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Review Article

A Narrative Review of Novel Monoclonal Antibodies in Oncology

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ABSTRACT

Monoclonal antibodies (mAbs) have become important therapeutic agents in oncology by selectively targeting tumour-associated antigens, immune checkpoints, and signalling pathways. This review summarizes novel mAb platforms, focusing on immune checkpoint inhibitors (ICIs), antibody–drug conjugates (ADCs), and bispecific antibodies (BsAbs), with emphasis on mechanisms, clinical applications, efficacy, safety, advantages, challenges, and future prospects. Published evidence was organized according to antibody platform, molecular target, cancer type, treatment setting, efficacy endpoint, comparator, and clinically relevant toxicity. Direct randomized comparisons were emphasized when available, while single-arm studies were interpreted as evidence of activity rather than superiority. Pembrolizumab and nivolumab demonstrate durable benefit in selected cancers; T-DM1 and polatuzumab vedotin illustrate targeted cytotoxic delivery; and blinatumomab demonstrates immune-cell redirection. Toxicity remains platform-dependent, including immune-mediated adverse events with ICIs, payload-related effects with ADCs, and cytokine-release or neurologic events with BsAbs. Novel mAbs have broadened treatment options, but their clinical value remains dependent on tumour biology, biomarkers, treatment setting, efficacy, and toxicity management. Future development should emphasize biomarker selection, antibody engineering, resistance management, combination strategies, and safer molecular designs.

INTRODUCTION

Cancer remains a major cause of morbidity and mortality worldwide despite advances in diagnosis and treatment. Conventional approaches, including chemotherapy, radiotherapy and

surgery, have improved survival in many malignancies, but their effectiveness may be limited by non-selective toxicity, treatment resistance and disease recurrence. These limitations have accelerated the development of targeted and biological therapies designed to act

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more selectively on tumour-associated molecular pathways. Monoclonal antibodies (mAbs) are a class of targeted agents that recognize specific antigens or signalling molecules involved in tumour growth and immune regulation. Their clinical use has expanded across breast, colorectal, lung, haematological and other cancers. Advances in antibody engineering have further produced immune checkpoint inhibitors (ICIs), antibody–drug conjugates (ADCs) and bispecific antibodies (BsAbs), which extend the functions of conventional antibodies through immune modulation, targeted payload delivery and dual-target engagement. However, their benefits vary according to tumour biology, biomarker status, treatment setting and mechanism, and may be accompanied by platform-specific toxicities and resistance. Therefore, understanding the development, mechanisms, clinical applications, efficacy and safety of these newer platforms is important for their interpretation. This narrative review summarizes developments in novel monoclonal antibodies in oncology, emphasizing ICIs, ADCs and BsAbs, their clinical evidence, limitations, safety considerations and future directions.

Monoclonal antibodies (mAbs) are an important class of targeted therapeutic agents that recognize specific antigens or molecular targets expressed by tumour cells or involved in tumour-associated signalling pathways. Their development has expanded the therapeutic options available for several cancers, including breast, colorectal, lung, haematological and other malignancies. By selectively interacting with defined targets, mAbs can interfere with tumour-cell proliferation, promote immune-mediated destruction of cancer cells or modify signalling pathways essential for tumour survival.

Recent advances in antibody engineering have resulted in novel monoclonal antibody platforms with mechanisms that extend beyond those of conventional antibodies. Immune checkpoint inhibitors (ICIs), antibody–drug conjugates (ADCs) and bispecific antibodies (BsAbs) represent important developments in this field. ICIs enhance antitumour immune responses by blocking inhibitory immune pathways such as programmed cell death protein 1 (PD-1), programmed death-ligand 1 (PD-L1) and cytotoxic T-lymphocyte-associated antigen 4 (CTLA-4). ADCs combine the target-selective properties of antibodies with potent cytotoxic agents, enabling targeted delivery of therapeutic payloads to cancer cells. BsAbs are engineered to recognize two different antigens or epitopes and can facilitate interactions between tumour cells and immune effector cells.

Although these newer antibody-based therapies have expanded treatment possibilities, their clinical benefits are associated with challenges including adverse effects, resistance, heterogeneous treatment responses, complex manufacturing requirements and differences in therapeutic outcomes among cancer types. Therefore, understanding the evolution from conventional monoclonal antibodies to newer antibody platforms is important for evaluating their therapeutic applications and limitations.

The present narrative review aims to summarize recent developments in novel monoclonal antibodies used in oncology, with particular emphasis on immune checkpoint inhibitors, antibody–drug conjugates and bispecific antibodies. It discusses their mechanisms of action, major therapeutic applications, clinical efficacy and safety profiles, while highlighting important differences between newer antibody-based approaches and conventional monoclonal



antibody therapies. The review also considers emerging developments and future prospects in monoclonal antibody-based cancer treatment.

2. REVIEW APPROACH

This article is structured as a narrative review. The supplied comparative-review manuscript provided the principal clinical evidence and terminology, while the supplied bioanalytical review structure informed the organization into background, objective, method, evidence synthesis, comparative tables, challenges and future

perspectives. No new pooled effect estimate was calculated because the underlying studies differ in cancer type, population, comparator, endpoint and follow-up. [1–5]

Evidence was organized according to antibody platform, molecular target or mechanism, cancer setting, comparator, efficacy endpoint and clinically relevant toxicity. Direct randomized comparisons were emphasized when available; single-arm evidence was interpreted as activity rather than proof of superiority. [6–18]

Table 1. Major monoclonal-antibody platforms discussed in the review

Platform	Representative examples	Core mechanism	Clinical role	Key toxicity	Key references
Conventional/naked mAbs	Trastuzumab; rituximab	Targeted antigen/receptor binding	Established targeted treatment	Infusion and target-related effects	Justiz-Vaillant et al. [1] 2025; Pento [4] 2017
ICIs	Pembrolizumab; nivolumab; ipilimumab	PD-1/PD-L1 or CTLA-4 blockade	Reactivation of antitumour immunity	Immune-related adverse events	Reck et al. [6] 2016; Larkin et al. [7]2015; Wolchok et al. [8]2025
ADCs	T-DM1; polatuzumab vedotin; trastuzumab deruxtecan	Antibody + linker + cytotoxic payload	Targeted payload delivery	Cytopenias; hepatic, GI or neurologic effects	von Minckwitz et al. [9] 2019; Tilly et al. [12] 2022; Tsuchikama et al. [22]2024
BsAbs	Blinatumomab; amivantamab	Dual-target binding / immune-cell engagement	Immune redirection or dual-pathway targeting	CRS; infusion and neurologic effects	Kantarjian et al. [14]2017; Park et al. [15] 2021; Klein et al. [21]2024

3. IMMUNE CHECKPOINT INHIBITORS

ICIs act by blocking inhibitory signals that restrain T-cell responses. Pembrolizumab and nivolumab target PD-1, while atezolizumab targets PD-L1 and ipilimumab targets CTLA-4. Their clinical benefit depends not only on the individual drug but also on tumour immune biology and, in several settings, the expression of relevant biomarkers. [1–3,6–8] [32,34]

In KEYNOTE-024, pembrolizumab produced a median progression-free survival of 10.3 months compared with 6.0 months for platinum-based chemotherapy in previously untreated advanced NSCLC with PD-L1 expression of at least 50%. In melanoma, CheckMate 067 established durable benefit with nivolumab-containing treatment compared with ipilimumab alone, with longer-term follow-up supporting persistent clinical benefit in selected patients. [6–8]



The main safety distinction from conventional chemotherapy is the pattern of toxicity, rather than an absence of adverse effects. Immune-mediated adverse events may involve the skin, bowel, liver, lung and endocrine organs. Combination checkpoint blockade can increase immune-mediated toxicity, making early recognition and treatment essential. [7,8] [33,34]

Table 2. Comparative evidence for immune checkpoint inhibitors

Therapy	Cancer setting	Comparator	Efficacy finding	Important toxicity	Reference name / no.
Pembrolizumab	Advanced NSCLC, PD-L1 $\geq 50\%$	Platinum chemotherapy	Median PFS 10.3 vs 6.0 months	Immune-related adverse events	Reck et al. [6] 2016
Nivolumab + ipilimumab	Untreated advanced melanoma	Ipilimumab alone	Longer PFS with nivolumab-containing therapy	Higher immune-mediated toxicity with combination	Larkin et al. [7]2015
Nivolumab + ipilimumab	Advanced melanoma, long-term follow-up	Ipilimumab	Durable long-term overall benefit reported	Chronic immune-related toxicity remains relevant	Wolchok et al. [8]2025
ICIs as a class	Biomarker-selected solid tumours	Conventional therapy / active comparator	Benefit varies by disease and biomarker	Organ-specific immune inflammation	Justiz-Vaillant et al. [1]2025; Delgado & Garcia-Sanz [2]2023

Interpretation

The major strength of ICIs is the possibility of durable immune control after treatment exposure. However, response heterogeneity, primary or acquired resistance and immune-related toxicity limit universal benefit. Therefore, efficacy should be interpreted alongside biomarker status and treatment setting rather than as a simple comparison with chemotherapy. [1,2,21,23]

4. ANTIBODY–DRUG CONJUGATES

ADCs are composed of an antibody, linker and cytotoxic payload. The antibody provides target recognition, the linker controls stability and release, and the payload produces the cytotoxic

effect after delivery to the tumour cell. This design can improve the therapeutic index compared with systemic delivery of an equally potent free cytotoxic drug, but it does not eliminate systemic toxicity. [5,17,22] [28–30]

T-DM1 provides an important clinical example. In the KATHERINE study, three-year invasive disease-free survival was 88.3% with T-DM1 compared with 77.0% with trastuzumab in patients with HER2-positive early breast cancer and residual invasive disease after neoadjuvant therapy. In EMILIA, T-DM1 also improved progression-free and overall survival compared with lapatinib plus capecitabine in previously treated HER2-positive advanced breast cancer. [9–11]



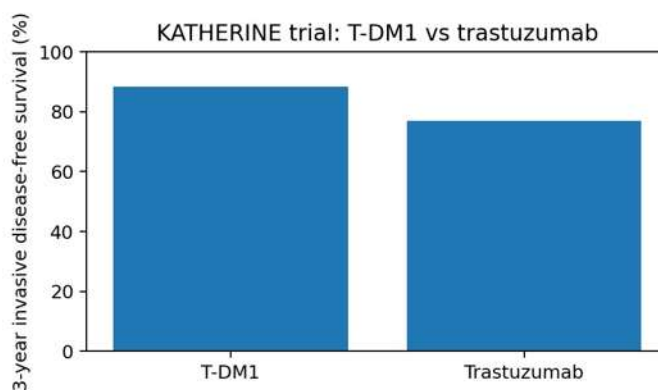


Figure 1. Three-year invasive disease-free survival reported in the KATHERINE comparison. Values are taken from the supplied review and represent one trial-specific comparison.

Polatuzumab vedotin adds another example of payload-directed therapy in lymphoma. In POLARIX, polatuzumab vedotin plus R-CHP improved the reported progression-related outcome compared with R-CHOP in previously untreated diffuse large B-cell lymphoma. ADC

development is now moving toward improved linkers, novel payloads, bispecific ADCs, dual-payload systems and tumour-activated designs intended to address heterogeneity and resistance. [12,13,22]

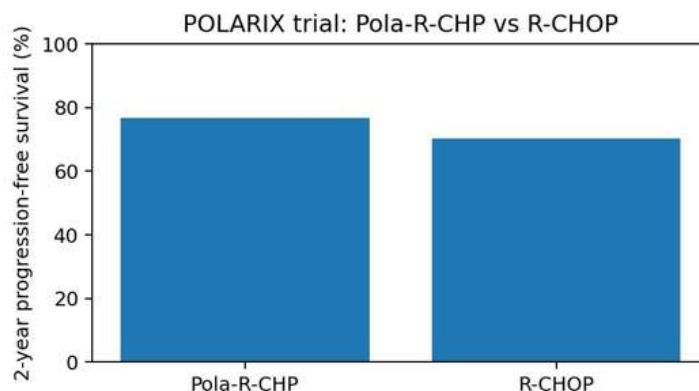


Figure 2. Reported progression-free survival values for Pola-R-CHP and R-CHOP in the cited phase III DLBCL study. The two bars are from one study and should not be compared directly with Figure 1.

Table 3. Antibody–drug conjugates: mechanism and clinical evidence

ADC	Target / design	Clinical comparison	Reported efficacy	Main safety issue	Reference name / no.
T-DM1	HER2-directed antibody + DM1 payload	Trastuzumab in residual early breast cancer	3-y IDFS 88.3% vs 77.0%	Thrombocytopenia; liver abnormalities; neuropathy	von Minckwitz et al. [9]2019; Loibl et al. [10]
T-DM1	HER2-directed ADC	Lapatinib + capecitabine	Median PFS 9.6 vs 6.4 months; OS 30.9 vs 25.1 months at reported analysis	Thrombocytopenia and hepatic toxicity	Verma et al. [11]2012
Next-generation ADCs	Improved antibody/ linker/ payload engineering	Platform development	Potential to address resistance and heterogeneity	Payload- and design-dependent toxicity	Tsuchikama et al. [22]2024; Dumontet et al. [23]2023

Interpretation

ADC efficacy depends on target expression, internalization, linker stability, payload potency and tumour heterogeneity. The same structural features that increase antitumour activity can also influence adverse events. Thus, next-generation ADC research increasingly focuses on balancing potency, selectivity and controlled payload release. [17,22,23] [28–30]

5. BISPECIFIC ANTIBODIES

Bispecific antibodies are engineered to recognize two antigens or epitopes. Some engage a tumour antigen and an immune-cell antigen, while others inhibit two signalling pathways. This dual recognition creates mechanisms that are difficult to reproduce with conventional single-target antibodies. [14–16,21,24] [27,31]

Blinatumomab is a CD19×CD3 T-cell engager used in B-cell precursor acute lymphoblastic leukemia. In the TOWER study, blinatumomab improved overall survival compared with standard chemotherapy in relapsed or refractory disease. Cytokine-release syndrome and neurologic events are characteristic risks and require structured monitoring. [14]

Amivantamab, an EGFR×MET bispecific antibody, demonstrated activity in EGFR exon 20 insertion-mutated NSCLC in the CHRYSALIS study. Because the cited study was single-arm, its response rate should be interpreted as evidence of activity rather than direct evidence of superiority over chemotherapy. [15] Bispecific-antibody research is rapidly expanding toward multispecific formats, conditional activation and designs intended to improve tumour selectivity. [16,21,24] [27,31]

Table 4. Bispecific antibodies and their clinical role

Agent	Targets	Cancer setting	Evidence	Important toxicity	Reference name / no.
Blinatumomab	CD19 × CD3	Relapsed/ refractory B-cell precursor ALL	Improved OS median 7.7 vs chemotherapy4.0	Cytokine-release syndrome; neurologic events	Kantarjian et al. [14]2017
Amivantamab	EGFR × MET	EGFR exon 20 insertion-mutated NSCLC	40% objective response in cited CHRYSALIS population	Infusion reactions; rash and target-related effects	Park et al. [15]2021
Bispecific antibodies	Tumour antigen × immune-cell target	Haematological and emerging solid tumours	Immune-cell redirection or dual-pathway blockade	CRS; neurologic and infusion reactions	Klein et al. [21]2024; Goebeler et al. [24]2024
Next-generation BsAbs	Dual / multispecific designs	Investigational oncology settings	Potential to improve selectivity and overcome resistance	Design- and target-dependent toxicity	Fontana et al. [16]2026; Klein et al. [21]2024

Interpretation

The key advantage of BsAbs is functional proximity: an engineered molecule can bring immune cells close to malignant cells or inhibit

two relevant pathways simultaneously. Their major challenges include antigen selection, cytokine activation, tumour heterogeneity, dosing logistics and the need to identify patients most likely to benefit. [16,21,24] [27,31]



6. COMPARATIVE THERAPEUTIC EFFICACY

Direct numerical comparisons between unrelated clinical trials should be interpreted cautiously. The evidence in this review therefore retains each

efficacy result with its disease, population, comparator and endpoint. This approach avoids treating a high response rate in a single-arm study as equivalent to a survival advantage from a randomized trial. [6–16]

Table 5. Comparative efficacy of selected novel monoclonal-antibody strategies

Novel antibody	Comparator	Cancer / population	Endpoint and result	Clinical interpretation	Reference name / no.
Pembrolizumab	Platinum chemotherapy	Advanced NSCLC; PD-L1 $\geq$ 50%	PFS 10.3 vs 6.0 months	Randomized evidence of benefit in biomarker-selected disease	Reck et al. [6]2016
Nivolumab + ipilimumab	Ipilimumab	Untreated advanced melanoma	Longer PFS with nivolumab-containing therapy	Combination provides durable benefit but more immune toxicity	Larkin et al. [7]2017; Wolchok et al. [8]2026
T-DM1	Trastuzumab	HER2+ early breast cancer with residual disease	3-y IDFS 88.3% vs 77.0%	Strong direct comparative evidence after neoadjuvant therapy	von Minckwitz et al. [9]2019; Loibl et al. [10]2025
T-DM1	Lapatinib + capecitabine	HER2+ advanced breast cancer	PFS 9.6 vs 6.4 months; OS 30.9 vs 25.1 months	Improved outcomes in previously treated advanced disease	Verma et al. [11]2012
Polatuzumab-R-CHP	R-CHOP	Previously untreated DLBCL	2-y PFS 76.7% vs 70.2%	Modest but clinically relevant progression benefit	Tilly et al. [12]2022; Morschhauser et al. [13]2026
Blinatumomab	Salvage chemotherapy	Relapsed/refractory B-cell precursor ALL	OS 7.7 vs 4.0 months	Supports immune-cell engagement in this setting	Kantarjian et al. [14]2017
Amivantamab	No randomized comparator in cited study	EGFR exon 20 insertion NSCLC	ORR 40% in CHRYSALIS	Demonstrates activity, not superiority	Park et al. [15]2021

7. EFFICACY–TOXICITY BALANCE

The clinical value of a novel antibody reflects both its therapeutic benefit and the burden associated with treatment. ICIs can produce prolonged disease control but may trigger immune-mediated inflammation. ADCs can deliver highly potent payloads to tumour cells but may cause hematologic, hepatic, gastrointestinal or neurologic toxicity. BsAbs can produce strong

immune-cell engagement but require careful management of cytokine-release and infusion-related events. [1,17,21–24].

8. TOXICITY AND CLINICAL MONITORING

Toxicity patterns differ according to the biological mechanism of each antibody platform. Conventional chemotherapy is associated with



broad tissue toxicity, whereas ICIs produce immune-mediated adverse events. ADCs add payload- and linker-related toxicity to target-related effects, and BsAbs may activate immune cells so strongly that cytokine-release syndrome or neurologic toxicity occurs. [1,4,14,17,21]

Table 6. Major toxicity patterns, monitoring priorities and future safety direction

Platform	Major toxicity pattern	Monitoring focus	Risk-reduction approach	Reference name / no.
Conventional chemotherapy	Myelosuppression; GI effects; neuropathy	CBC, organ function, symptoms	Dose adjustment and supportive care	Pento [4]2017; Justiz-Vaillant et al. [1]2025
ICIs	Dermatitis; colitis; hepatitis; pneumonitis; endocrinopathies	Early recognition of immune-related symptoms; organ function	Prompt grading, corticosteroid-based management when indicated	Reck et al. [6]2016; Larkin et al. [7]2017; Delgado & Garcia-Sanz [2]2023
ADCs	Cytopenias; hepatic effects; neuropathy; GI effects; class-specific toxicities	CBC, liver function, neurologic and payload-specific assessment	Dose modification; improved linker/payload design	von Minckwitz et al. [9]2019; Tsuchikama et al. [22]2024
BsAbs	Cytokine-release syndrome; neurologic events; infusion reactions	Step-up dosing monitoring, inflammatory and neurologic assessment	Step-up dosing, premedication and engineering of target affinity	Kantarjian et al. [14]2017; Goebeler et al. [24]2024

9. CHALLENGES

Several challenges remain, including dependence on biomarkers, primary and acquired resistance, antigen loss, tumour heterogeneity, manufacturing complexity, and limited long-term safety data for some emerging platforms. For ADCs, target density, internalization and payload resistance can limit benefit. For BsAbs, selecting safe tumour antigens and controlling immune activation remain central problems. For ICIs, resistance may arise through changes in antigen presentation, tumour microenvironment or immune escape. [16,21–24]

Another challenge is evidence heterogeneity. A randomized trial with a survival endpoint provides a different level of comparative evidence from a single-arm response study. Consequently, narrative interpretation should preserve the study design and should not convert different endpoints into one universal efficacy score. [6–16]

10. PRACTICAL FRAMEWORK FOR FUTURE COMPARATIVE REVIEWS

A robust evidence framework should define eligibility criteria in advance, specify databases and search dates, document the screening process, extract comparable efficacy and safety outcomes, and assess risk of bias when a systematic-review approach is used. When the objective is narrative synthesis, transparency about source selection and the limits of cross-trial comparisons remains essential. [1–5,25]

Clinical implications

In practice, selection of a monoclonal antibody should consider target expression, tumour type, previous therapy, biomarker status, expected benefit, toxicity profile, and the feasibility of clinical monitoring. The same platform may have different value in different cancers because target biology and treatment context change. [1–3,21]



11. CONCLUSION

Novel monoclonal antibodies have broadened the therapeutic options available in oncology. ICIs can produce durable immune responses in selected patients; ADCs combine antigen recognition with delivery of potent cytotoxic payloads; and BsAbs can redirect immune cells or inhibit multiple pathways. Comparative clinical studies demonstrate meaningful benefits in defined settings, but they do not establish universal superiority of one antibody platform over conventional treatment. [1–16]

The most appropriate interpretation is therefore context-dependent. Efficacy must be linked to the disease population, biomarker, comparator and endpoint, while toxicity must be interpreted according to the mechanism of the antibody. A structured narrative approach helps prevent inappropriate numerical ranking and makes the evidence easier to apply clinically. [6–18]

Further progress will depend on improved patient selection, safer molecular designs, rational combination strategies, effective resistance management, and longer follow-up. Continued development of next-generation ADCs, bispecific/multispecific antibodies and immune-targeted approaches is likely to expand precision oncology, provided that therapeutic gains remain balanced against toxicity, manufacturing complexity and accessibility. [21–25] [26,27,30,31]

12. FUTURE PERSPECTIVES

Future development is likely to focus on improving the therapeutic index of antibody platforms rather than simply increasing target affinity. In ADCs, next-generation linkers, novel payloads, bispecific ADCs, dual-payload systems and tumour-activated constructs are being

investigated to address resistance and tumour heterogeneity. [22,23] [26,28–30]

Bispecific and multispecific antibodies are moving toward more sophisticated immune-cell engagement, conditional activation and combinations with other immune or targeted treatments. Recent reviews describe a rapidly expanding development pipeline and emphasize target selection, control of cytokine toxicity and treatment sequencing as major priorities. [21,24] [27,31]

Combination strategies are also important. ADCs may be combined with ICIs because tumour-cell killing can alter antigen presentation and immune activation, but combination toxicity must be evaluated carefully. A 2024 systematic review and meta-analysis reported encouraging activity for ADC plus ICI regimens while also highlighting adverse effects and heterogeneity between studies. [25] [35]

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