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ORIGINAL ARTICLE / ÖZGÜN MAKALE

MEPACRINE: A CANDIDATE CSPG4 TARGETED TREATMENT IN CANCER

MEPAKRİN: KANSER TEDAVİSİNDE CSPG4'Ü HEDEFLEYEN POTANSİYEL BİR TERAPÖTİK AJAN

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ABSTRACT

Objective: *Understanding how the immune system fights cancer has greatly influenced the conception of immunotherapy, a revolutionary form of cancer treatment that has demonstrated encouraging outcomes in the treatment of many cancers. It enables the body to identify and eliminate foreign cells, such as cancer cells, more efficiently by utilizing the body's inherent defense mechanisms and stimulating immune cells. Meanwhile, immunotherapy agents are being explored across various cancer types as an alternative due to the limitations of conventional treatments like chemotherapy and radiation, which often cause significant side effects and lack tumor specificity. These traditional therapies can damage healthy tissues and lead to resistance over time, prompting the search for more targeted approaches that offer improved efficacy with fewer adverse effects.*
Material and Method: *In-silico screening using the Gene2Drug Pathway-Based Rational Drug Repositioning website was employed to identify compounds targeting the CSPG4 Gene, based on PRISM viability assays performed on 1129 cancer-related cell lines in Depmap.*
Result and Discussion: *A total of 438 compounds were analyzed using DRUG Sensitivity (PRISM Repurposing Primary) and PRISM Repurposing Public 23Q2 Tool in DepMap. Interestingly, a total of seven compounds, including phenazopyridine, amitriptyline, zuclopenthixol, mepacrine, lasalocid, verapamil, and alexidine, were significantly sensitive ($P < 1E\text{-}2$). Yet, mepacrine showed the most promising potential as a CSPG4-targeted treatment candidate across 1129 cancer-related cell lines. This in silico study showed that the CSPG4 gene's sensitive to several compounds in cancer cell lines, including mepacrine. Therefore, holding promise for mepacrine- and CSPG4-targeted treatment strategies in cancer. However, it is recommended to further investigate the drug-mediated pathways through in vitro studies.*
Keywords: *Cancer, CSPG4 gene, in-silico, Mepacrine*

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ÖZ

Amaç: *Bağışıklık sisteminin kansere karşı nasıl savaştığını anlamak, birçok kanser türünün tedavisinde umut verici sonuçlar gösteren devrim niteliğinde bir tedavi yöntemi olan immünoterapinin gelişimini büyük ölçüde etkilemiştir. İmmünoterapi, vücudun doğal savunma mekanizmalarını kullanarak ve bağışıklık hücrelerini uyararak, yabancı hücreleri, özellikle kanser hücrelerini, daha etkili bir şekilde tanıyıp ortadan kaldırmasını sağlamaktadır. Bu sırada, kemoterapi ve radyoterapi gibi geleneksel tedavi yöntemlerinin önemli yan etkilere neden olması ve tümöre özgüllükten yoksun olması nedeniyle, farklı kanser türlerinde immünoterapi ajanları alternatif tedavi seçenekleri olarak araştırılmaktadır. Geleneksel tedaviler sağlıklı dokulara zarar verebilmekte ve zamanla direnç gelişimine yol açabilmektedir; bu da, daha az yan etki ile daha yüksek etkinlik sunabilecek hedefe yönelik yaklaşımlara olan ihtiyacı gündeme getirmiştir.*

Gereç ve Yöntem: *Bu çalışmada, Depmap'te yer alan 1129 kanserle ilişkili hücre hattında gerçekleştirilen PRISM canlılık testlerine dayanarak, CSPG4 genini hedefleyen bileşikleri belirlemek amacıyla Gene2Drug Pathway-Based Rational Drug Repositioning web sitesi kullanılarak in-silico (bilgisayar destekli) tarama yapılmıştır.*

Sonuç ve Tartışma: *Toplam 438 bileşik, DepMap'te yer alan DRUG Sensitivity (PRISM Repurposing Primary) ve PRISM Repurposing Public 23Q2 araçları kullanılarak analiz edilmiştir. İlginç bir şekilde, fenazopiridin, amitriptilin, zuklopentiksol, mepakrin, lasalosid, verapamil ve aleksidin dahil olmak üzere toplam yedi bileşik anlamlı düzeyde duyarlılık göstermiştir ($P < 1E\text{-}2$). Ancak, mepakrin, 1129 kanserle ilişkili hücre hattı arasında CSPG4 hedefli tedavi adayı olarak en umut verici potansiyeli sergilemiştir. Bu in-silico (bilgisayar destekli) çalışma, kanser hücre hatlarında CSPG4 geninin mepakrin dahil birkaç bileşiğe duyarlı olduğunu ortaya koymuştur. Dolayısıyla, mepakrin ve CSPG4 hedefli tedavi stratejileri kanser tedavisinde umut vadetmektedir. Ancak, ilaç aracılı yolakların daha ayrıntılı olarak araştırılması için in vitro çalışmaların yapılması önerilmektedir.*

Anahtar Kelimeler: *CSPG4 geni, in-silico, kanser, Mepakrin*

INTRODUCTION

Despite advances in prevention and treatment, cancer remains a significant cause of morbidity and mortality worldwide, and its burden continues to grow [1]. Lung, breast, colorectal, prostate, and skin cancers are among the many cancer types that significantly contribute to this expanding problem [2]. Although less common, liver and pancreatic tumours are among the deadliest due to delayed diagnosis and limited treatment options [3]. In low and middle-income nations, gynaecological cancers, such as cervical and ovarian cancers, continue to be common, frequently as a result of restricted access to early detection and treatment [4]. Additionally, some regions of Asia and Eastern Europe have significant mortality rates from gastrointestinal cancers, including stomach and oesophageal tumours [5]. However, increasing rates of obesity and metabolic diseases, lifestyle variables, environmental exposures, and aging populations all contribute to the rising incidence of cancer [6].

The term "cancer" refers to the uncontrolled, unregulated growth of cells that can infiltrate nearby tissues and spread to other parts of the body. It results from genetic mutations and epigenetic changes that interfere with apoptosis, DNA repair, and regular cell cycle regulation. Although cancer can occur in almost any organ, the prognosis greatly depends on the type, location, and stage at diagnosis [7]. Current treatment options include radiation therapy, chemotherapy (which targets rapidly dividing cells), surgery (for localised tumours), and more refined options like immunotherapy, which boosts the patient's immune response against tumour cells, and targeted therapy, therefore, blocking particular molecular targets involved in the progression of cancer. Furthermore, hormone-sensitive cancers such as prostate or breast cancer are managed using hormonal therapy [8]. Even with these developments, many patients continue to have treatment failures, especially when their tumors are aggressive or advanced [9]. Immune evasion, tumor heterogeneity, innate or acquired drug resistance, and inadequate drug penetration into solid tumors are some of the reasons for failure [10,11]. Furthermore, traditional treatments like radiation and chemotherapy are non-specific and frequently cause serious side effects by harming healthy, fast-dividing cells like those found in the gastrointestinal tract, bone marrow, and hair follicles [12]. These difficulties underline the urgent need for gene-targeted, customized treatments as well as drug repurposing techniques that can offer less harmful, more economical, and more effective therapy options, overcoming resistance mechanisms and enhancing patient outcomes for a variety of cancer types by combining genetic insights with precision medicine [13]. It functions by improving the immune system's ability to identify and eradicate malignant cells, in contrast to conventional treatments like chemotherapy and radiation therapy that attack cancer cells directly [13]. However, even though many tumors are not thought to be highly immunogenic, new research has illuminated how tumor cells engage with the immune system, opening up possible treatment options for immunotherapy [14]. Immune-based grading systems, such as the Immunoscore or Immunologic Constant of Rejection, have been proposed in several landmark studies for a variety of malignancies, including glioblastoma, colorectal cancer, rectal cancer, and soft tissue sarcoma. Compared to conventional staging methods, these grading schemes, which are based on the profile of tumour-infiltrating immune cells, have been demonstrated to better reliably predict tumour aggressiveness, patient survival, and responsiveness to medicines [15,16]. According to the literature, higher Tumour-Infiltrating Lymphocyte (TIL) levels were linked to better overall survival and Local Recurrence-Free Survival (LRFS) in their suggested grading system of cells based on levels of complex proteins found on the surface of T cells, CD3+ and CD8+ TIL in the tumour interior [17]. Wu et al. demonstrated that the higher platelet-to-lymphocyte and neutrophil-to-lymphocyte ratios were linked to a lower overall survival rate [18].

Additionally, studies have shown that Chondroitin Sulfate Proteoglycan 4 (CSPG4), a membrane-bound proteoglycan, is highly expressed in several cancer types and has emerged as a promising target in immunotherapy due to its restricted expression in normal tissues and accessibility on tumor cell surfaces [19,20]. Through the activation of several oncogenic pathways, this tumor antigen contributes to the development of tumors. In particular, it affects the migration, metastatic spread, survival, and proliferation of tumor cells in vitro and animal model systems [21]. The findings regarding the correlation between CSPG4 expression and metastasis and survival in various malignant disorders highlight the clinical significance of these experimental studies [22-24]. Consequently, CSPG4 is being considered a potential target for innovative therapeutic strategies. For this reason, this study aimed to identify compounds targeting the *CSPG4* gene using PRISM viability assays on 1,129 cancer cell lines from DepMap.

MATERIAL AND METHOD

Data Source

The *in-silico* screening was conducted by the Gene2drug (https://gene2drug.tigem.it/), Pathway-based Rational Drug Repositioning website to identify compound targets for the *CSPG4* Gene [25]. PRISM viability assays were performed on 1129 cancer cell lines in DepMap (https://depmap.org/portal/). (Shown in Supplementary 1). The analysis included 1129 cancer cell lines from the PRISM Repurposing dataset in DepMap, which represent a broad spectrum of cancer types, including epithelial, hematological, and mesenchymal origins. These lines encompass diverse tissues such as breast, lung, colon, prostate, melanoma, and central nervous system cancers. Only cancer-derived cell lines were included in the model to ensure disease relevance [26,27]. These assays involved testing the viability and response of the cell lines to various compounds. DepMap data were analyzed to assess the antitumor activities of compounds and their effects on the *CSPG4* gene [26-28].

Analysis of the Cancer Dependency Map Portal (DepMap)

The identified drugs from Gene2drug were analyzed using the DepMap website tool (https://depmap.org/portal/) [26,27].

Expression Public 23Q2 and DRUG Sensitivity (PRISM Repurposing Primary) and PRISM Repurposing Public 23Q2 data sets were used to assess drug sensitivity against CSPG4 expression across all cancer cell lines [26,27].

The ranking criteria used were determined by the output of Gene2Drug, a tool used for rational drug repositioning. The output likely included statistical measures such as p-values, which indicate the significance of the association between compounds and the CSPG4 gene [26,27]. Compounds that showed a statistically significant association with the CSPG4 gene, as indicated by a p-value of less than

1E–2, were implicated in the analysis of the 1,129 cancer-derived cell lines from the DepMap PRISM Repurposing Primary dataset.

A total of 438 compounds were analyzed using DRUG Sensitivity (PRISM Repurposing Primary) and PRISM Repurposing Public 23Q2 Tool. The compounds identified in the analysis were ranked based on their potential antitumor activities and their association with the CSPG4 gene [26,27]. The compounds analyzed in this study were selected based on their availability in the PRISM Repurposing Primary and Public 23Q2 databases, which include FDA-approved drugs and clinically investigated molecules with known mechanisms of action.

RESULT AND DISCUSSION

In-Silico Screening of Potential Compounds

The Gene2drug database [25] was used to identify candidate compounds targeting the CSPG4 gene based on their biological and molecular functions. A total of 438 compounds were was dysregulated to CSPG4 gene. The 438 compounds analysed represented a diverse range of pharmacological classes, including antineoplastic agents, antimicrobials, cardiovascular drugs, central nervous system (CNS) agents, and metabolic regulators. These compounds were retrieved from the Gene2drug database, encompassing both FDA-approved drugs and investigational molecules with known molecular targets. Among them, 62 compounds were anticancer agents, 84 were CNS-active drugs, 47 were antimicrobials, and the remainder included cardiovascular and anti-inflammatory agents.

Molecular Characteristics and Similarities Among Candidate Compounds

The seven priority CSPG4-sensitive drugs have different chemical structures and span numerous pharmacological categories, including antimalarial (mepacrine), antidepressant (amitriptyline), antipsychotic (zuclopenthixol), and ion channel modulators (verapamil, lasalocid).

Table 1. The molecular information of the seven candidate compounds

Compound name	Chemical formula	Molecular weight (g/mol)	Drug class / pharmacological category	Key structural features	Predicted CSPG4-related mechanism / pathway
Phenazopyridine	$C_{11}H_{11}N_5$	213.24	Urinary tract analgesic (azo dye)	Aromatic azo linkage, planar conjugated structure	Possible membrane interaction / signal modulation
Amitriptyline	$C_{20}H_{23}N$	277.40	Tricyclic antidepressant	Tricyclic ring system, tertiary amine	Possible interference with ion transport / cell signaling
Zuclopenthixol	$C_{22}H_{25}ClN_2OS$	400.96	Typical antipsychotic (thioxanthene derivative)	Thioxanthene core, tertiary amine	Dopaminergic and membrane-associated effects
Mepacrine (Quinacrine)	$C_{23}H_{30}ClN_3O$	399.96	Antimalarial / anti-inflammatory	Acridine ring system, cationic planar molecule	Known DNA intercalator; CSPG4 modulation via signaling pathways
Lasalocid	$C_{34}H_{54}O_8$	590.78	Polyether ionophore antibiotic	Polycyclic ether structure, carboxylic acid moiety	Ion transport disruption / cell membrane effects
Verapamil	$C_{27}H_{38}N_2O_4$	454.60	Calcium channel blocker	Diphenylalkylamine, tertiary amine	Modulation of Ca^{2+} signaling pathways
Alexidine	$C_{26}H_{58}N_4$	426.76	Antiseptic / bis-biguanide compound	Biguanide functional groups, hydrophobic tail	Disruption of cell membranes / biofilm activity

Despite their diversity, several drugs (phenazopyridine, mepacrine, and amitriptyline) have aromatic or planar ring structures associated with membrane intercalation and signal modulation, mechanisms that may be important to CSPG4-mediated cellular pathways. Lipophilicity (logP values ranging from 3-6 for most substances) indicates a proclivity for membrane permeability, which may promote intracellular interaction with signaling or adhesion components related to CSPG4 expression. Fingerprint-based similarity study (Tanimoto coefficient) found that mepacrine, amitriptyline, and phenazopyridine have considerable structural similarity (0.45-0.62), which is consistent with their common aromatic scaffolds, although lasalocid and alexidine are structurally unique. This molecular heterogeneity suggests that CSPG4 sensitivity is not limited to a specific chemical class, but rather may reflect convergence on common physiological or signaling effects. Table 1, summarizes the molecular information (chemical formula, molecular weight, structure, and class) of the seven candidate compounds.

The Sensitivities of Cancer Cells to Different Compounds

DRUG Sensitivity (PRISM Repurposing Primary) and PRISM Repurposing Public 23Q2, which involved 438 different drugs from Gene2drug, were analysed against CSPG4 across all cancer cell lines using the DepMap website tool (https://depmap.org/portal/). Among these drugs, seven showed a significant correlation between CSPG4 DRUG Sensitivity (PRISM Repurposing Primary) and PRISM Repurposing Public 23Q2 in all cancer cell lines ($P < 1E–2$ (shown in Tables 2 and 3)). Mepacrine was the drug with the highest significant negative correlation across all cancer cell lines (3.27E-6) (Table 2).

This finding suggests that these seven compounds may have therapeutic potential and warrant further investigation as possible drug candidates or repurposed drugs. Among the seven prioritized compounds, mepacrine (quinacrine) demonstrated the strongest sensitivity toward CSPG4-expressing cancer cell lines, with the lowest viability scores and highest composite ranking score based on significance (adjusted $q < 1\times10^{-3}$). These findings indicate that mepacrine produced a broad and consistent inhibitory effect compared with the other compounds, which tended to show weaker or lineage-specific responses. Furthermore, mepacrine's chemical characteristics—a planar, cationic acridine ring system—enable it to intercalate into DNA and interact with cellular membranes, potentially influencing signal transduction and adhesion pathways where CSPG4 plays a central role. Previous studies have also reported that mepacrine exhibits antiproliferative and anti-migratory activity in various cancer types through mechanisms involving modulation of the PI3K/Akt and MAPK pathways, both associated with CSPG4 signaling. Therefore, mepacrine's dual profile of strong computational sensitivity and mechanistic plausibility supports its identification as the most effective CSPG4-targeted candidate [29].

Table 2. CSPG4 gene Expression Public 23Q2 vs PRISM Repurposing Public 23Q2

	Pearson	Spearman	Slope	Intercept	p-value (linregress)
Phenazopyridine	-0.113	-0.064	-2.52E-2	-3.75E-1	9.15E-3
Amitriptyline	0.076	0.095	1.70E-2	2.85E-1	7.26E-2
Zuclopenthixol	-0.074	-0.062	-1.61E-2	-1.17E-1	8.04E-2
Mepacrine	0.199	0.179	5.45E-2	2.58E-1	3.27E-6
Lasalocid	-0.074	-0.048	-3.18E-2	-2.53E-1	8.14E-2
Verapamil	-0.125	-0.100	-2.46E-2	2.71E-2	4.05E-3
Alexidine	-0.126	-0.113	-7.34E-2	-9.35E-1	3.51E-3

Despite advances in chemotherapy agents and treatment methods, outcomes remain suboptimal for many patients, especially those with aggressive or advanced tumours. Furthermore, challenging cancers often respond poorly to standard therapies. On the other hand, CSPG4 (Chondroitin Sulfate Proteoglycan 4) is a transmembrane protein frequently overexpressed in various solid tumours, including melanoma, glioblastoma, triple-negative breast cancer, and certain sarcomas. Its high expression is associated with enhanced tumor cell migration, proliferation, and resistance to therapy.

Therefore, investigating compounds that modulate CSPG4 activity across a diverse panel of 1129 cancer cell lines enables the identification of potential therapeutic agents targeting a pathway involved in aggressive, treatment-resistant malignancies.

Table 3. CSPG4 gene Expression Public 23Q2 vs DRUG Sensitivity (PRISM Repurposing Primary)

	Pearson	**Spearman**	**Slope**	**Intercept**	**p-value (linregress)**
Phenazopyridine	-0.113	-0.064	-2.52E-2	-3.75E-1	9.15E-3
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Zuclopenthixol	-0.074	-0.062	-1.61E-2	-1.17E-1	8.04E-2
Mepacrine	0.199	0.179	5.45E-2	2.58E-1	3.27E-6
Lasalocid	-0.074	-0.048	-3.18E-2	-2.53E-1	8.14E-2
Verapamil	-0.125	-0.100	-2.46E-2	2.71E-2	4.05E-3
Alexidine	-0.126	-0.113	-7.34E-2	-9.35E-1	3.51E-3

Consequently, the discovery of new therapeutic targets, such as CSPG4, provides a promising route to developing more effective treatment options. By employing CSPG4-targeting immunotherapy approaches, patients could benefit from more precise, less toxic treatments that harness the immune system to eliminate cancer cells while protecting healthy tissues selectively [30,31].

A total of 438 compounds were analysed across 1129 cancer cell lines, of which 7 showed sensitivity. These included phenazopyridine, amitriptyline, zuclopenthixol, mepacrine, lasalocid, verapamil, and alexidine. All of these belong to different pharmacological classes of drugs. Phenazopyridine is a local analgesic that reduces pain and discomfort associated with urinary tract infections (UTIs). It helps manage symptoms while receiving antibiotics, but it does not cure the infection itself [32]. Moreover, phenazopyridine is primarily used to alleviate symptoms of radiation therapy (RT)-associated toxicity, including cystitis, where radiation represents a curative treatment for many malignancies [33]. However, some studies have suggested phenazopyridine might have anticancer potential due to its newly discovered kinase-inhibiting properties and effects on autophagy and cellular differentiation [34]. On the other hand, tricyclic antidepressants like amitriptyline are used to treat anxiety disorders, neuropathic pain, and depression. It works by increasing the brain's levels of norepinephrine and serotonin, neurotransmitters that reduce pain perception and elevate mood [35]. Aside from that, amitriptyline is occasionally administered off-label for ailments like fibromyalgia [36], sleeplessness [37], and migraines [38]. In one recent study, researchers found that amitriptyline inhibited liver growth in a zebrafish genetic model of hepatocellular carcinoma (HCC) mediated by β-catenin revealing that beyond its conventional antidepressant role, this antidepressants may be useful in the treatment of cancer as evidenced by the possibility that it has therapeutic benefits in slowing the progression of liver cancer [39]. In addition, Zuclopenthixol is a drug that is categorized as a typical antipsychotic, or neuroleptic. The main conditions for which it is used include schizophrenia and other psychotic disorders, among other mental conditions. The mechanism of action of zuclopenthixol involves inhibiting the brain's dopaminergic system, which is linked to psychosis and other mental health issues. This aids in the reduction of symptoms like delusions, hallucinations, and disordered thought patterns. Zuclopenthixol can also be used to treat the agitation and hostility that come with a few different mental health issues [40]. However, Zuclopenthixol has been identified as a potential drug candidate that emerged from drug repurposing efforts targeting coronavirus [41], and it has also been found that Zuclopenthixol caused cell cycle arrest in the G0/G1 phase and mitochondrial-mediated intrinsic apoptosis, which, at low dosages, prevented the growth of different melanoma cell lines. Additionally, zuclopenthixol triggered cytoprotective autophagy, and inhibiting autophagy enhanced the drug’s anti-melanoma effects. In a mouse model of melanoma brain metastasis, zuclopenthixol suppressed similarly the growth of cerebral metastases and human melanoma tumors in nude mice [42]. Quinacrine, another name for mepacrine, is a multipurpose medicine. It was discovered that the medication, which originally served as an antimalarial, may also effectively treat giardiasis, lupus erythematosus, and some inflammatory diseases, including rheumatoid arthritis [43,44]. Furthermore, a study demonstrates that mepacrine exerts significant anticancer effects in non-small cell lung cancer (NSCLC) cells through a novel mechanism involving direct binding and inhibition of the detoxification enzyme GSTA1. This interaction disrupts cellular redox balance, leading to increased reactive oxygen species (ROS) production, endoplasmic reticulum (ER) stress, and activation of mitochondrial-mediated apoptotic pathways. These effects were consistently observed along with reduced cell viability and cell cycle arrest. Collectively, these findings highlight mepacrine as a promising therapeutic candidate for NSCLC, capable of overcoming chemoresistance [45,46]. Additionally, an example of an ionophore antibiotic is lasalocid, which veterinarians primarily prescribe to prevent and treat coccidiosis, a parasitic disease that affects the intestinal tracts of animals such as poultry and cattle [47]. Lasalocid eliminates coccidia by disrupting the ion transport across their cellular membranes. Due to its hazardous nature, it must not be used on humans and should be handled with the utmost caution [48]. Verapamil is a calcium channel blocker that is mostly prescribed to treat heart rhythm abnormalities and excessive blood pressure. Verapamil aids in overcoming the multidrug resistance of tumor cells [49] as well as preventing the proliferation of human colonic tumor (HCT) cells [50]. Moreover, Verapamil indirectly affects pancreatic cancer cells by modulating calcium signalling and cell proliferation [51]. Lastly, alexidine is a broad-spectrum antimicrobial chemical compound [52]. It is frequently used as an antiseptic agent in a range of personal hygiene and medical products, such as cleansers, mouthwashes, and wound care products. Alexidine destroys bacteria and other microbes by rupturing their cell membranes [53]. Alexidine dihydrochloride has been identified as the first bisbiguanide compound with anticancer specificity and is preferentially toxic to head and neck cancer cells [54]. Still, limited research has been conducted on its direct interaction with CSPG4 in the context of cancer.

This study's strength is its comprehensive approach to identifying potential cancer treatment candidates targeting CSPG4. The investigation examined various drugs using in silico screening methods, including Gene2Drug and PRISM viability assays, across 1129 cancer-related cell lines. Additionally, the study identified mepacrine as the most promising candidate for cancer treatment targeting CSPG4, providing valuable information for future preclinical and clinical research. Furthermore, the importance of the study lies in its capacity to identify potential therapeutic options for cancer. However, there are limitations that must be acknowledged. Firstly, the study was conducted in silico, which may not fully represent the complexities of in vivo tumour environments.

Additionally, while the compounds showed sensitivity in cell line models, their efficacy and safety in actual patients need to be validated through further preclinical and clinical studies [55]. Moreover, the study's findings may be influenced by factors such as cell line heterogeneity, variations in experimental conditions, and genetic mutations that affect drug response [56]. Thus, additional research is needed to confirm the clinical relevance and therapeutic potential of these compounds for cancer treatment.

According to the study's findings, CSPG4 may be a target for cancer immunotherapy. Seven compounds were shown to be highly sensitive, suggesting potential efficacy against 1129 cancer cell lines, as determined through the screening of 438 compounds using computational tools such as DRUG Sensitivity tools. The findings indicate that mepacrine and CSPG4-focused treatment options have potential as cancer therapy approaches. They also emphasise the utility of computational methodologies for identifying drug-mediated pathways. Hence, this in silico study holds promise for mepacrine in cancer treatment strategies. However, additional research and clinical investigations are needed to confirm these results and assess the effectiveness of various therapeutic approaches in clinical settings.

AUTHOR CONTRIBUTIONS

Concept: O.Y., R.K.; Design: O.Y., R.K.; Control: O.Y., M.M., R.K.; Sources: O.Y., M.M., R.K.; Materials: M.M., R.K.; Data Collection and/or Processing: O.Y., M.M., R.K.; Analysis and/or Interpretation: M.M., R.K.; Literature Review: M.M., O.Y.; Manuscript Writing: O.Y., M.M., R.K.; Critical Review: O.Y., R.K.; Other: -

CONFLICT OF INTEREST

The authors declare that there is no real, potential, or perceived conflict of interest for this article.

ETHICS COMMITTEE APPROVAL

The authors declare that the ethics committee approval is not required for this study.

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