

RADIOTHERAPY AND RADIO-SUPPORT

Radiotherapy refers to the use of ionizing radiation to treat disease: this newsletter will focus specifically on the use of radiation to treat cancer. Ionizing radiation deposits energy that injures or destroys cells in the area being treated by damaging their genetic material and consequently preventing them from growing. The success of radiation therapy depends on the delivery of an adequate dose to the entire tumour volume without causing severe damage to surrounding normal tissues; therefore, the radiation is aimed as accurately as possible at the tumour. However, healthy cells will be inevitably affected causing the numerous side-effects of radiotherapy. The tolerance of healthy tissues to radiation is related to the volume irradiated, the nature and function of organs within that volume and the stage of cancer treated.

Sources and Methods of Radiotherapy

Over the last 20 years, the use of radium as a source of radiation has been replaced with artificial isotopes such as cobalt-60, caesium-137 and iridium-192.

Isotopes may be administered in the following ways:

- implanted directly into tissues (e.g. iridium needles in the treatment of carcinoma of the tongue).
- inserted into a cavity (e.g. caesium sources inserted into the uterus and vagina for the treatment of carcinoma of the cervix).
- systemically (e.g. iodine-131 in the treatment of thyroid cancer).

External beam radiation therapy: revolutionized in the 1950's, this method involves the use of linear accelerator machines to generate a stream of electrons which is accelerated to high speed by microwave energy before hitting a tungsten target. This interaction results in the emission of high-energy X-rays. It is thought that this method ensures the skin receives a lower dose of radiation than with other methods as the point of maximum dose is 1-2cms below the skin surface. It is used to treat localized cancers.

In external beam treatments, the maximum therapeutic effect is generally achieved by employing a practice called 'fractionation', where the total dose of radiotherapy is divided into small parts over several weeks.

Treatment Planning and Dosage

When planning a course of radiotherapy, the following three factors are taken into account:

- the size of the tumour: a larger number of fractions will normally be required to eliminate a larger tumour.
- tolerance of normal tissues: the total dose which can be applied to a tumour is limited by the tolerance of the surrounding normal tissue - this varies greatly between tissues.
- radio-sensitivity of tumour cells: some tumour cells are more radiosensitive and others are more radio-resistant, as shown in the table below.

Highly radiosensitive	Moderately radiosensitive	Relatively resistant	Very resistant
-----------------------	------------------------------	----------------------	----------------

Lymphomas	Breast cancer	Squamous cell lung cancer	Melanoma
Ewing's sarcoma	Small cell lung cancer	Hypernephroma	Osteosarcoma
Seminoma	Ovarian cancer	Bladder carcinoma	Pancreatic carcinoma
Wilm's tumour	Medulloblastoma	Rectal carcinoma	
Myeloma	Basal cell carcinoma	Soft tissue sarcoma	
	Teratoma	Cervical carcinoma	

Table1. Relative radio-sensitivity of tumours.

When is radiotherapy used?

About four out of ten people with cancer have radiotherapy as part of their treatment. There are five main reasons why radiotherapy is given in the treatment of cancer:

- Curative or radical treatment - a modality of local control alternative to surgery. Radiotherapy may be indicated where a) it will give better functional or cosmetic results than surgery, b) in the case of very radiosensitive tumours c) in inoperable tumours, d) at sites where surgery carries a high rate of morbidity and e) in patients unfit for radical surgery.
- Palliative treatment - to relieve symptoms and reduce pain. The aim is to give sufficient treatment to relieve symptoms without short-term side-effects for as long as the patient is expected to survive.
- Neoadjuvant or induction treatment - before surgery to shrink a tumour or reduce the risk of it spreading during surgery.
- Adjuvant treatment - after surgery to kill off remnants of the tumour. It may be given to the site of the primary disease to reduce local recurrence or to sites of potential metastatic spread.
- Total Body Irradiation (TBI) - given to patients prior to a bone marrow transplant.

Radiation injury

The tissue penetrating power of high-energy X-rays and g-rays means that normal tissues will be irradiated as well as the tumour. The important site of radiation damage is nuclear DNA. The damage appears to be induced indirectly. The radiation first produces highly reactive radicals which in turn damage the DNA, impairing the reproductive integrity of the cell. The amount of cell death following exposure to irradiation is proportional to the dose administered. There are certain tissues which are damaged acutely by relatively low doses of irradiation (the energy deposited in a tissue is measured in gray (Gy; 1 Gy = J/kg):

- Bone marrow: this can regenerate after exposure to 10Gy, but above this dose permanent aplasia may occur. The white count and platelet count begin to fall within 10 days of exposure.
- Intestine: doses of 10Gy or over cause severe loss of crypt cells leading to loss of villi and extensive ulceration.
- Skin: Erythema occurs at doses below 10Gy. At 20 Gy, the skin starts to desquamate and ulcerate.
- Lung: Above 10Gy in a single fraction, pneumonitis occurs and is increasingly severe with increase in dose.

Side-effects

The complications of radiotherapy depend on the radiation sensitivity of normal tissues in the path of the beam, and may be immediate or delayed.

Tissue	Complication	
	Immediate	Delayed
Skin	Erythema, Desquamation	Fibrosis, Telangiectasia Squamous carcinoma
Oral cavity	Mucosal ulceration	Loss of saliva
Gut	Nausea, diarrhoea	Fibrosis and stricture
Bone	Bone necrosis	Loss of bone growth in children
Kidney	Acute nephritis	Chronic nephritis Hypertension
CNS	Radiation myelitis and encephalitis	Demyelination Possible alteration of personality and intellect
Eye	Conjunctivitis	Dry eye Cataract formation
Gonads	Sterility	Sterility
Bone marrow	Leucopenia	Suppression of haemopoiesis in area irradiated

Table 2. Side effects of radiotherapy

The most frequently seen short-term side effects of radiotherapy, although they will vary depending on the area of treatment, are as follows:

- local necrosis
- pain
- inflammation
- local exudation with a burning feeling
- tiredness
- hair loss
- diarrhoea
- loss of appetite and weight
- shortness of breath
- difficulty in swallowing
- loss of taste or metallic taste
- cystitis

Obviously side-effects vary depending on the area of the body which is treated. However, looking at the most common side-effects, we can attempt to group them according to the following Chinese pathological patterns:

- **Deficiency of Qi, Blood and Yin (of the Stomach, Spleen, Lungs, Liver and Kidneys)**
Hair loss, diarrhoea, bone-marrow suppression, fatigue, loss of appetite, neurological damage, shortness of breath, loss of taste.

- **Blood-Heat**
Skin reactions, cystitis, burning feeling, local necrosis.
- **Blood stasis**
Pain, inflammation, local necrosis.

The treatment principles to adopt are therefore:

- Tonify Qi Blood and Yin (Huang Qi Radix Astragali membranacei, Dang Gui Radix Angelicae sinensis, Shou Wu Radix Polygoni multiflori, Gou Qi Zi Fructus Lycii chinensis, Sheng Di Huang Radix Rehmanniae glutinosae, Wu Wei Zi Fructus Schisandrae chinensis, Yu Zhu Rhizoma Poligonati odorati, Zhi Mu Radix Anemarrhenae asphodeloidis)
- Cool Blood (Mu Dan Pi Cortex Moutan radicis, Sheng Di Huang Radix Rehmanniae glutinosae, Zhi Mu Radix Anemarrhenae asphodeloidis)
- Invigorate Blood (Mu Dan Pi Cortex Moutan radicis, Hong Hua Flos Carthami tinctorii, Dan Shen Radix Salviae miltiorrhizae).

Analysis of individual herbs in Radio-Support

- Huang Qi: tonify Qi and raise immune response
- Dang Gui: nourish Blood
- Hong Hua: invigorate Blood
- Dan Shen: invigorate Blood
- Shou Wu: nourish Blood
- Gou Qi Zi: nourish Blood
- Wu Wei Zi: nourish Yin
- Nu Zhen Zi: nourish Yin
- Zhi Mu: nourish Yin and cool Blood
- Mu Dan Pi: cool and invigorate Blood
- Sheng Di Huang: nourish Yin and cool Blood
- Yu Zhu: nourish Yin
- Yu Zhu: nourish Yin
- Gan Cao: harmonize

Pharmacology of Radio-Support ingredients

I shall report only the pharmacology of the above plants that is relevant to radiotherapy, immune function, inflammation, digestion or carcinoma. Thus, for each plant, there are many other pharmacological actions not reported below. These data are not available for all of Radio-Support's ingredients.

It should also be noted that such data are reported for reference only as they reflect a reductionist view of the action of herbs that is at variance with the Chinese medicine view. Some of the research studies reported present a doubly-reductionist view: firstly, they use single herbs and secondly, many of them use single constituents of a herb. By contrast, Chinese medicine uses only formulae composed of several herbs. It is a well-known fact that, first of all, the action of a herb is more than the sum-total of the actions of its individual constituents and secondly, the synergistic action of the herbs within a formula is more than the sum-total of its individual herbs. Furthermore, many of the studies reported are based on animal experiments which could be criticized on ethical grounds.

HUANG QI
Radix Astragali membranacei

Constituents

2'4'-dihydroxy-5,6-dimethoxyisoflavone, kumatakenin, choline, betaine, polysaccharides, glucuronic acid, folic acid.

Pharmacology

- **Enhancement of immune function**

The decoction given to mice increased the phagocytic activity of the reticuloendothelial system. Oral administration or nasal spray of Huang Qi offered protection against the common cold. Intraperitoneal administration of the polysaccharides from the root of *Astragalus membranaceus* antagonized the atrophy of immune tissues such as spleen, thymus and intestinal lymph nodes as well as leukopenia caused by immunosuppressant prednisolone in mice. Intraperitoneal administration of the homogeneous fraction of the polysaccharides astragalan I and II increased the weight and cell number of mouse spleen. Two months of oral treatment with the herb in subjects susceptible to common cold greatly increased the levels of SIgA and IgG in the nasal secretion.

-

- **Antibacterial effect**

In vitro, Huang Qi was effective against *Shigella shigae*, *Bacillus anthracis*, *Streptococcus hemolyticus*, *Corynebacterium diphtheriae*, *Diplococcus pneumoniae*, *Staphylococcus aureus*.

- **Prevention of renal toxicity in chemotherapy**

A double-blind trial of 49 patients undergoing chemotherapy showed that the decoction of Huang Qi *Radix Astragali membranacei* and *Fu Ling Sclerotium Poriae cocos* markedly reduced the incidence of renal toxicity. Rats with experimentally-induced glomerulonephritis, when treated with Huang Qi had significantly less proteinuria than control groups as well as milder pathological tissue changes.

- **Effect on endurance**

Decoction of Huang Qi given to mice significantly increased their endurance in swimming tests.

- **Endocrine effect in patients undergoing radiotherapy**

In a randomized clinical trial, the plasma hydrocortisone level in stage II carcinoma of the cervix was observed. The average level in 18 patients before and after irradiation were 8.0 and 6.1 g/100ml, whereas the before and after levels were 9.5 and 9.1 g/100ml in patients who received a decoction of Huang Qi *Radix Astragali membranacei* and *Nu Zhen Zi Fructus Ligustri lucidi* for two months.

- **Anti-inflammatory effect**

Intravenous dose of 5 mg/Kg or oral dose of 50 mg/Kg of astramembranin I inhibited the increase in vascular permeability induced by serotonin or histamine in rats.

- **Hepatoprotective effect**

Intravenous administration of 10 mg/Kg of astramembranin I induced accumulation of cAMP in rabbit plasma.

DANG GUI

Radix Angelicae sinensis

Constituents

Ligustilide, n-butylidene phthalide, palmitic acid, beta-sitosterol, beta-sitosteryl palmitate, sucrose, vitamin B12, nicotinic acid, folic acid, folinic acid, biotin, vitamin A and E.

Pharmacology

-

Effect on coronary flow

Perfusion of the 2% fluid extract into the isolated heart of guinea pigs significantly dilated the coronary vessels and increased coronary flow.

-

Effect on platelet aggregation

The aqueous extract of the root and its ingredient ferulic acid inhibited rat platelet aggregation and serotonin release.

-

Effect on immune system

The herb enhanced the phagocytic function of abdominal macrophages of animals.

-

Anti-inflammatory effect

The aqueous extract of the root decreased vascular permeability. The inhibitory activity in mice by oral administration was comparable to that of aspirin; like aspirin, it also inhibited the release of 5-HT and other inflammatory substances.

HONG HUA

Flos Carthami tinctorii

Constituents

Red pigment carthamin, yellow pigments safflor yellow A, safflor yellow B, safflomin A, luteolin and 7-O-b-D-glucopyranoside, b-sitosterol and 3-O-b-D-glucopyranoside.

Pharmacology

-

Cardiovascular effect

Intravenous administration of 10mg/kg of the injection solution of the herb increased coronary flow by 60.4% in the in situ heart of dogs with catheterized coronary sinus.

-

Anticoagulation effect

The alcoholic extract of the herb prolonged the clotting time of the blood, plasma recalcification time and serum thrombin time, and reduced serum prothrombin time of dogs. The alcoholic extract and decoction of the herb also inhibited rabbit or rat platelet aggregation induced by ADP and collagen.

-

Effect on hypoxic endurance

In rats with acute hypoxic encephalopathy, daily oral dose of 0.5g of the alcoholic extract of the herb for 5 days and one intraperitoneal dose of 1g prior to operation resulted in a 83% survival rate whereas the survival rate in the control group was 30%. The pathology of ischemic damage was milder and recovery was faster in the medication group than in the control.

DAN SHEN
Radix Salviae miltiorrhizae

Constituents

Tanshiones I, IIA and IIB, isotanshinones I and II, cryptotanshinone, isocryptotanshinone, methyl tanshinonate, hydroxytanshinone IIA, miltirone, 1-dihydrotanshinon I, salviol, protocatechuic aldehyde, protocatechuic acid, b-(3,4-dihydroxyphenyl) lactic acid, and vitamin E.

Pharmacology

•

Effect on Coronary Circulation

In anaesthetized dogs and cats, intravenous infusion of 3-4g/kg of the injection solution of the herb significantly increased coronary flow and reduced coronary resistance. At 4g/kg the coronary flow was increased by 70.47% and the resistance reduced by 46.4%.

•

Anticoagulant and anti-platelet aggregation effects

In vitro experiments showed that the decoction of the herb was inhibitory on all three stages of the coagulation process. It transformed fibrinogen to fibrin which then degraded into FDP (fibrinogen degradation products). The ethanolic extract of the herb inhibited rabbit platelet aggregation induced by ADP r collagen. Tanshinone IIA sodium sulfonate inhibited ADP-induced platelet aggregation of the blood from coronary patients.

•

Antimicrobial and anti-inflammatory effects

The 1:1 decoction of the herb inhibited Staphylococcus aureus, Escherichia coli, Proteus vulgaris, Shigella flexneri and Salmonella typhi. The total tanshinones showed antiinflammatory activity in mice. Tanshinones also showed bacteriostatic activity against Staphylococcus aureus and Mycobacterium sp.

•

Antihepatotoxic effect

The decoction of the herb was able to decrease the elevated SGPT and pathological changes in rabbits with acute liver damage induced by CC14. It was also effective in restoring liver function and preventing liver fibrosis in clinical studies.

•

Effect on Hypoxia tolerance

The survival period or survival rate of mice or rats under normobaric or hypobaric hypoxic conditions could be markedly increased by injection of the herb. The drug decreased the rate of oxygen consumption and increased the animals' tolerance to anoxia, which was previously reduced by guanethidine at a late phase.

•

Effects on the Immunologic function

Intramuscular injection of the herb decoction to mice at the dose of 0.2ml daiy for 5 days markedly increased the macrophage activity in chicken erythrocytes. The compound injection of the herb could increase T luphocytes in chronic bronchitis complicated with pulmonary heart disease, as well as in asthmatic bronchitis and in chronic bronchitis associated with pulmonary emphysema.

•

Action on Metabolism of DNA

Incorporatioin of 3H-thymine-D-deoxyribose into the DNA of the myocardia of mice with

acute anoxia was not significantly altered by the compound injection of the herb but its incorporation in spleen as compared with the control was significantly decreased. The incorporation in the livers of the treatment group, however, was significantly increased.

- **Effect on skin diseases**

Various therapeutic effects were achieved with injection of the herb in the treatment of psoriasis, scleroderma, neurodermatitis, eczema, pruritis, urticaria, Behcet's syndrome and erythema nodosum.

SHOU WU

Radix Polygoni multiflori

Constituents

Emidon, physcion, chrysophanol, rhein, chrysolphanol anthrone, 2,3,5,4'-tetrahydroxystilbene 2-O- β -D-glucopyranoside and its 2''- and 3''-O-monogalloyl esters, 3-O-galloyl procyanidin B-2, catechin, epicatechin, 3-O-galloylcatechin, 3-O-galloylepicatechin, polygoacetophenoside, lecithin.

Pharmacology

- **Immunologic and adrenocorticotropic effects**

The herb significantly increased the weights of the thymus, peritoneal lymph node and adrenal gland of mice and potentiated the phagocytosis of murine peritoneal macrophages. It also antagonized the immuno-suppressive effect of prednisolone and leukocyte reduction due to prednisolone. The thymus atrophy and serum g-globulin reduction in mice were also blocked by administration of the herb. In adrenalectomized mice, administration of the herb resulted in increase of hepatic glycogen.

- **Antioxidant activity**

The aqueous extract of the herb produced antioxidant activities both in vitro and in vivo as indicated by its ability to protect against carbon tetrachloride-induced hepatotoxicity in rats and to scavenge ferri-heme oxidants generated in an in vitro system. The antioxidant components were contained in the ethyl acetate fraction of the extract.

- **Antibacterial action**

In vitro studies showed that the herb was inhibitory against *Mycobacterium tuberculosis* var. *hominis* and *Shigella flexneri*.

- **Effects on neurasthenia**

Good therapeutic effects were reported in 141 cases of neurasthenia with insomnia, treated with the 20% injection and the *P. multiflorum* tablet. The medication was superior to chlordiazepoxide, meprobamate, and bromides in inducing sleep.

GOU QI ZI

Fructus Lycii chinensis

Constituents

Betaine, dehydro-a-cyperone and solavetivone, polyene alcohols zeaxanthine, physaligenin and cryptoxanthine, b-Sitosterol and melissic acid, 1-O-b-D-glycopyranosyl-(2S, 3R, 4E, 8Z)-2-N-palmitoyloctadecasphinga-4,8-dienine and 1-O-b-D-glycopyranosyl-(2S,3R,4E,8Z)-2-N-(2'hydroxypalmitoyl)octadecasphinga-4,8-dienine,

Pharmacology

-

Immunoregulating effects

Daily oral administration of 0.4ml of the 100% water extract of the fruit of *L. barbarum* for 3 days or one intramuscular injection of 0.1 ml of the 100% ethanolic extract significantly increased phagocytosis of the reticuloendothelial system of mice. In mice, *L. barbarum* polysaccharides (LBP) at intraperitoneal dose of 5 or 10mg/kg increased T lymphocyte proliferation. At 5mg/kg it also enhanced the cytotoxicity of CTL and NK cells. The splenic plaque-forming cells (PFC) in aged mice were increased to a normal adult mouse level following intraperitoneal administration of 1-2mg/kg of LBP.

-

Adjuvant therapeutic effect on tumours

The herb showed synergistic actions with chemo- and radio-therapy and reduced their side effects. The inhibition of sarcoma W256 in rats by cyclophosphamide (Cy) was augmented after oral dose of the aqueous extract of the herb and white cell reduction due to Cy was attenuated. In another experiment with mouse brain G422 tumour, combination of LBP with cranial irradiation of ⁶⁰Co and BCNU not only increased the life span of the tumour-bearing mice but also improved cellular immune functions.

-

Hematopoietic effect

Oral administration of 0.5ml of the 10% decoction daily for 10 days promoted the hematopoiesis in mice, increasing the number of leukocytes. It also protected from leukocytogenesis-inhibition by cyclophosphamide. Three daily doses of 10mg/kg of LBP stimulated the proliferation of the bone marrow stem cells and increased the number of progenitors of granulocytes and macrophages of mice.

In 50 healthy subjects taking 50g of the herb daily for 10 days, the white cell count was significantly increased from 6446-2811 to 7143-2938. The same dosage given to 28 malignant cancer patients receiving chemotherapy increased the white cell count from 3909-310 to 6371-2500.

-

Anti-peroxidation and anti-hepatotoxic effects

The herb showed inhibition on lipid peroxidation of RBC membrane induced by H₂O₂. The effect of free radicals on the cells was prevented and reversed by incubation with LBP as shown by determining the changes in electrical parameters of the cell membrane of *Xenopus* oocytes. The resting membrane potential was raised, and the membrane resistance and time constant were decreased.

-

Adjuvant cancer treatment

79 advanced cancer patients were treated with LAK/IL-2 combining with LBP. Initial results of the treatment from 75 valuable patients indicated that objective regression of cancer was achieved in patients with malignant melanoma, renal cell carcinoma, colorectal carcinoma, lung cancer, nasopharyngeal carcinoma or malignant hydrothorax.

WU WEI ZI
Fructus Schisandrae chinensis

Constituents

Lignan compounds including schisandrol A and schisandrin B, citral, a- and b-chamigrene, and b-chamigrenal, citric acid, malic acid, tartaric acid, vitamin C, fatty oil.

Pharmacology

•

Anti-hepatotoxic effect

Anti hepatotoxic effects of 22 lignans from Schisandra fruit were evaluated by utilizing CC14 and GalN-induced cytotoxicity in primary cultured rat hepatocytes as model systems. Prominent protective actions were found with wuweizisu C and schisantherin D against CC14-produced cytotoxicity. Deoxygomisin A, gomisin N, Wuweizisu C, gomisin C, and schisantherin D were effective in preventing GalN-induced cell damage.

•

Respiratory Stimulation

Intravenous administration of the decoction of the herb produced respiratory stimulating effects in normal and anaesthetized rabbits and dogs. It increased both frequency and amplitude of respiration.

•

Adaptogen-Like and Immune Regulation actions

The fruit can increase the resistance of the body against nonspecific stimuli. It decreased local oedema due to burns in mice and increased survival rate and survival time of the animals.

•

Neurasthenia

The 40-100% tincture of the herb at 2.5ml twice to three times daily for a course of two weeks to one month alleviated or relieved insomnia, headache, dizziness, blurred vision, palpitation and nocturnal emission.

NU ZHEN ZI
Fructus Ligustri lucidi

Constituents

Oleanolic acid, acetyloleanolic acid, betulin, lupeol, salidroside, mannitol, oleic acid, linolic acid, palmitic acid.

Pharmacology

•

Incremental effect on white blood cells

The fruit increased white blood cells in leukopenia due to chemotherapy or radiotherapy in mice.

- **Effect on immune function**

The fruit promoted lymphoblast transformation and increased the number of cells with haemolytic plaques. The in vitro restorative effect of the aqueous extract of the herb was studied in cancer patients and in normal, healthy donors. Using the local graft versus host (GvH) reaction as a test assay for T-cell function, the extract affected an immune restoration in 9 of 13 cancer patients with an increase in local GvH reaction from 32.3/36.1 mm³ to 118/104.9mm³; these results suggest the herb contains powerful immune stimulants.

- **Antineoplastic action**

The extract given by intragastric administration to mice gave a 49% inhibition rate against cervical cancer. The extract of the herb has been found to reverse tumour-associated macrophage suppression; these data suggest that the herb has cancer chemo-preventative properties.

- **Effect on leukopenia**

The injection of an extract of the fruit given once or twice daily could be used in cancer patients to prevent and treat leukopenia caused by chemotherapy.

- **Anti-inflammatory effect**

Paw oedema in rats was inhibited by oral administration of 12.5 or 25g/kg of the decoction of the herb for 5 days.

ZHI MU

Radix Anemarrhenae asphodeloidis

Constituents

Timosaponins A1, A2, A3, and A4, timosaponins B1, B2, etc., sarsasapongenin, markogenin, neogitogenin, norlignans such as hinokiresinol and oxy-hinokiresinol, anemarans A-D, xanthone C-glucoside and mangiferin.

Pharmacology

- **Antipyretic effect**

Subcutaneous injection of the aqueous extract of the rhizome (4g/kg) decreased the body temperature of rabbits inoculated with *Escherichia coli*.

- **Antimicrobial effect**

The rhizome decoction showed in vitro inhibitory effect on *Bacillus dysenteriae*, *B. typhosus*, *B. paratyphosus*, *B. coli*, *B. proteus*, *B. diphtheriae*, *Vibrio comma*, *Staphylococcus*, *Diplococcus pneumoniae*, *Streptococcus hemolyticus*, and *Candida albicans*.

- **Effects on blood glucose**

The aqueous extract of the herb could lower the blood glucose level in normal rabbits.

MU DAN PI
Cortex Moutan radicis

Constituents

Paenol, paenoside, pasenolide, paeniflorin, volatile oil and phytoesterol.

Pharmacology

•

Antimicrobial action

The decoction of the root showed strong antibacterial action in vitro against *Bacillus subtilis*, *Escherichia coli*, *Salmonella typhi*, *Salmonella paratyphi*, *Proteus vulgaris*, *Staphylococcus aureus*, *Streptococcus haemolyticus*, *Doplococcus pneumonia* and *Vibrio cholerae*.

•

Anti-inflammatory action

Paenol given intragastrically inhibited swelling of rat paws induced by dextran. Paenol inhibited the increase of intra-abdominal capillary permeability of mice and cutaneous capillary permeability of guinea pigs caused by acetic acid. The methanolic extract, the glycosidic fraction and paenol inhibited blood platelet aggregation.

•

Hypotensive effect

The blood pressure of dogs with essential or renal hypertension was significantly reduced after oral administration of 5g/Kg of the decoction of the root bark for 5 days and 10g/Kg for two more days.

•

CNS effects

Intraperitoneal or oral administration of paenol decreased the spontaneous activity of mice, antagonized caffeine-induced hyperactivity and prolonged cyclobarbital-induced sleep.

GAN CAO
Radix Glycyrrhizae uralensis

Constituents

Triterpenes glycyrrhizin, flavonoids berniarin, umbelliferone, ferulic acid, sinapic acid, amino-acids, biotin, beta-sitosterol.

Pharmacology

•

Glucocorticoid-like action

Injection of glycyrrhizin in healthy subjects increased free cortisol levels in the blood. Intraperitoneal administration of a low dose of glycyrrhizin to rats caused atrophy of the thymus gland and increased weight of the adrenal gland suggesting a cortico-tropin-like action; in patients with mild Addison's disease requiring daily intramuscular injection of 12.5mg of cortisone, concurrent daily intramuscular dose of glycyrrhizin increased urinary free 17-hydroxycorticosterone and decreased the conjugated 17-hydroxycorticosterone.

- **Mineralocorticoid-like action**
The extract reduced the urinary volume and sodium excretion and increased potassium excretion in various animal species.
- **Anti-inflammatory action**
The anti-inflammatory effect of the herb resembles that of butazone or hydrocortisone; cotton pledget-induced granulation, formaldehyde-induced paw swelling and subcutaneous granulomatous inflammation in rats were all inhibited by glycyrrhetic acid.
- **Effect on the immune system**
Glycyrrhizin inhibited egg-white-induced allergic reaction in guinea pigs. Glycyrrhizin inhibited the degranulation of mast cells elicited by the histamine liberation agent, Compound 48/80, so that it suppressed the release of the allergy mediators.
- **Anti-ulcer action**
Injection of the herb extract produced significant inhibition of ulcers in albino rats, together with marked reduction in gastric juice and free acid. In many clinical studies on the use of Gan Cao for ulcers, the effectiveness was usually around 90%.
- **Anti-neoplastic action**
Glycyrrhetic acid inhibited the transplanted Oberling-Guerin myeloma in rats.
- **Effect on lipid metabolism**
In rats with atherosclerosis, Gan Cao lowered cholesterol levels and stopped the progression of the lesions.
- **Antihepatotoxic effect**
Oral administration of the extract of the herb showed hepatoprotective effects against carbon tetrachloride-induced cytotoxicity in rats; it markedly abated hepatic degeneration and necrosis, promoted the recovery of hepatocellular glycogen and ribonucleic acid and also lowered serum glutamic pyruvic transaminase. Glycyrrhizin and glycyrrhetic acid are able to prevent the development of cirrhosis.

CHEN PI

Pericarpium Citri reticulatae

Constituents

Dlimonen, citral, hesperidin, neohesperidin, tangeretin, nobiletin, citromitin, 5-O-desmethyleitromitin, inositol, Vitamin B1.

Pharmacology

- **Actions on the gastro-intestinal smooth muscles**
The herb decoction inhibited the motility of the isolated small intestines of mice and rabbits.

- **Action against gastric ulcers**
Daily injections of methylhesperidin for 6 days markedly reduced the incidence of ulcers and inhibited gastric secretions.
- **Anti-inflammatory action**
Both hesperidin and methylhesperidin had vitamin P-like actions. Hesperidin inhibited the inflammatory reaction of croton oil granulation in rats. Intraperitoneal dose of 10mg/Kg of hesperidin inhibited increased permeability caused by histamine in mice.

YU ZHU

Rhizoma Polygonati odorati

Constituents

Convallamarin, convallarin, odospiroside, polyfuroside and POD-II, or 3-O-b-glucopyranosyl - (1-2) - (b-D-xylopyranosyl - (1-3)-b-D-glucopyranosyl - (1-4)-galactopyranosyl - 25(R) - spirost-5-en-3-b,14a-diol, quercetin glycoside, kaempferol, vitexin-2"-O-sophoroside, cosmosiin, vitexin, vitexin-2"-O-dlucoside, saponarin.

Pharmacology

- **Immunostimulating effect**
Oral administration of 10.4g/kg of the ethanolic extract of the herb to mice with burn injury markedly increased serum hemolysin level, stimulated antibody production and phagocytosis of the peritoneal macrophages. The hot water extract of the herb also stimulated phagocytes as measured with carbon clearance activity in mice
- **Effect on blood glucose**
Intramuscular administration of 0.5g/kg of the macerate of the herb to rabbits increased blood glucose, but oral administration resulted in reduction of blood glucose after an initial increase. Oral dose of the macerate also decreased blood sugar levels in rats with diabetes induced by epinephrine, glucose or alloxan. In mice the methanolic extract of the herb produced anti-diabetic effect against epinephrine- or streptozotocin-induced hyperglycemia.
- **Action on smooth muscles**
The 20% decoction of the herb initially excited the isolated intestine of mice and inhibited it thereafter; it had a weak excitatory action on the isolated uteri of mice.

SHENG DI HUANG

Radix Rehmanniae glutinosae

Constituents

Catalpol, ajugol, leonuride, aucubin, melittoside, rehmanniosides A-D (glycosides). E-feruloylajugol, Z-feruloylajugol, p-coumaroylajugol, p-hydroxybenzoylajugol, vanilloylajugol, 4-(a-L-rhamnopyranoxyloxy)-3-methoxybenzoylajugol (ajugol esters). Jioglutoside A and jioglutoside B (iridoid glycosides). Acetoside, isoacetoside, purpureaside

C, echinacoside, castanosides A and F, rehmaglutins A-D, glutinoside, rehmaionosides A, B and C, rehmapicroside, b-sitosterol, mannitol, campesterol.

Pharmacology

•

Effects on adrenocortical function and cortisol metabolism

The herb was able to stop the decrease of plasma corticosterone concentration due to administration of dexamethasone and prevent the adrenal cortex from atrophy.

•

Anti-inflammatory and immuno-suppressive effects

Formaldehyde-induced oedema of rat paws subsided after oral administration of the decoction or alcoholic extract at the daily dose of 10g/kg for 5 days. At the oral dose of 100mg/kg, jionoside B and acetoside produced 36% and 18% suppression of hemolytic plaque forming cells in the spleens of mice. In the same test conditions intraperitoneal dose of 30mg/kg of cyclophosphamide had a 52.5% suppression.

•

Effect on Hemorheology

The effects of the herb on the hemorheology of inflammatory, thrombotic and intact animals were examined. Oral administration of 200mg/kg of the 50% ethanolic extract of the herb inhibited the reduction of fibrinolytic activity and erythrocyte deformability, the decrease in erythrocyte counts and the increase in connective tissue of the thoracic artery in a chronic inflammatory model, adjuvant-induced arthritis.

•

Antiradiation effect

The 100% injection solution of the root given intraperitoneally at 1ml daily for 6 days mitigated platelet damage in rats caused by 600 rad of g-irradiation. The aqueous extract of the root inhibited in vitro fungi mentagrphyton, Microsporum gypseum and M. audouini. The decoction of the root showed protective effect in mice against CC14-caused liver intoxication. Oral or intraperitoneal administration of 10g/kg of the decoction or the alcoholic extract potentiated the hypnotic effect of pentobarbital sodium. Intraperitoneal dose of 20g/kg of the decoction or the alcoholic extract protected mice from hypobaric hypoxia.

Radio-support works better if it is started some time before the beginning of radiotherapy and continued for about six months after the end especially for radiotherapy in the abdominal cavity. It is important to note that 'during the treatment' means during the course of treatment, i.e. also in the days of break from the treatment. The dosage is as follows:

Two weeks before start of treatment: 2 tablets twice a day

Four days before the start of treatment: 2 tablets three times a day

During the treatment: 3-4 tablets three times a day

After the end of the treatment for about 6 months: 2 tablets three times a day

It is best to take the tablets away from meals. i.e. about 1 hour before or after a meal, swallowed with hot water. The tablets should also be taken separately from other medication, at least 1 hour away. If the patient feels very nauseous and finds it difficult to swallow the tablets, these could be crushed and powdered, immersed in a small amount of hot water with three slices of fresh ginger and the water sipped slowly.

The dosage during treatment indicated above should be adjusted according to the severity of the side-effects and the above dosage could be reduced or increased.

If the patient is receiving both radio- and chemo-therapy and is taking both Radio-Support and Chemo-Support, the dosage of each should be reduced. Adjustments can be made according to the patient's side-effects and timing of therapies in this situation by using a higher ratio of Radio-Support during days surrounding radiotherapy or when its side-effects are heightened. Similarly, the dosage of Chemo-Support can be increased if the side-effects experienced from chemotherapy are more severe, or during the days surrounding the administration of chemotherapy.

Radio-Support should be discontinued approximately six weeks after the end of the treatment when the condition should be reassessed and a different formula given to treat the condition underlying the original cancer.

Acupuncture used along side Radio-Support can further help to reduce the side-effects of radiotherapy. Furthermore, it has the additional advantage that it can be tailored to the specific side-effects of the individual patient. The following are suggested point combinations for specific symptoms and signs.

Fatigue

Ren-12 Zhongwan, ST-36 Zusanli, SP-6 Sanyinjiao, BL-20 Pishu, BL-21 Weishu.

Nausea and vomiting

Ren-13 Shangwan, P-6 Neiguan, ST-34 Lianqui, ST-36 Zusanli. In addition to acupuncture, the following massage technique is very effective to combat nausea and vomiting: apply a massage oil liberally to the lower legs, make a loose fist with your hands, starting from ST-36, massage downwards along the Stomach channel using the knuckles of the index fingers all the way down to the ankle and then massage upwards along the spleen channel using your thumbs. This technique harmonizes the ascending and descending of Stomach- and Spleen-Qi, stimulating Stomach-Qi to descend and Spleen-Qi to ascend.

Loss of appetite

ST-36 Zusanli, SP-6 Sanyinjiao, BL-20 Pishu, BL-21 Weishu, Ren-12 Zhongwan.

Loss of taste

ST-36 Zusanli, SP-6 Sanyinjiao, BL-20 Pishu, BL-21 Weishu, Ren-12 Zhongwan, L.I.-4 Hegu.

Diarrhoea

ST-25 Tianshu, ST-37 Shangjuxu

Stomatitis, mouth ulcers

ST-44 Neiting, L.I.-4 Hegu, L.I.-11 Quchi.

Metallic taste

LIV-2 Xingjian, LIV-3 Taichong, L.I.-4 Hegu, L.I.-11 Quchi, Ren-12 Zhongwan.

Alopecia

BL-17, Geshu (with direct moxa cones), BL-11 Dashu (with direct moxa cones), BL-20 Pishu, BL-23 Shenshu.

Cystitis

Ren-3 Zhongji, BL-63 Jinmen, BL-28 Pangguangshu, BL-32 Ciliao, SP-9 Yinlingquan.

Fever

L.I.-11 Quchi, KI-2 Rangu, Du-14 Dazhui.

Skin rash

L.I.-11 Quchi, SP-10 Xuehai.

Shortness of breath

LU-7 Lieque, LU-9 Taiyuan, BL-13 Feishu, Du-12 Shenzhu, BL-43 Gaohuangshu.

Difficulty in swallowing

Ren-23 Lianquan, L.I.-4 Hegu, LIV-3 Taichong.

BIBLIOGRAPHY

- Levitt S, Kahn F, Potish R, Perez C, **Technological Basis of Radiation Therapy**, Lippincott, Williams and Wilkins, Maryland 1992.
- Souhami R, Moxham J, **Textbook of Medicine**, Churchill Livingstone, Edinburgh, 1994.
- Zhu YP, **Chinese Materia Medica**, Harwood Academic Publishers, Amsterdam, 1998.
- Chang H.M. and But P.P. Hay, **Pharmacology and Applications of Chinese Materia Medica**, World Scientific, Hong Kong, Vols. I and II, 1986.