; white blood cell, CRP; C-reactive protein SII; Systemic Immune-Inflammation Index, SIRI; Systemic Immune-Response Index

DISCUSSION

In this study, pre- and post-treatment changes in parameters such as complete blood count, CRP, SIRI, and SII were retrospectively evaluated in patients treated with medical therapy alone and those who underwent combined medical and surgical management for TOA. Among patients treated solely with medical therapy, post-treatment hemoglobin, leukocyte, monocyte, neutrophil, CRP, SII, and SIRI values showed a significant decrease compared to pre-treatment values, while platelet counts significantly increased ($p<0.05$). In patients who underwent surgical treatment in addition to medical therapy, a significant decrease was observed in hemoglobin, leukocyte, monocyte, neutrophil, CRP, SII, and SIRI values, while lymphocyte and platelet counts significantly increased after therapy compared to before therapy ($p<0.05$).

Accordingly, laboratory findings revealed, as expected, prominent leukocytosis and elevated CRP levels in patients admitted to our clinic with a diagnosis of TOA. Across all patients, statistically significant, moderate, and consistent changes were observed in CRP levels and SII and SIRI values before and after treatment (Figure 2).

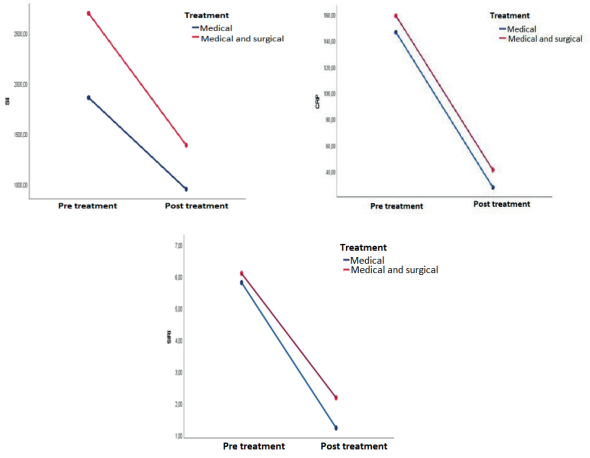

Figure 2. Pre-and post-treatment CRP levels and the SII and SIRI values

CRP; C-reactive protein SII; Systemic Immune-Inflammation Index, SIRI; Systemic Immune-Response Index

Complete blood count indices have attracted considerable attention from researchers in multiple medical specialties. Peripheral blood cells play numerous roles in immune regulation, cytokine secretion, and tissue regeneration. Therefore, they can reflect altered immune responses in various systemic diseases. Peripheral leukocytes, lymphocytes, neutrophils, platelets, and acute-phase proteins contribute to inflammation and can be easily detected.[9]

In TOA, a severe pelvic infection, laboratory parameters typically show elevations in leukocytes, neutrophils, and platelets.[10,11] Neutrophils may be elevated even when the total leukocyte count is normal. A relative decrease in lymphocyte count may also occur. This lymphopenia can be interpreted as an impairment in cellular immune response, while increases in neutrophil and platelet counts are likely a response to systemic inflammation.[12]

Recently, many researchers have suggested a strong relationship between peripheral blood counts of platelets, neutrophils, and lymphocytes and various inflammatory diseases and tumors.[9] SII and SIRI are parameters derived from these three immune-related cells and are thought to more effectively represent the immune response and systemic inflammation status.[6] These indices have been reported to reflect disease status more reliably than individual blood parameters alone.[13]

Elevated SII values have been associated with greater disease severity and unfavorable outcomes in various illnesses and cancers.[14,15] Qi and colleagues defined the Systemic Immune Response Index, derived from neutrophil, monocyte and lymphocyte counts, and confirmed that SIRI reflects both local immune response and systemic inflammation.[16] SIRI has been extensively studied as a prognostic indicator in malignancies and is an independent factor in predicting prognosis in various cancers. The first meta-analysis based on evidence has confirmed the association between high SIRI values and poor prognosis in malignancies.[17] Research continues to use SII and SIRI to monitor the course of infections.

In line with the literature, this study demonstrated statistically significant decreases in hemoglobin, leukocyte, neutrophil, and monocyte levels and statistically significant increases in lymphocyte and platelet levels after therapy in comparison to before therapy ($p<0.05$). In all patients, post-treatment measurements of CRP, SII, and SIRI showed statistically significant decreases compared to pre-treatment values ($p<0.001$).

SIRI and SII values calculated from complete blood count parameters are novel and broad indicators of inflammation that effectively represent both localized immune responses and overall systemic inflammatory activity in the body. Current studies confirm that SII and SIRI are more effective in indicating chronic inflammatory states compared to traditional inflammatory markers. Hence, they may act as important markers of systemic inflammation, offering improved diagnostic accuracy and reliability.8 Since obtaining SII and SIRI values is low-cost and straightforward, their application in clinical research is gradually increasing.[8]

This study has several limitations. Firstly, the retrospective design restricts the ability to establish causal relationships. Additionally, the relatively small sample size may limit the generalizability of the findings. The absence of long-term follow-up prevents a thorough evaluation of post-treatment complications and recurrence. Moreover, the lack of multivariate analysis limits the ability to control for potential confounding factors. Therefore, to better assess the clinical utility of SII and SIRI in infection follow-up, larger, multicenter, prospective randomized controlled trials with long-term follow-up are needed.

CONCLUSION

Considering the high mortality and morbidity associated with untreated ruptured cases and the negative impact on fertility, the optimal strategy should be chosen for TOA

patients based on age, fertility desire, and clinical presentation, with early medical and surgical treatment planned accordingly. Further investigation is needed into new parameters that could be used to monitor the inflammatory process and treatment outcomes.

Ethical Approval

Ethical approval for this study was obtained from the Clinical Research Ethics Committee of Sakarya University Faculty of Medicine (April 30, 2024; Approval No: 356725).

Informed Consent

All persons gave their informed consent prior to their inclusion in the study.

Peer-review

Externally and internally peer-reviewed.

Authorship Contributions

Concept: A.B.T., H.U.Y., Design: A.B.T., S.Y., H.U.Y., Data Collection/Processing: A.B.T., S.Y., H.U.Y., Analysis/Interpretation: A.B.T., S.Y., H.U.Y., Literature Search: A.B.T., S.Y., H.U.Y., Writing: A.B.T., S.Y., H.U.Y., Critical Review: A.B.T., S.Y., H.U.Y.

Conflict of Interest

No conflict of interest was declared by the authors.

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