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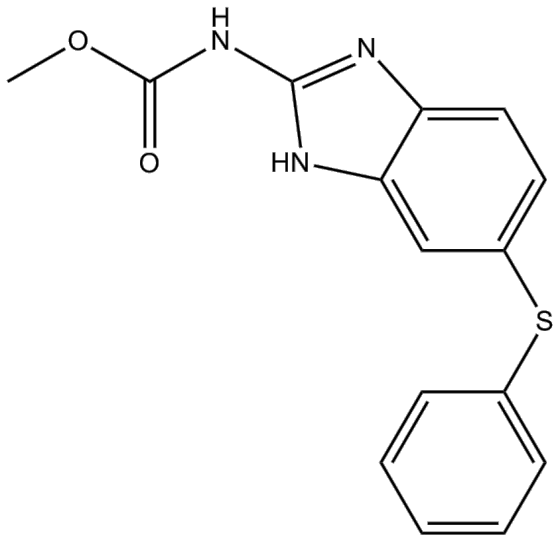
Fenbendazole vs Cancer



Fenbendazole

Related: Mebendazole vs cancer

https://www.dailymail.co.uk/health/article-6965325/Oklahoma-grandfather-claims-drug-DOGS-cured-cancer-tumor-free.html
26 April 2017

Oklahoma grandfather who claims a drug for DOGS cured him of 'head-to-toe' cancer is tumor-free two years after doctors gave him three months to live
By Natalie Rahhal

Joe Tippens, of Oklahoma was diagnosed with late-stage small cell lung cancer in 2016
By January 2017, it had spread throughout his body
Joe's life expectancy was three months, but doctors enrolled him in a clinical trial that they hoped could give him up to a year longer
A veterinarian suggested he try the dog de-worming drug, fenbendazole, which has shown cancer-fighting properties in cell studies
By May 2017, all cancer had disappeared from Joe's scans
Now, two years later, he is still cancer free and Oklahoma medical researchers plan to look into Joe's case
WARNING: There have been no trials of fenbendazole for treating cancer, there

may be risks involved and the medication is not recommended by doctors

In January 2017, Joe Tippens was certain that he would die of small cell lung cancer.

But then a veterinarian suggested he try something unconventional, to say the least: a drug for dogs.

The medication, fenbendazole, is an anti-worm compound used to treat hookworms, roundworms and other gut parasites in animals, primarily dogs.

In recent years, studies suggesting anti-worm drugs might have cancer-fighting properties have been cropping up in a growing number of journals.

It's far from a proven treatment, but with three months to live and nothing to lose, Joe decided to take a chance on it.

Joe was diagnosed with small cell lung cancer in 2016, turning his plans upside down, just two days before he was set to move to Switzerland from Oklahoma.

He kept up a fighting attitude, but in January 2017, he got the news that no one is prepared to hear.

The aggressive cancer was everywhere. It had spread to his liver, pancreas, bladder, stomach, neck and bones.

His PET scan 'lit up like a Christmas tree,' he says on his website.

At that late stage of small cell lung cancer, Joe's odds of survival were less than one percent, and the average life expectancy was three months.

He had a trans-Atlantic move planned. He was expecting a grandson. And now everything had to come to a halt.

Doctors at MD Anderson Cancer Center in Texas told him they wouldn't give up, and would put him in a clinical trial that wouldn't save Joe, but might give him a year or so to live.

He might get to meet his grandson.

'A year (or so) sounds a lot better than 3 months, so I said "let's go for it,"' Joe writes.

Browsing an online forum for his alma mater, Oklahoma State University, Joe saw a post that caught his eye that same month: 'If you have cancer or know someone who does, give me a shout.'

He did, and from the poster, a veterinarian, he learned that scientists had accidentally discovered that a dog de-worming drug seemed to combat many cancers in mice.

The same scientist that had conducted that research, as it happened, had stage 4 brain cancer, and the same prognosis Joe had been given, according to the vet.

She started popping the dog pills, and within six weeks, as the vet told it, the scientist's cancer was gone.

Joe, who was 'a skeleton with skin hanging off of it' at half his previous weight, he told KOCO 5 News, placed an order of fenbendazole.

His new dosage of dog pills cost just $5 a week. His insurance company had spent '$1.2 million on me with traditional means,' he said.

According to a study published in Nature, the drug compound essentially starves cancer cells and kills them.

It also is, of course, already in production, cheaper, and, according to cell studies and reports from people who have tried it, not very toxic, especially compared to chemo and immunotherapies.

That said, it was a risk.

Joe stayed in the clinical trial (he does not disclose what therapy he received) added vitamin E, CBD, bioavailable curcumin and, of course, the dog medicine.

He didn't mention the de-worming drug to his doctors.

In May, Joe's first grandchild, Luke, was born. Joe was there to meet him.

Two-and-a-half weeks later, he had another PET scan.

'Three months earlier...There was cancer in my body from head to toe. And it was a terrifyingly dangerous metastasis that leaves virtually 100% of its victims dead within 3 months. Here I was 3 months later and the PET scan was completely dark.....void of any light.....anywhere,' Joe writes.

He was dumbfounded. His oncologist was dumbfounded, according to Joe's account.

Joe writes that his doctor told him, 'We don't quite know what to make of this as you are the only patient on the clinical trial with this kind of response.'

In September 2017, Joe went for yet another scan, and was still cancer free. At last he told his doctor what he'd been doing outside the hospital.

There was no way at that point to prove that it was the de-worming drug that vanished Joe's cancer, but his doctor did tell him that he was an 'outlier' of the trial, Joe writes.

Joe's final scan was taken in January of 2018, and when he had a follow-up appointment that April, he writes that his oncologist kicked him out of the cancer center - because Joe had no cancer to treat.

His results seem too-good-to-be true, but Joe claims to have collected over 40 examples of similar success stories.

And his results were good enough to pique the interest of the president of the Oklahoma Medical Research Foundation, Dr Stephen Prescott.

'I'm usually skeptical, and I was and maybe still am about this one, but there's interesting background on this' he told KOCO.

Now, Dr Prescott and Joe are working on a case study report, according to KOCO.

Joe is careful to note that he's not a doctor, and is 'only one man with limited resources.'

'I am not prescribing medicine and I am not qualified to give advice on medical treatments.

BUT.....I am qualified to tell my story to as many people as possible.'

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A Drug Made for Animals and Taken by Humans to Treat Cancer: Fenbendazole

From anti-worms to anti-cancer

Previously, we discussed on this website the anti-worm drug Mebendazole (Ref.), which based on a good amount of scientific and clinical evidence, shows relevant anti cancer potential. Indeed, there are case reports published in peer review papers showing that Mebendazole can induce anti-cancer response in some aggressive cancers.

In the same article (Ref.) we explored the mechanism behind the anticancer action of Mebendazole, and found out that Mebendazole acts in a similar way as a group of chemotherapies such as Taxol. Yet, in contrast to chemotherapies, due to the way Mebendazole works, its toxicity is incomparably lower. Because of its good safety profile, the drug is an over the counter drug in most of the countries.

I specifically like the anti-worms, anti-parasites, antibiotics, antiviral drugs, as a pattern start to emerge suggesting that the origin of cancer may be related to such a trigger (e.g. viruses, parasites, etc.) in much more cases than we currently are aware of. Multiple findings and observations, that I will discuss in a different post, indicate that such triggers may initiate cancer when they land in a “fertile ground”, represented by specific genetic weaknesses combined with a compromised immune system (due to e.g. stress, lifestyle, medication, etc.). This is why, I would seriously consider using anti-worms, anti-parasites, antibiotics, antiviral

drugs as a part of more comprehensive treatment approaches that could also include conventional therapies. As long as the toxicity is low, it could make sense to cycle various drugs of this type.

The anti-worm drug Fenbendazole has anti-cancer potential

In the same group of drugs as Mebendazole, a group called benzimidazoles, there is another anti-worm drug called Fenbendazole. Fenbendazole, is a drug used typically not for humans like Mebendazole, but for animals (including fish, birds and mammals). It is labelled to kill worms such as roundworms, hookworms, whipworms, and some tapeworms. Fenbendazole is found under various brand names such as Panacur or Safe-Guard.

I did came across this drug some years ago during my research, but only recently I was motivated to look closely at it following several e-mails from friends who shared with me the blog of a man with Small Cell Lung Cancer, who successfully treated his cancer with Fenbendazole (Ref.). On his website, Joe Tippens, not only reports his experience but also anecdotally reports being in contact with more patients experiencing benefits while using Fenbendazole, including two cases of 4th stage Pancreatic Cancer, Prostrate Cancer, Colorectal Cancer, Non-Small Cell Lung Cancer, Melanoma, Colon Cancer. This anecdotal report would not be enough to trigger me writing this post, if I would not be convinced by the existing scientific evidence indicating the anti cancer potential connected with many of the benzimidazoles drugs. Therefore, I do believe that if Mebendazole could show relevant anti-cancer effects in humans, which it did, Fenbendazole could do it as well and hopefully even better.

In some diseases, it has been indeed shown that Fenbendazole can be more effective than Mebendazole. For example, when tested against Cryptococcus neoformans (an encapsulated fungal organism that can cause disease such as meningoencephalitis in immunocompromised hosts), it has been shown that Fenbendazole was more active than Mebendazole or other drugs against this opportunistic fungus (Ref.).

While there is more prior literature suggesting anti cancer effectiveness related to Fenbendazole, the paper I found most relevant to specifically cite here first is a paper that was just published during 2018 in one of the most prestigious scientific magazine, that is Nature, which adds a lot of weight to the communicated message. This paper, entitled “Fenbendazole acts as a moderate microtubule destabilizing agent and causes cancer cell death by modulating multiple cellular pathways“, concludes the following:

“The results, in conjunction with our earlier data, suggest that Fenbendazole is a new microtubule interfering agent that displays anti-neoplastic activity and may be evaluated as a potential therapeutic agent because of its effect on multiple cellular pathways leading to effective elimination of cancer cells.”

In this paper, the authors cite potential anti cancer mechanisms associated with Fenbendazole, including disruption of microtubule function and proteasomal interference, but it was also associated with blocking the glucose uptake by cancer cells (through reducing the expression of Glut-4 transporter as well as hexokinase) and thus starving cancer cells. This means Fenbendazole could also work nicely in supporting chemotherapy and radiotherapy as well as metabolic therapies. Because of the way it works (interacting with a site on tubulin similar to colchicine but distinct from that of Vinca alkaloids), Fenbendazole will not compete with

Vinca alkaloids (such as Taxol) but instead will add to the anti cancer effect of these conventional treatments similar to other benzimidazoles (Ref.).

Interestingly, when insulin stimulates glucose uptake in the cells, glucose transporter isoform 4 (GLUT4) translocates from intracellular vesicles to the plasma membrane ready to absorb glucose. This movement of GLUT4 towards the plasma membrane takes place via both rapid vibrations around a point and short linear movements (generally less than 10 microm). The linear movement seems to take place along microtubules. When disrupting the microtubules with drugs such as Fenbendazole, GLUT4 movements are disrupted as well strongly reducing insulin-stimulated glucose uptake (Ref.).

While Fenbendazole could be relevant for many types of cancers (as also suggested by the anecdotal reports listed above and by literature on the anticancer effects of benzimidazoles drugs) prior literature has so far indicated it's anti cancer effects in Non-small Cell Lung Cancer Cells (NSCLC)

Fenbendazole inhibits the cellular proteasome function dose- and time-dependently and leads to accumulation of ubiquitylated derivatives of various cellular proteins, including p53, which, in turn, leads to apoptosis via the mitochondrial pathwaythe cells first undergo G2/M arrest followed by apoptosis Fenbendazole induced endoplasmic reticulum stress, reactive oxygen
species production, decreased mitochondrial membrane potential, and cytochrome c release that eventually led to cancer cell death. Lymphoma .

Prostate Cancer (Ref.) and taxane-resistant prostate cancer cells Glioblastoma

The questions, is why I would consider using Fenbendazole, a drug used for animals, when we already have Mebendazole made for use in humans that is associated to similar anticancer mechanisms? There are three major reasons for me to do that and consider trying Fenbendazole as well:

First, as discussed above, in some diseases, Fenbendazole was more effective than Mebendazole;
Second, it is known that this type of drugs is not very well absorbed in the body and the absorption may differ from person to person. Therefore switching between different drugs with similar expected mechanisms may make sense as one of them may be better absorbed in our specific case;
Third, there is a good chance that the underlying anti-cancer mechanism is different for each of the drugs, even if the scientific observations suggest similar mechanisms of action (we should always remember that science represents not a complete understanding of nature, but only steps towards a better understanding).

Fenbendazole is well tolerated in humans

Although a drug that is used for animals, according to a report available at the European Medicine Agency "Fenbendazole seems to be well tolerated in humans after oral exposure (single oral dose up to 2,000 mg/per person; 500 mg/per person for 10 consecutive days)"

What Type and how is Fenbendazole used

Taking Panacur C granules from Merck

There are people taking it for deworming and they seem to prefer the Fenbendazole version that is meant to be used for fish (Ref.). In this case, its is used in the range of 5mg/kg/day to 10mg/kg/day.

However, on his website, Joe Tippens, shows a picture of Panacur C box from Merck, sold as Canine Dewormer, containing Fenbendazole granules 22.2%. This means every gram of granules contains 222mg of pure Fenbendazole.

Dose and treatment regime

In his treatment protocol, following a discussion with one scientist from Merck animals who treated her brain cancer with Fenbendazole, Joe Tippens uses 1g granules (containing 222mg pure Fenbendazole) each day, and he is taking that 3 consecutive days. He than stops taking Fenbendazole for the next 4 days. After that he starts again, and he goes like this continuously during the year. So the drug administration is 3 days ON and 4 days OFF.

If due to any reason taking Fenbendazole for ever it's not an option, I would at least consider taking it for 3 days, then repeat a three day course at three weeks and again at three months. This the minimum treatment schedule in my view and is inline with the rule of 3's used when treating whipworms (Trichuris vulpis). The idea behind this treatment regime is that some warms such as Whipworms take 3 months to mature from an egg to an adult. If you kill adults at day 1, then three weeks later there will be some immature adults which will have matured, but you'll still have eggs and larval worms present (Ref.). Nevertheless, this is the minimum regime I would use but I would probably better follow the treatment regime used by Joe Tippens (continuous 3 days ON and 4 days OFF) for 2-3 months and check if there is a response. If there is response, and tumors are shrinking I would continue, if not I would stop. Joe Tippens said he will take it for the rest of his life. He states there were no side effects for him or for over 50 people he knows taking it.

Since it has been shown that 500 mg/per person for 10 consecutive days is well tolerated in humans (Ref.), and since as discussed below the absorption of Fenbendazole in humans is poor, it may help to use from time to time a higher dose, such as 2g granules (each gram containing 222 mg pure Fenbendazole) each day, which would lead to a daily dose of 444 mg Fenbendazole.

Therefore, a suitable daily dose of Fenbendazole for longer term use may be between 220 mg (the dose that was effective for Joe Tippens) and 500mg (the dose shown tolerable in humans).

Since there are various produces for Fenbendazole under different brands, in different forms (granules, solution, capsules) and for different animals, it is best to check on the package to understand how much active ingredient (Fenbendazole) is in one gram (or ml) of the product we buy. And make sure that the daily dose of active ingredient (Fenbendazole) is somewhere between 220 mg and 500 mg. Better to take it with or after food

Like many benzimidazoles, Fenbendazole is very poorly soluble in aqueous systems, which are found in the gastrointestinal tract, causing its low absorption to the bloodstream and thus very low bioavailability. Maximal plasma concentration levels of benzimidazoles in humans

is known to be markedly increased if the substance is used immediately after a meal (Ref.1, Ref.2).

As for the case of Mebendazole, I expect another way to increase its absorption in the body is by combining it with Cimetidine (Ref.).

Add Vitamin E to possibly enable Fenbendazole effectiveness

During 2008, at the School of Medicine from Johns Hopkins University, it has been found that Fenbendazole could affect the growth of a human lymphoma cell line only when combined with vitamins (Ref.). Supplemented vitamins included B, D, K, E, and A.

Indeed, in his treatment regime, Joe Tippens also included the following: Tocotrienol form of Vitamin E (800IU per day, 7 days a week); Bio-Available Curcumin (600mg per day, 7 days a week), and CBD (25mg per day, 7 days a week) oil (Ref.).

The common vitamin that is both present in the supplement vitamins in the article cited above and Joe's treatment regime is Vitamin E (800IU per day, 7 days a week). He uses a VITAMIN E (AS D-ALPHA TOCOPHEROL) complex of 400IU called Perfect E, containing:

MIXED TOCOPHEROLS (~D-GAMMA TOCOPHEROL 400 mg; ~D-DELTA TOCOPHEROL 9 mg; ~D-BETA TOCOPHEROL 7 mg) TOCOTRIENOLS (FROM PALM) (~GAMMA TOCOTRIENOL 19 mg; ~DELTA TOCOTRIENOL 6 mg; ~ALPHA TOCOTRIENOL 12 mg; ~BETA TOCOTRIENOL 1 mg)

Given that each capsule has 400UI, 2 capusles/day should match Joe's schedule.

Indeed, other studies have also shown that the combination of Fenbendazole and Vitamin E can be effective against cancer.

Where to buy

Panacure C can be found all over the world at online shops. It can be found in packages of 3 packets of 1g granules (or 222mg Fenbendazole, for small dogs) or 3 packets of 2g granules (or 444mg Fenbendazole, for adult dogs). Fenbendazole should not be confused with Flubendazole.

REFERENCES

https://www.ncbi.nlm.nih.gov/pubmed/28078780

In vitro anti-tubulin effects of mebendazole and fenbendazole on canine glioma cells.

Benzimidazole anthelmintics have reported anti-neoplastic effects both in vitro and in vivo. The purpose of this study was to evaluate the in vitro chemosensitivity of three canine glioma cell lines to mebendazole and fenbendazole. The mean inhibitory concentration (IC50) (±SD) obtained from performing the MTT [3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide] assay after treating J3T, G06-A, and SDT-3G cells for 72 h with mebendazole were 0.030?±?0.003, 0.080?±?0.015 and 0.030?±?0.006 µM respectively, while those for fenbendazole were 0.550 ?±?0.015, 1.530?±?0.159 and 0.690?±?0.095 µM;

treatment of primary canine fibroblasts for 72?h at IC50 showed no significant effect. Immunofluorescence studies showed disruption of tubulin after treatment. Mebendazole and fenbendazole are cytotoxic in canine glioma cell lines in vitro and may be good candidates for treatment of canine gliomas. Further in vivo studies are required.

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https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3436308

Impairment of the Ubiquitin-Proteasome Pathway by Methyl N-(6-Phenylsulfanyl-1H-benzimidazol-2-yl)carbamate Leads to a Potent Cytotoxic Effect in Tumor Cells

In recent years, there has been a great deal of interest in proteasome inhibitors as a novel class of anticancer drugs. We report that fenbendazole (FZ) (methyl N-(6-phenylsulfanyl-1H-benzimidazol-2-yl)carbamate) exhibits a potent growth-inhibitory activity against cancer cell lines but not normal cells. We show here, using fluorogenic substrates, that FZ treatment leads to the inhibition of proteasomal activity in the cells. Succinyl-Leu-Leu-Val-Tyr-methylcoumarinamide (MCA), benzyloxycarbonyl-Leu-Leu-Glu-7-amido-4-MCA, and t-butoxycarbonyl-Gln-Ala-Arg-7-amido-4-MCA fluorescent derivatives were used to assess chymotrypsin-like, post-glutamyl peptidyl-hydrolyzing, and trypsin-like protease activities, respectively. Non-small cell lung cancer cells transiently transfected with an expression plasmid encoding pd1EGFP and treated with FZ showed an accumulation of the green fluorescent protein in the cells due to an increase in its half-life. A number of apoptosis regulatory proteins that are normally degraded by the ubiquitin-proteasome pathway like cyclins, p53, and I?Ba were found to be accumulated in FZ-treated cells. In addition, FZ induced distinct ER stress-associated genes like GRP78, GADD153, ATF3, IRE1a, and NOXA in these cells. Thus, treatment of human NSCLC cells with fenbendazole induced endoplasmic reticulum stress, reactive oxygen species production, decreased mitochondrial membrane potential, and cytochrome c release that eventually led to cancer cell death. This is the first report to demonstrate the inhibition of proteasome function and induction of endoplasmic reticulum stress/reactive oxygen species-dependent apoptosis in human lung cancer cell lines by fenbendazole, which may represent a new class of anticancer agents showing selective toxicity against cancer cells.

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https://www.ncbi.nlm.nih.gov/pubmed/19049251

Unexpected antitumorigenic effect of fenbendazole when combined with supplementary vitamins.

Diet containing the anthelminthic fenbendazole is used often to treat rodent pinworm infections because it is easy to use and has few reported adverse effects on research. However, during fenbendazole treatment at our institution, an established human lymphoma xenograft model in C.B-17/Icr-prkdcscid/Crl (SCID) mice failed to grow. Further investigation revealed that the fenbendazole had been incorporated into a sterilizable diet supplemented with additional vitamins to compensate for loss during autoclaving, but the diet had not been autoclaved. To assess the role of fenbendazole and supplementary vitamins on tumor suppression, 20 vendor-supplied 4-wk-old SCID mice were assigned to 4 treatment groups: standard diet, diet plus fenbendazole, diet plus vitamins, and diet plus both vitamins

and fenbendazole. Diet treatment was initiated 2 wk before subcutaneous flank implantation with 3 x 107 lymphoma cells. Tumor size was measured by caliper at 4-d intervals until the largest tumors reached a calculated volume of 1500 mm3. Neither diet supplemented with vitamins alone nor fenbendazole alone caused altered tumor growth as compared with that of controls. However, the group supplemented with both vitamins and fenbendazoleexhibited significant inhibition of tumor growth. The mechanism for this synergy is unknown and deserves further investigation. Fenbendazoleshould be used with caution during tumor studies because it may interact with other treatments and confound research results.

Fenbendazole Synthesis Patents

TW200740838
Novel benzimidazole (thio)carbamates with antiparasitic activity and the synthesis thereof

The present invention is concerned with novel benzimidazole (thio)carbamates with antiparasitic activity. The present invention provides compounds of the following general formula: Formula I, wherein X1 and X2 are O or S, wherein at least one of X1 and X2 is O, Y1 and Y2 are O or S, wherein at least one of Y1 and Y2 is O, R1 is alkyl of 1-4 carbon atoms, R2, R3 and R4 are independently of each other hydrogen, or a cation, R5 and R6 may both independently be hydrogen or halogen or alkyl having from 1-8 carbon atoms, or -OR7, wherein R7 is alkyl having from 1-8 carbon atoms, or -SR8, wherein R8 may be alkyl having from 1-8 carbon atoms, or aryl, or -CO-R9, wherein R9 is alkyl having from 1-8 carbon atoms, cycloalkyl having from 3-6 carbon atoms, or R9 is aryl, or -OSO2-Ar, wherein Ar is aryl, or -S(O)R10, wherein R10 is alkyl having from 1-8 carbon atoms, or wherein R10 is aryl. The compounds of the invention are highly soluble and stable in water. Moreover, it has been found that the compounds according to the invention are stable for over 8 hours at pH 5 and at pH 9, which are the lower and upper pH limits at which compounds should be stable for over 8 hours in order to be suitable for drinking water application. The compounds of the present invention have excellent antiparasitic, and especially anthelmintic activity in vivo, which is comparable to the state of the art, water insoluble, benzimidazole carbamates such as albendazole and fenbendazole.

CN103242238
Preparation method of fenbendazole

The invention discloses a preparation method of fenbendazole and provides a brand-new synthesis route of the fenbendazole. The fenbendazole is prepared from m-dichlorobenzene as a starting material through the steps of nitrification, condensation, amination, reduction and cyclization. The preparation method is characterized in that the starting material m-chloroaniline in the existing industrial route is changed to the cheap m-dichlorobenzene; the existing reduction technology with sodium sulfide dihydrate is changed to the clean and high-efficiency reduction technology; and the new synthesis technology is concise and simple, high in efficiency, slight in pollution, high in quality, and suitable to industrial production.

UCSF, March 29, 2017

Deworming Pill May Be Effective in Treating Liver Cancer

UCSF Researchers Use Computational Tools to Quickly Screen, Identify Drugs

By Laura Kurtzman

Hepatocellular carcinoma (HCC), a cancer associated with underlying liver disease and cirrhosis that often only becomes symptomatic when it is very advanced, is the second leading cause of cancer deaths around the world, and yet it has no effective treatment.

As with other conditions without treatments, the data that scientists need to understand and treat the disease may be sitting in plain view in databases that have barely been analyzed, says Atul Butte, MD, PhD, director of the Institute for Computational Health Sciences at UC San Francisco.

Bin Chen, PhD, a former postdoctoral scholar in Butte's lab and now a faculty member in Pediatrics in the Institute for Computational Health Sciences, recently published a paper in Gastroenterology about using data-mining computational tools to identify a treatment for HCC.

Gene Expression and Drug Targets

Taking advantage of publicly available gene expression data, he first derived a molecular disease signature for HCC – looking at 274 genes that are either up or down regulated in cancerous liver tissues, but not in normal liver tissues.

Then, he looked for drugs that were known to target those genes and found, to his surprise, that a close cousin of a deworming pill, when used in combination with the standard care drug, was highly effective at killing cancerous liver tissue that had been engrafted into experimental mice.

"We found these disease genes were reversed after six weeks of treatment in a patient-derived tissue in mouse model," Chen said, adding that the advantage of the approach he developed is that it targets a host of genes at the same time, rather than simply targeting a single mutation.

Chen said finding molecular signatures for diseases then looking for drugs that work against those signatures is a promising way of treating patients who may each have a different set of cancer mutations and might not respond to drugs that just targeted them one at a time.

"In this study, patients had similar gene expression profiles, but not identical," Chen said. "In most cases, cancers have many mutations, and patients will relapse. Our approach might be used to control the disease, to make it a chronic condition rather than a lethal one."

Head Start to a New Drug Candidate

Only a small number of drugs have been analyzed for their gene expression profiles, and so it was somewhat lucky that Chen found a hit with niclosamide. But even after discovering a match between the drug and the disease, his team of UCSF and Stanford University researchers was stymied. The drug, which was designed to kill parasites, did not work well in the mouse model, because it was not soluble.

It was only after Chen's team stumbled upon a paper that described its close cousin, NEN –

an ethanolamine salt that is soluble in human cells – that they made it work. When they combined NEN with sorafenib, the standard of care for advanced HCC, they found that the tumors stopped growing.

While NEN has been found safe to use against tapeworms in dogs and cats, scientists do not yet know how it would affect humans, or whether it would stop cancerous liver tissue from growing in humans.

But Chen said it is a promising drug candidate that could be developed at half or less than half the cost of a typical drug because of the head start he got by using advanced computational techniques to mine freely available data.

“Because our method is literally virtual, we can evaluate hundreds of drug candidates very quickly,” Chen said. “We looked at more than 1,000 drugs before discovering that the deworming pills were effective. This is a very efficient way to do drug discovery.”
