Review Article

Inflammation-related indicators have a potential to increase overall quality of the prostate cancer management: a narrative review

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Background and Objective: Increasing evidence suggests that inflammation plays an essential role in cancer development and progression. The levels of inflammation-related indicators are correlated with prognosis across a wide variety of tumor types, including prostate cancer (PCa), but its diagnostic and prognostic value in PCa remains controversial. In the present review, the diagnostic and prognostic value of inflammation-related indicators in PCa patients is investigated.

Methods: A literature review was performed using the PubMed database, screening articles from English and Chinese journals published mainly from 2015 to 2022.

Key Content and Findings: Inflammation-related indicators based on haematological tests have some diagnostic and prognostic value not only when used alone but also in combination with common clinical indicators such as prostate-specific antigen (PSA), and can significantly improve the accuracy of diagnostic results. Elevated neutrophil-to-lymphocyte-count ratio (NLR) is strongly associated with the detection of PCa in men with PSA levels of 4–10 ng/mL. Preoperative NLR levels in localized PCa patients affect their overall survival (OS), cancer-specific survival (CSS), and biochemical recurrence-free survival (BCRFS) after radical prostatectomy (RP). In patients with castration-resistant prostate cancer (CRPC), a high NLR is associated with poorer OS, progression-free survival (PFS), CSS, and radiographic PFS. Platelet-to-lymphocyte-count ratio (PLR) appears to have the greatest accuracy in predicting an initial diagnosis of clinically significant PCa. The PLR also has the potential to predict the Gleason score. Patients with higher PLR levels have a higher risk of death compared to those with a lower PLR. Elevated procalcitonin (PCT) is correlated with the development of PCa and may be useful in improving the diagnostic accuracy of PCa. Elevated C-reactive protein (CRP) levels are an independent predictor of poorer OS in metastatic PCa.

Conclusions: Numerous studies have been conducted on the value of inflammation-related indicators in guiding the diagnosis and treatment of PCa. The value of inflammation-related indicators in predicting the diagnosis and prognosis of PCa patients is now becoming clear.

Keywords: Prostate cancer (PCa); inflammation-related indicators; neutrophil-to-lymphocyte-count ratio (NLR); platelet-to-lymphocyte-count ratio (PLR); patient stratification

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Introduction

Prostate cancer (PCa) is a common solid tumour in men. According to the World Health Organization (WHO), there were 1,414,259 new cases of PCa and 375,304 PCa-related deaths worldwide in 2020. PCa is the second most common tumour in men worldwide (1). In 2020, China had a cumulative total of 115,426 cases of PCa and 51,094 deaths associated with PCa, ranking 10th in terms of incidence and 13th in terms of mortality from malignant tumours (2). Moreover, the cost of treating PCa is currently increasing more quickly than those of any other cancer (3). For doing this, the paradigm change from reactive treatments of the clinically manifested PCa to a predictive approach and personalised prevention is essential (4).

PCa is a systemic multi-factorial disease. Prostate-specific antigen (PSA) is the only biomarker used for the early detection of PCa. PSA is highly specific for prostate but not for PCa. Consequently, predictive diagnostics by liquid biopsy analysis is instrumental for the disease prediction, targeted prevention and curative treatments at early stages (5). It has been shown that a persistent inflammatory state is associated with malignancy and that inflammatory cells and mediators in the tumour microenvironment mediate a pro-inflammatory response, which can in turn act on the tumour and peritumoural cells in an autocrine and/or paracrine manner (6). The interaction between the two ultimately leads to a poorer prognosis and quality of survival. The tumor microenvironment that composed primarily of immune cells surrounding cancer cells could be a potential prognostic biomarker in PCa (7). Therefore, the levels of inflammation-related indicators may predict the diagnosis of patients, guide treatment, and predict prognostic benefit. The study of inflammation-related indicators and tumour development has been widely applied to a variety of tumours, including PCa (8), lung cancer (9), gastric cancer (10), colorectal cancer (11), and liver cancer (12).

Numerous studies have been conducted on the relationship between PCa and inflammation-related indicators; however, there remains a lack of uniform understanding. In this paper, we will review the literature and summarize the inflammation-related indicators that may be related to the diagnosis and prognosis of PCa and describe their value in clinical applications to provide new perspectives for clinical and research work. We present this article in accordance with the Narrative Review reporting checklist (available at https://tau.amegroups.com/article/view/10.21037/tau-23-55/rc).

Methods

The primary objective of our review was to review the inflammation-related indicators that may be related to the diagnosis and prognosis of PCa and describe their value in clinical applications. *Table 1* summarizes the search strategy used for our review. The PubMed database was used for the literature review. We searched for literature related to PCa and inflammation-related indicators. A total of 72 articles from English and Chinese journals published mainly from 2015 to 2022 were screened.

Overview of the inflammation-related indicators

With the progressive research on the relevance of inflammation to tumours, Trinchieri *et al.* (13) classified tumour-associated inflammation as the seventh major biological feature of cancer. In recent years, increasing evidence has indicated that systemic inflammatory response-related markers may be a new direction for tumour diagnosis, stratification, and prognosis-related markers. The commonly used markers of a systemic inflammatory response include lymphocyte-related inflammation indexes [neutrophil-to-lymphocyte-count ratio (NLR), platelet-to-lymphocyte-count ratio (PLR), lymphocyte-to-monocyte ratio (LMR), C-reactive protein (CRP), procalcitonin (PCT), serum albumin (ALB), lymphocyte count ratio (LCR), and the derived NLR (dNLR) (note: the NLR, PLR and LMR are all used to determine the dNLR)]. The NLR, PLR, LMR, and dNLR can be calculated from routine blood parameters, which is easy to obtain, does not create an additional burden on the patient, is easily accepted by the patient, and is highly operational, thus laying the foundation for their clinical application.

NLR and PCa diagnosis and prognosis (Table 2)

The effect of the inflammatory response on leukocyte sorting counts is usually manifested by neutrophilia and lymphocytopenia, so the NLR is widely used in studies involving the diagnosis, staging, and prognosis of malignancies. In men with PSA levels of 4–10 ng/mL, elevated NLR is strongly associated with the detection of PCa (14). The relationship between the NLR and the Gleason score has also been demonstrated in several studies, including the application of the NLR to predict the current Gleason score (15) and its subsequent elevation (16). However, there is also evidence that the NLR does not yet

Table 1 The search strategy summary

Items	Specification
Date of search	2022-12-08
Databases and other sources searched	PubMed
Search terms used	Search: ("Prostatic Neoplasms"[Mesh] OR Prostate Neoplasms OR Neoplasms, Prostate OR Neoplasm, Prostate OR Prostate Neoplasm OR Neoplasms, Prostatic OR Neoplasm, Prostatic OR Prostatic Neoplasm OR Prostate Cancer OR Cancer, Prostate OR Cancers, Prostate OR Prostate Cancers OR Cancer of the Prostate OR Prostatic Cancer OR Cancer, Prostatic OR Cancers, Prostatic OR Prostatic Cancers OR Cancer of Prostate) AND ((((((((((((neutrophil-to-lymphocyte-count ratio) OR (platelet to lymphocyte ratio)) OR (c reaction protein, CRP)) OR (Proealeitonin, PCT)) OR (monocyte counts)) OR (lymphocyte counts)) OR (plasma fibrinogen)) OR (lymphocyte to monocyte ratio)) OR (eosinophils-lymphocyte ratio)) OR (neutrophil count)) OR (butyrylcholinesterase)) OR (systemic immune-inflammation index)) OR (serum albumin)) OR (metabolic syndrome))
Timeframe	2015–2022
Inclusion and exclusion criteria	Inclusion criteria: original RCT, study on inflammation-related indicators in prostate cancer
	Exclusion criteria: secondary follow-up articles (i.e., not primary RCT article)
Selection process	The selection procedure followed the Preferred Reporting Items for Systematic Reviews principles

RCT, randomized controlled trial.

Table 2 The diagnostic and prognostic value of NLR in PCa

Inflammation-related indicators	Study design	Year	Study participants (number)	Effects/results	Major study limitations	References
NLR	Clinical trial	2021	Patients with PSA 4–10 ng/mL (n=201)	NLR could be a useful pre-PBx predictor of PCa	Retrospective cohort study, small sample size, not comparison the different stages of PCa	(14)
NLR	Clinical trial	2017	PCa patients (n=161)	Higher NLR was significantly associated with GS ≥7 PCa in comparison with GS ≤6 PCa	Retrospective nature, single center	(15)
NLR	Clinical trial	2021	PCa patients (n=571)	NLR can predict GS upgrading in patients scheduled for radical prostatectomy for PCa	Retrospective design, single tertiary center, mid- and long-term oncologic results are not indicated	(16)
NLR	Clinical trial	2019	Men undergoing an initial TRUS prostate biopsy (n=1,223)	The neutrophil/lymphocyte ratio did not discriminate between benign and malignant prostatic disease in patients with a PSA between 4–10 ng/mL	Not available	(17)
NLR	Clinical trial	2019	PCa patients (n=78)	Inflammatory markers can be predictive factors in the diagnosis of PCa	Single center	(18)

Table 2 (*continued*)

Table 2 (*continued*)

Inflammation-related indicators	Study design	Year	Study participants (number)	Effects/results	Major study limitations	References
NLR	Clinical trial	2021	Patients underwent robotic transperineal prostate biopsy (n=652)	There was no statistically significant difference of NLR between the benign and PCa group	Retrospective study	(19)
NLR	Meta-analysis	2016	15 cohorts with 16,266 patients	Elevated NLR predict poor OS and PFS/RFS in patients with PCa	Not available	(20)
NLR	Review and Meta-analysis	2016	18,092 cases from 22 related studies	Elevated NLR predicts lower prediction of the PSARS after chemotherapy and poor survival outcomes in PCa	Not available	(21)
NLR	Review and Meta-analysis	2016	9,418 patients from 18 studies	NLR could predict the prognosis for patients with locally advanced or castration-resistant PCa	Not available	(22)
NLR	Clinical trial	2016	PCa patients (n=2,301)	NLR is an independent prognostic factor for OS and CSS after a RP	Not available	(23)
NLR	Clinical trial	2016	Patients underwent RP (n=1,481)	High NLR was significantly related to unfavorable clinicopathological outcomes and worse BCR-free survival	Retrospective study, cohort was relatively small	(24)
NLR	Clinical trial	2017	PCa patients (n=2,302)	NLR is an independent factor for biochemical recurrence and overall survival in PCa patients	Retrospective review	(25)
NLR	Clinical trial	2016	PCa patients (n=73)	No association between NLR and biochemical failure after prostatectomy	Retrospective study, limited sample size	(26)
NLR	Clinical trial	2021	CRPC patients (n=63)	Use NLR could further classify patients into different risk groups	Small sample size, lack of independent validation, not adjusting important confounders	(27)
NLR	Clinical trial	2019	CRPC patients (n=303)	NLR≥2.5 at CRPC diagnosis is associated with a lower risk for CSS	Retrospective study, lack standard therapeutic approach	(28)
NLR	Randomised phase III trial	2016	Patients with metastatic CRPC (n=755)	Patients with a low NLR at baseline were more likely to develop grade ≥3 neutropenia	Not available	(29)
NLR	Clinical trial	2017	mCRPC patients (n=47)	NLR might be a useful prognostic biomarker in mCRPC patients treated with CBZ	Retrospective study, small sample size, observation period was short	(30)
NLR	Clinical trial	2019	mCRPC patients (n=106)	The NLR might be a useful biomarker for predicting the prognosis of mCRPC patients who are treated with ENZ	Retrospective study, some data were missing, small sample size	(31)
NLR	Clinical trial	2016	CRPC patients (n=193)	NLR >3 during treatment with ENZ seems to have both prognostic and predictive value in CRPC patients	Small sample size, the absence of external validation	(32)

Table 2 (*continued*)

Table 2 (*continued*)

Inflammation-related indicators	Study design	Year	Study participants (number)	Effects/results	Major study limitations	References
NLR	Clinical trial	2017	mCRPC patients (n=101)	Not observed a correlation between the different cut-off values of PLR or NLR and a PSA response ≥25%	Not available	(33)
NLR	Clinical trial	2018	mCRPC patients (n=189)	NLR could predict overall survival	Lack complete information, no patient-reported outcomes	(34)
NLR	Clinical trial	2022	BPH cases (n=494) and PCa cases (n=525)	PLR and NLR have a significant predictive value towards the development of metastatic disease but not in relation to variations in aggressiveness or T staging inside the non-metastatic PCa	Not available	(35)
NLR	Clinical trial	2019	BPH patients (n=43) and PCa patients (n=125)	NLR and PLR significantly increase in PCa patients with bone metastases and are valuable in the diagnosis of bone metastases in PCa patients	Not available	(36)
NLR	Clinical trial	2016	PCa patients (n=1,464)	The NLR value was significantly elevated in men with higher PSA	Retrospective study	(37)
NLR	Clinical trial	2018	Patients with bone metastasis of PCa (n=111)	Elevated NLR was independently predictive of poor prognosis	Retrospective study, treatment not consistent and randomized	(38)

NLR, neutrophil-to-lymphocyte-count ratio; PCa, prostate cancer; PSA, prostate-specific antigen; PBx, prostate biopsy; GS, Gleason score; TRUS, trans rectal ultra sound; OS, overall survival; PFS, progression-free survival; RFS, recurrence-free survival; CSS, cancer-specific survival; PSARS, the prediction of the PSA response; RP, radical prostatectomy; BCR, biochemical recurrence; CRPC, castration-resistant PCa; mCRPC, metastatic CRPC; ENZ, enzalutamide; PLR, platelet-to-lymphocyte-count ratio; BPH, benign prostatic hyperplasia.

accurately differentiate benign prostatic hyperplasia (BPH) from PCa (17,18) and does not predict positive prostate puncture biopsy results and scores (39). Moreover, the NLR may have a limited role in predicting early-stage PCa (19). The relationship between the NLR and the diagnosis of PCa is relatively small and contradictory, and more research is needed to further explore its clinical value.

In a meta-analysis conducted by Gu *et al.* (20) that included both Westerners and Asians, the prognostic value of the NLR in patients with PCa was confirmed, and the association of NLR with recurrence-free survival (RFS) and progression-free survival (PFS) in Asians and Caucasians was existed. This suggests that ethnic differences may influence the prediction of PCa prognosis by the NLR. Other meta-analyses (21,22) have demonstrated the relationship between NLR levels and the prognosis of PCa patients. The above studies suggest that the NLR has prognostic value in PCa and that it could be more actively incorporated into the PCa prognostic evaluation system in future studies.

Patients with localized prostate cancer (LPC) can be cured by radical surgery or radical radiotherapy. Preoperative NLR levels in LPC patients affect their overall survival (OS), cancer-specific survival (CSS), and biochemical recurrence-free survival (BCRFS) after radical prostatectomy (RP). OS, CSS (23), BCRFS (24), and postoperative NLR levels were also associated with patient prognosis (25). However, Maeda's study did not find a relationship between the NLR and prognosis in patients treated with RP (26), which may be related to their small sample size and lack of rigorous classification of patients with PCa by stage. Zanaty *et al.* (40) examined patients

Table 3 The diagnostic and prognostic value of PLR in PCa

Inflammation -related indicators	Study design	Year	Study participants (number)	Effects/results	Major study limitations	References
PLR	Clinical trial	2021	Serum PSA levels of ≥3.0 ng/mL or abnormal DRE findings patients (n=1,652)	The pre-biopsy PLR is not an independent predictor of CSPCa at the prostate biopsy	Non-randomized design, unique racial population	(43)
PLR	Clinical trial	2015	prostate biopsy patients (n=873)	PLR was found to be the additional predictor of prostatic carcinoma	Not available	(44)
PLR	Meta-analysis	2018	7,228 patients from 18 studies	Elevated NLR and PLR was associated with poor oncologic outcomes	Not available	(45)
PLR	Meta-analysis	2018	1,324 patients from 6 studies	High PLR was correlated with poor DFS and OS in patients with PCa	Not available	(46)
PLR	Clinical trial	2016	PCa patients (n=290)	PLR might play a significant role in the prognosis of PCa patients treated with ADT	Retrospective investigation, single institution	(47)
PLR	Clinical trial	2018	PCa patients (n=226)	The pretreatment NLR and PLR might be beneficial to predict the progression and prognosis of PCa	Erroneous data collection, small subject number	(48)

PLR, platelet-to-lymphocyte-count ratio; PCa, prostate cancer; CSPCa, clinically insignificant prostate cancer; NLR, neutrophil-to-lymphocyte-count ratio; DFS, disease-free survival; ADT, androgen deprivation therapy.

treated with robotic-assisted PCa resection and also did not find an association between the NLR and patient prognosis. The role of the NLR in patients with LPC is controversial. More studies with strict patient classification and adequate sample size are needed to clarify the prognostic value of the NLR.

The treatment of castration-resistant prostate cancer (CRPC) consists of cytotoxic chemotherapy, androgen deprivation therapy (ADT), molecular targeted therapy, and immunotherapy (41). Previous meta-analyses have demonstrated a strong association between the NLR and the prognosis of patients with CRPC (27). In patients with CRPC treated with docetaxel, a high NLR was associated with poorer OS (42), PFS (42), CSS, and radiographic PFS (rPFS) (28). NLR levels were also associated with prognosis in patients with CRPC treated with cabazitaxel (29,30). Androgen receptors in PCa cells are key to the development and progression of CRPC, and ADT remains the basic treatment for CRPC (41). For patients with CRPC treated with enzalutamide (31,32) or abiraterone (33), the NLR plays a corresponding prognostic predictive role. In addition, increased NLR in patients with CRPC treated with radium-233 radiotherapy is also associated with a poor prognosis (34). Studies on CRPC patients treated with different therapies have demonstrated the prognostic value of the NLR in these patients (27-34,41,42).

Metastasis is one of the most important factors affecting the prognosis of PCa. PCa can metastasize via the blood, lymph, or directly to adjacent organs, with lymph nodes and bone being the most common sites of metastasis. The NLR have a significant predictive value towards the development of metastases PCa (35). It can be used to aid in the diagnosis of bone metastases from PCa (36) and to predict the prognosis of patients with bone and lymphatic metastases from PCa (37,38).

PLR and PCa diagnosis and prognosis (Table 3)

The PLR plays an important role in PCa diagnosis. PLR appears to have the greatest accuracy in predicting an initial diagnosis of clinically significant PCa (csPCa) (35). It is significantly higher in patients with bone metastases from PCa, can predict the development of bone metastases, and there is a correlation between PLR and PSA levels (36). The PLR also has the potential to predict the Gleason score (23). A clinical study showed that pre-prostate biopsy PLR was not an independent predictor of csPCa (43). However, the predictive value of PLR for BPH and PCa has been

debated in different studies. In a clinical study conducted by Murray *et al.* (17) that included 1,223 patients, PLR levels were not statistically different between the BPH and PCa groups, while another clinical study that included 873 patients showed a statistical difference between the two (44). Thus, the PLR may be a potential predictor of PCa and in combination with PSA might reduce the need for unnecessary puncture biopsies.

The PLR is also a potential prognostic indicator. Guo *et al.* (45) suggested that patients with higher PLR levels have a higher risk of death compared to those with a lower PLR. A meta-analysis including Asians and Caucasians illustrated the prognostic value of the PLR for PCa, and a subgroup analysis also showed differences in the relationship between the PLR and disease-free survival (DFS) for different ethnic groups (46), suggesting that ethnic differences need to be considered in subsequent studies of the prognostic value of the PLR. Similar to the NLR, the PLR has a certain prognostic value in patients who progress to the CRPC stage (33) or in those treated with ADT (47). Sun *et al.* (48) demonstrated the prognostic value of the NLR and PLR and suggested that the NLR was more effective than the PLR as an independent prognostic indicator for PCa. However, more clinical studies comparing the two are needed to verify the reliability of this finding. In a study of PCa patients undergoing robotic-assisted RP conducted by Zanaty *et al.* (40), the predictive value of the PLR for PCa prognosis was not verified.

Therefore, the current research on the diagnostic and predictive value of the PLR for PCa is still inadequate and needs to be further validated by more retrospective clinical studies and supplemented by prospective studies.

Other inflammation-related indicators and PCa diagnosis and prognosis (Table 4)

PCT and CRP, as non-specific inflammation-related indicators, can reflect the level of inflammation in the body in the event of infection or tissue damage. Elevated PCT is correlated with the development of PCa (49) and may be useful in improving the diagnostic accuracy of PCa (50). Gómez-Gómez *et al.* (51) found that pre-puncture CRP levels in patients undergoing prostate puncture were associated with csPCa and higher Gleason scores. Similarly, in patients undergoing RP, elevated preoperative CRP (CRP ≥0.5 mg/dL) is correlated with a postoperative pathological diagnosis of aggressive PCa (52).

In terms of prognostic prediction, the association between CRP and the prognosis of patients receiving different treatment modalities, such as RP (52), chemotherapy (53), and radiotherapy (54), has also been demonstrated. In addition, elevated CRP levels were an independent predictor of poorer OS in metastatic PCa (55). In contrast, other studies have not found a correlation between CRP and PCa (56,57), which may be related to the low specificity of CRP; however, further investigation is needed in the future.

Elevated lymphocyte and monocyte counts are associated with high Gleason scores in PCa (58,59) and monocyte counts can also be used to predict the prognosis of PCa patients (60,61). Bahig *et al.* (61) reported that neutrophil counts are a predictor of prognosis in LPC patients; Vidal *et al.* (62) found similar findings in White men undergoing RP but did not find them to be associated with the prognosis of Black men undergoing RP. More research is needed on the role of leukocyte sorting counts in PCa, with particular attention to the effect of different ethnicities on the results.

Many studies support the hypothesis that genetic variations in inflammatory response genes, including IL4, IL6, CCL-2, CCL-5, COX-1, COX-2, could affect the level and function of the protein products, resulting in the differential PCa risk among carriers of different variants. Genotyping of the polymorphisms was performed by using evaluating single nucleotide polymorphisms (SNPs) spanning the entire gene on PCa patients and controls, and the association of each polymorphic genotype with PCa risk was evaluated by using logistic regression analysis based on allele, heterozygous, and homozygous comparison models. For example, the COX-2 (-1195G>A) polymorphism was shown to increase PCa risk in both heterozygous and homozygous comparison models (63). The C allele of IL-4 rs2243250 polymorphism could make PCa risk grow while the C allele of IL-6 rs10499563 polymorphism make down (64). However, no relation was observed for COX-1 (50C>T). Therefore, it is highly suggested to pay more attention to the polymorphism of inflammation-related genes, which maybe serve as potential predictive biomarkers for PCa risk in the Chinese population.

In addition to the above inflammation-related indicators, others such as plasma fibrinogen (FBG), the LMR, and the eosinophils-lymphocyte ratio (ELR) have also been shown to be associated with the diagnosis of PCa. A study by Leng *et al.* (69) found a positive correlation between FBG and the Gleason score, total PSA (tPSA) levels, and clinical T-stage. In a retrospective analysis, Xie *et al.* (70) reported that FBG

Table 4 The diagnostic and prognostic value of other inflammation-related indicators in PCa

Inflammation-related indicators	Study design	Year	Study participants (number)	Effects/results	Major study limitations	References
PCT	Clinical trial	2021	PCa patients (n=149)	PCT level was associated with PCa	Not available	(49)
PCT	Clinical trial	2018	Low prostate-specific antigen level (2–20 ng/mL) patients (n=227)	PCT can be a novel supplementary biomarker to increase the accuracy of PCa screening	Not available	(50)
CRP	Observational study	2019	Underwent ultrasound guided prostate biopsy patients (n=524)	Higher circulating CRP levels were associated with a more aggressive Gleason score	Not available	(51)
CRP	Clinical trial	2016	PCa patients (n=7,205)	Preoperative CRP is elevated in patients with pathological features of aggressive PCa and BCR after RP	Not available	(52)
CRP	Clinical trial	2016	CRPC patients (n=115)	CRP may be an important biomarker of PFS and OS in CRPC patients treated with docetaxel	Not available	(53)
CRP	Clinical trial	2015	PCa patients (n=261)	CRP has been identified as a prognostic factor for poor CSS, OS and DFS in PCa patients	Not available	(54)
CRP	Clinical trial	2015	PCa patients (n=135)	CRP level is useful to predict the prognosis of metastatic PCa patients	Small sample size	(55)
CRP	Case–control study	2017	PCa patients (n=229) and controls (n=252)	No significant association between CRP with PCa	Not available	(56)
CRP	Clinical trial	2015	PCa patients (n=629)	CRP does not appear to possess the predictive value	Relatively short follow-up prospective study	(57)
Lymphocyte and monocyte counts	Clinical trial	2016	PCa patients (n=217)	Relative neutrophilia and lymphocytosis might indicate an early manifestation of harboring a more aggressive PCa	Retrospective study	(58)
Monocyte counts	Cohort study	2017	Patients underwent prostate biopsy (n=1,107) and PCa patients (n=290)	Elevated monocyte counts were an independent diagnostic biomarker for PCa	Retrospective investigation, single institution	(59)
Monocyte counts	Clinical trial	2016	CRPC patients (n=214)	Elevated monocyte counts were associated with aggressive tumor features and poor survival outcomes of patients	small number of subjects did not address the direct correlation	(60)
Neutrophil count	Clinical trial	2015	PCa patients (n=1,772)	Neutrophil count appears to be an independent prognostic factor for overall mortality in localized PCa	Small number of events, lack validation cohort	(61)

Table 4 (*continued*)

Table 4 (*continued*)

Inflammation-related indicators	Study design	Year	Study participants (number)	Effects/results	Major study limitations	References
Neutrophil count	Clinical trial	2018	Radical prostatectomy patients (n=1,826)	Neutrophils-positive association with risk of all-cause mortality in white men	Limited number of events	(62)
COX-2	Clinical trial	2015	PCa patients (n=543) and controls (n=753)	COX-2 (-1195G>A) polymorphisms may be associated with increased PCa risk	Small sample size, only included five polymorphisms	(63)
IL-4 rs2243250 and IL-6 rs10499563 polymorphisms	Clinical trial	2016	PCa patients (n=439) and controls (n=524)	The variant allele of rs2243250 of IL-4 and rs10499563 of IL-6 was associated with increased and decreased PCa risk	Not available	(64)
LMR	Clinical trial	2019	Patients underwent prostate biopsy (n=621)	LMR is a useful tool at detecting PCa	Not available	(65)
Butyrylcholinesterase	Clinical trial	2016	PCa patients (n=535)	BChE was significantly associated with BRFS	Limited number of patients	(66)
SII, ALB, and FBG	Clinical trial	2019	mCRPC patients (n=179)	Pretreatment SII, albumin, and fibrinogen are independent prognostic factors in mCRPC patients treated with first-line docetaxel	Not available	(67)
MS and INF	Clinical trial	2018	mCRPC patients (n=551)	Pretreatment identification of MS and INF alterations might represent an available and easy tool for better prognostication of patients with mCRPC	Small number of MS+ patients, retrospective design	(68)

PCa, prostate cancer; PCT, procalcitonin; CRP, C-reactive protein; BCR, biochemical recurrence; RP, radical prostatectomy; CRPC, castration-resistant PCa; PFS, progression-free survival; OS, overall survival; CSS, cancer-specific survival; DFS, disease-free survival; LMR, lymphocyte-to-monocyte ratio; BChE, butyrylcholinesterase; BRFS, biochemical recurrence-free survival; mCRPC, metastatic CRPC; MS, metabolic syndrome; INF, inflammation.

and the NLR were both independent risk factors for the development of PCa and that FBG was an independent predictor of International Society of Urological Pathology (ISUP) grade ≥3 and bone metastasis in PCa. The LMR has predictive value in differentiating PCa from prostate enlargement and prostatitis, especially in patients with PSA levels of 4–10 ng/mL, and its combination with free/total PSA (f/tPSA) is more predictive (65). The ELR can be used as a predictor of elevated Gleason score to assess low-risk PCa and guide patients to proactive monitoring (16).

For PCa prognosis, there are also less studied inflammatory factors such as neutrophil count (61), butyrylcholinesterase (66), systemic immune-inflammation index (SII), ALB, FBG (67), etc. In a study on the prognosis of CRPC patients treated with docetaxel, Man *et al.* (67) suggested that SII, ALB, and FBG levels could also be used as predictors of patient prognosis, providing new ideas for subsequent clinical studies that could be performed to predict the prognosis of patients with PCa at different stages of progression or treatment modalities, as well as for the investigation of other tumours. Serum levels of butyrylcholinesterase are associated with liver injury, inflammation, and malnutrition (66). Conteduca *et al.* (68) found that metabolic syndrome (MS) was associated with PFS and OS in CRPC patients. MS is a group of metabolic disorder syndromes whose pathogenesis involves patients being in a chronic low-grade inflammatory state for a long time, with inflammatory phenomena such as increased cytokines. This perspective further demonstrates the importance of the inflammatory response in the

development of PCa.

The predictive value of the above inflammation-related indicators for the diagnosis and prognosis of PCa has been widely studied but has not yet been applied in clinical practice. Therefore, there is a need to find more meaningful predictors or develop comprehensive predictive models to further guide diagnosis and treatment after screening and to predict the prognosis of patients.

Summary and discussion

Currently ineffective PCa screening

The promotion of PSA screening led to a rapid increase in the incidence of PCa from the late 1980s to the early 1990s (71). However, PSA is less specific and may lead to unnecessary puncture biopsies and consultations. Also, prostate puncture operations, drug treatments, and surgery may result in serious complications for patients. Inflammation-related indicators based on haematological tests have some diagnostic and prognostic value both when used alone and in combination with common clinical indicators such as PSA, and can significantly improve the accuracy of diagnostic results.

Paradigm change from reactive to predictive and preventive PCa management is essential

PCa incidence is permanently increasing in adolescents and young adults (aged 15–40 years). Also, the rates of metastasising PCa are steadily growing up in the young population (4,72). Socio-economic burden is enormous: PCa treatment costs increase more rapidly than for any other cancer (4). To this end, inflammation-related indicators is a promising approach in predicting the diagnosis and prognosis of PCa patients. The relationship between NLR levels and PCa has been extensively reported. The diagnostic value of NLR for PCa lies primarily in its use in combination with PSA for screening patients with suspected PCa, thereby improving the specificity of screening and predicting poor pathological outcomes, among other things. This not only reduces the need for patients to undergo unnecessary tests but also provides guidance regarding whether to undergo aggressive interventions. The prognostic value of the NLR has been studied in a wider variety of patients and in a more detailed way than diagnosis, owing to the different stages of progression and treatment modalities of PCa patients. NLR prognosis has mainly involved LPC, CRPC, metastatic PCa, and its different treatment modalities, including radical surgery, radiotherapy, chemotherapy, and ADT. Numerous studies have shown that NLR has a strong prognostic predictive value; however, some of the findings are controversial and more studies are needed to further confirm them.

Targeted modulation of inflammation for PCa is currently lacking in clinical practice, but one study has shown that the use of NSAIDs such as aspirin is negatively associated with PCa incidence and specific mortality (73). Another study based on dietary inflammatory index suggests that diet may influence the prognosis of patients with more aggressive PCa through its inflammatory potential (74). Dietary interventions aimed at reducing inflammation may be considered to improve the survival of men with PCa (74).

The diagnostic and prognostic value of the PLR and other inflammation-related indicators have also been reported but more research is needed to explore their applicability in clinical work, as there are only a few studies and contradictions between some of the results. We think the possible reason for inconsistent previous research results is the patient stratification that differently. Other possible explanations for the different findings were probably related to the variation in the methodology.

The shortcomings in the existing studies

Many studies have been conducted on the value of inflammation-related indicators in guiding the diagnosis and treatment of PCa; yet, there are still many shortcomings in the existing studies. Firstly, most of the existing studies were only conducted on single factors and on patients with single conditions. There is also a lack of comprehensive studies and a systematic evaluation system has not been developed. Additionally, more studies on patients from different ethnic groups and different geographical areas are needed. Secondly, the conclusions of the existing studies are somewhat divergent, and the value of clinical translation is open to question. Thirdly, retrospective clinical data analysis accounts for the majority of existing research; there are few prospective studies, and the role of inflammation-related indicators has not been fully confirmed.

Conclusions

Although the value of inflammation-related indicators in predicting the diagnosis and prognosis of PCa is now

becoming clear, further studies are still needed to validate the present findings. Also, the correlation between relevant inflammation-related indicators and prognosis may suggest mechanisms of tumour progression, and more basic research is needed to support clinical work.

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Footnote

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References

1. World Health Organization. International Agency for research on cancer. 2020. Available online: https://gco.iarc.fr/today/data/factsheets/populations/900-world-fact-sheets.pdf
2. World Health Organization. International Agency for research on cancer. 2020. Available online: https://gco.iarc.fr/today/data/factsheets/populations/160-china-fact-sheets.pdf
3. Mazurakova A, Samec M, Koklesova L, et al. Anti-prostate cancer protection and therapy in the framework of predictive, preventive and personalised medicine - comprehensive effects of phytochemicals in primary, secondary and tertiary care. EPMA J 2022;13:461-86.
4. Ellinger J, Alajati A, Kubatka P, et al. Prostate cancer treatment costs increase more rapidly than for any other cancer-how to reverse the trend? EPMA J 2022;13:1-7.
5. Kucera R, Pecen L, Topolcan O, et al. Prostate cancer management: long-term beliefs, epidemic developments in the early twenty-first century and 3PM dimensional solutions. EPMA J 2020;11:399-418.
6. Crusz SM, Balkwill FR. Inflammation and cancer: advances and new agents. Nat Rev Clin Oncol 2015;12:584-96.
7. Lu G, Cai W, Wang X, et al. Identifying prognostic signatures in the microenvironment of prostate cancer. Transl Androl Urol 2021;10:4206-18.
8. Zeng J, Chen Z. The relationship between chronic inflammation of the prostate and prostate cancer. Journal of Modern Urogenital Oncology 2019;11:257-60.
9. Conway EM, Pikor LA, Kung SH, et al. Macrophages, and Lung Cancer. Am J Respir Crit Care Med 2016;193:116-30.
10. Piazuelo MB, Riechelmann RP, Wilson KT, et al. Resolution of Gastric Cancer-Promoting Inflammation: A Novel Strategy for Anti-cancer Therapy. Curr Top Microbiol Immunol 2019;421:319-59.
11. Chen JH, Zhai ET, Yuan YJ, et al. Systemic immune-inflammation index for predicting prognosis of colorectal cancer. World J Gastroenterol 2017;23:6261-72.
12. Yang YM, Kim SY, Seki E. Inflammation and Liver Cancer: Molecular Mechanisms and Therapeutic Targets. Semin Liver Dis 2019;39:26-42.
13. Trinchieri G. Cancer and inflammation: an old intuition with rapidly evolving new concepts. Annu Rev Immunol 2012;30:677-706.
14. Masuda H, Mikami K, Otsuka K, et al. Validation of the Effectiveness of Neutrophil-to-lymphocyte Ratio (NLR) as a Predictive Factor in Patients Undergoing Prostate Biopsy With Prostate Specific Antigen (PSA) Between 4.0 and 10.0 ng/ml. In Vivo 2021;35:1641-6.
15. Wang H, Gu L, Wu Y, et al. The values of neutrophil-lymphocyte ratio and/or prostate-specific antigen in discriminating real Gleason score ≥ 7 prostate cancer from group of biopsy-based Gleason score ≤ 6. BMC Cancer 2017;17:629.

16. Karadağ S, Ekşi M, Özdemir O, et al. Is neutrophile to lymphocyte ratio a predictor of Gleason score upgrading according to risk classifications in patients with prostate cancer. Arch Esp Urol 2021;74:599-605.
17. Murray NP, Fuentealba C, Reyes E, et al. Predictive Value of Neutrophil to Lymphocyte Ratio in the Diagnosis of Significant Prostate Cancer at Initial Biopsy: A Comparison with Free Percent Prostate Specific Antigen, Prostate Specific Antigen Density and Primary Circulating Prostate Cells. Asian Pac J Cancer Prev 2019;20:3385-9.
18. Espinoza AR, Lavi J, Otaño N, et al. Serum cellular inflammatory markers in the diagnosis of prostate cancer. Arch Esp Urol 2019;72:641-6.
19. Du J, Lim EJ, Huang HH, et al. Predictive value of neutrophil-to-lymphocyte ratio in diagnosis of early prostate cancer among men who underwent robotic transperineal prostate biopsy. Medicine (Baltimore) 2021;100:e28007.
20. Gu X, Gao X, Li X, et al. Prognostic significance of neutrophil-to-lymphocyte ratio in prostate cancer: evidence from 16,266 patients. Sci Rep 2016;6:22089.
21. Cao J, Zhu X, Zhao X, et al. Neutrophil-to-Lymphocyte Ratio Predicts PSA Response and Prognosis in Prostate Cancer: A Systematic Review and Meta-Analysis. PLoS One 2016;11:e0158770.
22. Tang L, Li X, Wang B, et al. Prognostic Value of Neutrophil-to-Lymphocyte Ratio in Localized and Advanced Prostate Cancer: A Systematic Review and Meta-Analysis. PLoS One 2016;11:e0153981.
23. Jang WS, Cho KS, Kim KH, et al. Prognostic impact of preoperative neutrophil-to-lymphocyte ratio after radical prostatectomy in localized prostate cancer. Prostate Cancer Prostatic Dis 2016;19:298-304.
24. Lee H, Jeong SJ, Hong SK, et al. High preoperative neutrophil-lymphocyte ratio predicts biochemical recurrence in patients with localized prostate cancer after radical prostatectomy. World J Urol 2016;34:821-7.
25. Jang WS, Cho KS, Kim MS, et al. The prognostic significance of postoperative neutrophil-to-lymphocyte ratio after radical prostatectomy for localized prostate cancer. Oncotarget 2017;8:11778-87.
26. Maeda Y, Kawahara T, Koizumi M, et al. Lack of an Association between Neutrophil-to-Lymphocyte Ratio and PSA Failure of Prostate Cancer Patients Who Underwent Radical Prostatectomy. Biomed Res Int 2016;2016:6197353.
27. Chong W, Zhang Z, Luo R, et al. Integration of circulating tumor cell and neutrophil-lymphocyte ratio to identify high-risk metastatic castration-resistant prostate cancer patients. BMC Cancer 2021;21:655.
28. Koo KC, Lee JS, Ha JS, et al. Optimal sequencing strategy using docetaxel and androgen receptor axis-targeted agents in patients with castration-resistant prostate cancer: utilization of neutrophil-to-lymphocyte ratio. World J Urol 2019;37:2375-84.
29. Meisel A, von Felten S, Vogt DR, et al. Severe neutropenia during cabazitaxel treatment is associated with survival benefit in men with metastatic castration-resistant prostate cancer (mCRPC): A post-hoc analysis of the TROPIC phase III trial. Eur J Cancer 2016;56:93-100.
30. Uemura K, Kawahara T, Yamashita D, et al. Neutrophil-to-Lymphocyte Ratio Predicts Prognosis in Castration-Resistant Prostate Cancer Patients Who Received Cabazitaxel Chemotherapy. Biomed Res Int 2017;2017:7538647.
31. Kumano Y, Hasegawa Y, Kawahara T, et al. Pretreatment Neutrophil to Lymphocyte Ratio (NLR) Predicts Prognosis for Castration Resistant Prostate Cancer Patients Underwent Enzalutamide. Biomed Res Int 2019;2019:9450838.
32. Conteduca V, Crabb SJ, Jones RJ, et al. Persistent Neutrophil to Lymphocyte Ratio >3 during Treatment with Enzalutamide and Clinical Outcome in Patients with Castration-Resistant Prostate Cancer. PLoS One 2016;11:e0158952.
33. Lozano Martínez AJ, Moreno Cano R, Escobar Páramo S, et al. Platelet-lymphocyte and neutrophil-lymphocyte ratios are prognostic but not predictive of response to abiraterone acetate in metastatic castration-resistant prostate cancer. Clin Transl Oncol 2017;19:1531-6.
34. Parikh S, Murray L, Kenning L, et al. Real-world Outcomes and Factors Predicting Survival and Completion of Radium 223 in Metastatic Castrate-resistant Prostate Cancer. Clin Oncol (R Coll Radiol) 2018;30:548-55.
35. Salciccia S, Frisenda M, Bevilacqua G, et al. Comparative Prospective and Longitudinal Analysis on the Platelet-to-Lymphocyte, Neutrophil-to-Lymphocyte, and Albumin-to-Globulin Ratio in Patients with Non-Metastatic and Metastatic Prostate Cancer. Curr Oncol 2022;29:9474-500.
36. Zhang JY, Ge P, Zhang PY, et al. Role of Neutrophil to Lymphocyte Ratio or Platelet to Lymphocyte Ratio in Prediction of Bone Metastasis of Prostate Cancer. Clin Lab 2019. doi:10.7754/Clin.Lab.2018.181040.
37. Kawahara T, Yokomizo Y, Ito Y, et al. Pretreatment neutrophil-to-lymphocyte ratio predicts the prognosis in patients with metastatic prostate cancer. BMC Cancer

2016;16:111.
38. Owari T, Miyake M, Nakai Y, et al. A Genitourinary Cancer-specific Scoring System for the Prediction of Survival in Patients with Bone Metastasis: A Retrospective Analysis of Prostate Cancer, Renal Cell Carcinoma, and Urothelial Carcinoma. Anticancer Res 2018;38:3097-103.
39. Maeda Y, Kawahara T, Kumano Y, et al. The Neutrophil-to-Lymphocyte Ratio before Repeat Prostate Needle Biopsy for Predicting Prostate Cancer. Urol Int 2016;96:123-4.
40. Zanaty M, Ajib K, Alnazari M, et al. Prognostic utility of neutrophil-to-lymphocyte and platelets-to-lymphocyte ratio in predicting biochemical recurrence post robotic prostatectomy. Biomark Med 2018;12:841-8.
41. Jia Z, Chen Z, Gao X. Advances in the treatment of desmoid-resistant prostate cancer. Journal of Clinical Urology 2020;35:312.
42. Yao A, Sejima T, Iwamoto H, et al. High neutrophil-to-lymphocyte ratio predicts poor clinical outcome in patients with castration-resistant prostate cancer treated with docetaxel chemotherapy. Int J Urol 2015;22:827-33.
43. Lee JW, Jeong H, Son H, et al. Platelet-to-lymphocyte ratio is not a predictor of clinically significant prostate cancer at the prostate biopsy: A large cohort study. Sci Rep 2021;11:14240.
44. Yuksel OH, Urkmez A, Akan S, et al. Predictive Value of the Platelet-To-Lymphocyte Ratio in Diagnosis of Prostate Cancer. Asian Pac J Cancer Prev 2015;16:6407-12.
45. Guo J, Fang J, Huang X, et al. Prognostic role of neutrophil to lymphocyte ratio and platelet to lymphocyte ratio in prostate cancer: A meta-analysis of results from multivariate analysis. Int J Surg 2018;60:216-23.
46. Wang J, Zhou X, He Y, et al. Prognostic role of platelet to lymphocyte ratio in prostate cancer: A meta-analysis. Medicine (Baltimore) 2018;97:e12504.
47. Wang Y, Xu F, Pan J, et al. Platelet to lymphocyte ratio as an independent prognostic indicator for prostate cancer patients receiving androgen deprivation therapy. BMC Cancer 2016;16:329.
48. Sun Z, Ju Y, Han F, et al. Clinical implications of pretreatment inflammatory biomarkers as independent prognostic indicators in prostate cancer. J Clin Lab Anal 2018;32:e22277.
49. Ilktac A, Kalkan S, Caliskan S. C-reactive protein and procalcitonin levels in prostate cancer. Int J Clin Pract 2021;75:e13935.
50. Canat L, Atalay HA, Can O, et al. Serum procalcitonin levels in prostate cancer: A new biomarker? Urologia 2018;85:46-50.
51. Gómez-Gómez E, Carrasco-Valiente J, Campos-Hernández JP, et al. Clinical association of metabolic syndrome, C-reactive protein and testosterone levels with clinically significant prostate cancer. J Cell Mol Med 2019;23:934-42.
52. Sevcenco S, Mathieu R, Baltzer P, et al. The prognostic role of preoperative serum C-reactive protein in predicting the biochemical recurrence in patients treated with radical prostatectomy. Prostate Cancer Prostatic Dis 2016;19:163-7.
53. Liao SG, Cheng HH, Lei Y. C-Reactive Protein is a Prognostic Marker for Patients with Castration-Resistant Prostate Cancer. Oncol Res Treat 2016;39:266-71.
54. Thurner EM, Krenn-Pilko S, Langsenlehner U, et al. The elevated C-reactive protein level is associated with poor prognosis in prostate cancer patients treated with radiotherapy. Eur J Cancer 2015;51:610-9.
55. Xu L, Zhao Q, Huang S, et al. Serum C-reactive protein acted as a prognostic biomarker for overall survival in metastatic prostate cancer patients. Tumour Biol 2015;36:669-73.
56. Tulloch-Reid MK, McFarlane-Anderson N, Bennett FI, et al. Effects of cholesterol, C-reactive protein, and interleukin-6 on prostate cancer risk in a population of African ancestry. Cancer Causes Control 2017;28:1313-21.
57. Schnoeller TJ, Steinestel J, Steinestel K, et al. Do preoperative serum C-reactive protein levels predict the definitive pathological stage in patients with clinically localized prostate cancer? Int Urol Nephrol 2015;47:765-70.
58. Kwon YS, Han CS, Yu JW, et al. Neutrophil and Lymphocyte Counts as Clinical Markers for Stratifying Low-Risk Prostate Cancer. Clin Genitourin Cancer 2016;14:e1-8.
59. Wang YQ, Zhu YJ, Pan JH, et al. Peripheral monocyte count: an independent diagnostic and prognostic biomarker for prostate cancer - a large Chinese cohort study. Asian J Androl 2017;19:579-85.
60. Shigeta K, Kosaka T, Kitano S, et al. High Absolute Monocyte Count Predicts Poor Clinical Outcome in Patients with Castration-Resistant Prostate Cancer Treated with Docetaxel Chemotherapy. Ann Surg Oncol 2016;23:4115-22.
61. Bahig H, Taussky D, Delouya G, et al. Neutrophil count is associated with survival in localized prostate cancer. BMC Cancer 2015;15:594.
62. Vidal AC, Howard LE, de Hoedt A, et al. Neutrophil, lymphocyte and platelet counts, and risk of prostate

cancer outcomes in white and black men: results from the SEARCH database. Cancer Causes Control 2018;29:581-8.
63. Cui X, Yan H, Ou TW, et al. Genetic Variations in Inflammatory Response Genes and Their Association with the Risk of Prostate Cancer. Biomed Res Int 2015;2015:674039.
64. Chen J, Ying XM, Huang XM, et al. Association between polymorphisms in selected inflammatory response genes and the risk of prostate cancer. Onco Targets Ther 2016;9:223-9.
65. Caglayan V, Onen E, Avci S, et al. Lymphocyte-to-monocyte ratio is a valuable marker to predict prostate cancer in patients with prostate specific antigen between 4 and 10 ng/dl. Arch Ital Urol Androl 2019;90:270-5.
66. Koie T, Ohyama C, Hatakeyama S, et al. Significance of preoperative butyrylcholinesterase as an independent predictor of biochemical recurrence-free survival in patients with prostate cancer treated with radical prostatectomy. Int J Clin Oncol 2016;21:379-83.
67. Man YN, Chen YF. Systemic immune-inflammation index, serum albumin, and fibrinogen impact prognosis in castration-resistant prostate cancer patients treated with first-line docetaxel. Int Urol Nephrol 2019;51:2189-99.
68. Conteduca V, Caffo O, Galli L, et al. Association among metabolic syndrome, inflammation, and survival in prostate cancer. Urol Oncol 2018;36:240.e1-240.e11.
69. Leng Z, Su W, Li J, et al. Study on the relationship between plasma fibrinogen level and clinicopathological features of prostate cancer. Chinese Journal of Lumpectomy and Urology (electronic version) 2020;14:12-5.
70. Xie T. Correlation of plasma FBG, NLR, PLR and MLR with the risk of prostate cancer. Southern Medical University, 2019.
71. Torre LA, Siegel RL, Ward EM, et al. Global Cancer Incidence and Mortality Rates and Trends--An Update. Cancer Epidemiol Biomarkers Prev 2016;25:16-27.
72. Golubnitschaja O, Kubatka P, Mazurakova A, et al. Systemic Effects Reflected in Specific Biomarker Patterns Are Instrumental for the Paradigm Change in Prostate Cancer Management: A Strategic Paper. Cancers (Basel) 2022;14:675.
73. Liu Y, Chen JQ, Xie L, et al. Effect of aspirin and other non-steroidal anti-inflammatory drugs on prostate cancer incidence and mortality: a systematic review and meta-analysis. BMC Med 2014;12:55.
74. Zucchetto A, Gini A, Shivappa N, et al. Dietary inflammatory index and prostate cancer survival. Int J Cancer 2016;139:2398-404.

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