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血液透析技术中 多功能保护服的研发、创新与拓展

The Research, Innovation and Development of Multi Functional Protective Clothing for Hemodialysis

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摘要：

近年来，血液透析技术愈发普及，但笔者观察到，血液透析技术的相关护理工作有待完善。为减少患者痛苦、保护患者隐私、提高血液透析护理工作的效率，保障患者安全，笔者积极探索有效固定血液透析患者中心静脉导管、提高病患者身体素质的防护服。

在理论学习、文献研究的基础上，笔者理论联系实际，积极寻求临床观摩及实践机会，多次深入三甲医院，结合临床实际进行该课题的研究和调查，对该防护服进行深入完善。最终，研制出一种血液透析技术中囊括防止导管脱落、辅助治疗、预防尿毒症并发症等多功能防护服；并结合康复医学、护理学、高分子材料学及传统中医的精华，拓展到高血压患者的保健与理疗中，对此进行了专项的研究和探讨。

目前，该设计已投入临床试用，并得到广州、武汉两家三甲医院医患的好评；同时已被国家专利局受理，拟于 2016 年年底获得专利证书。

关键词：

血液透析,尿毒症, 高血压, 多功能,防护服

Title: The Research, innovation and Development of Multi-Functional Protective Clothing for Hem dialysis

Abstract:

In recent years, with hem dialysis being increasingly popular, in order to reduce the suffering of patients, protect patient privacy and to improve the efficiency of the treatment of hem dialysis, the author actively explore the effective methods to fix central venous catheter of the blood dialysis patients. We develop a kind of hem dialysis multifunctional protective clothing.

Based on theoretical study and document research, with the combination of theory and practice, the author actively entered the three-A hospital to practice for several times. Based on clinical research and investigation, under the guidance of some experts, the protective clothing was improved. Finally, a kind of multifunctional protective clothing with functions anti-falling of catheters, aid therapy and prevention of Uremic complications in hem dialysis is designed. Combined with rehabilitation medicine, nursing, polymer science in pharmaceuticals and essence of traditional Chinese medicine, the function have been extended to caring and curing of hypertension patients, to which special research is carried out.

This design has been on probation and clinical application, receiving great deal of support and compliment from the hospital. The Chinese Patent Office has already receipted the application and will send the certificate in December, 2016.

Key words: hem dialysis; uremia; hypertension; multi-function; protective clothing;

本参赛个人声明所提交的论文是在指导老师下进行的研究工作和取得的研究成果。尽本人所知, 除了文中特别加以标注和致谢中所罗列的内容以外, 论文中不包含其他人或本人已经发表或撰写过的研究成果。若有不实之处, 本人愿意承担一切相关责任。

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论文题目:

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论文正文:

引言

1. 课题研究的背景

1. Subject research background

终末期肾功能衰竭俗称尿毒症。尿毒症不是一个独立的疾病,而是各种晚期的肾脏病共有的临床综合征,是慢性肾功能衰竭进入终末阶段时出现的一系列临床表现所组成的综合征。

End-stage renal failure is commonly known as uremia which is not an independent disease but a common clinical syndrome of different kidney diseases and a syndrome of a series of clinical manifestation when chronic renal failure develops to ending stage.

血液透析(Hem dialysis),简称血透,通俗的说法也称之为人工肾、洗肾,是血液净化技术的一种,利用仪器和设备,将患者的血液引出体外,经过一定程序清除体内某些代谢废物或有毒物质,再将血液引回体内的过程^[1]。维持性血液透析(下称血透)是救治终末期肾功能衰竭(尿毒症)患者一种长期安全有效的替代方法^[2]。

近年来,随着血液透析技术的发展,许多病患者迎来了希望。笔者在医院探望正在接受血透治疗的亲友时,发现血透护理的过程中存在需要改进的地方,笔者查询了大量文献资料,通过请教专业人士,再结合到医院的社会实践,对血液透析技术的护理,主要是血透导管维护与固定提出自己的设想,研发出一套结构简单、操作便捷、易于换药、能有效防止患者导管滑脱发生的新型多功能保护服。

Hem dialysis, referred to as HD, a common phrase that is called the artificial kidney, kidney dialysis, is one of the types of blood purification technology, using instruments and equipment to lead to patients with blood in vitro, and then, lead back to the body after a certain process to remove the body of certain metabolic waste or toxic substances^[1]. Maintenance hem dialysis is a safe, effective and alternative method for the treatment of end-stage renal failure (uremia) patients^[2].

In recent years, with the development of hem dialysis technology, many patients have the hope. The author found that the process of hem dialysis care needs to be improved when she visited some relatives and friends who were receiving hem dialysis treatment in the hospital. By requiring the massive literature material, consulting professional for guide and combining social practice in hospitals, the author put forward his own idea of nursing care for hem dialysis technology, mainly

the hem dialysis catheter maintained and fixed, then developed a new type of multi-functional protective clothing, a set of simple structure, convenient operation and easy to change medicine so that patients can effectively prevent catheter slippage happened.

2. 存在问题

2. Existing problems

2.1. 普通病号服现状

2.1. General hospital gown

2.1.1. 易着凉且暴露隐私

2.1.1. Easy to catch a cold and expose the privacy

目前, 医院广泛使用的普通病号服与家居服类似, 按照常规设计, 全身均是完整的布料, 没有开口或留活瓣, 每次检查时都必须脱掉病号服, 裸露出胸背部。这样做的弊端如下: 一是脱、穿浪费时间, 且易着凉; 二是容易绊到身上的其他装置, 如置留针头等; 三是会暴露隐私。

Ordinary patient clothing is like household to take. Every time check, patients must be off his hospital gown, exposing bare chest and back. To do that, the first is a waste of time being off and wear, and easy to catch a cold; second is easy to stumble the other device of to the body, such as puncture needle; the third is exposing the privacy.

2.1.2. 压迫血管通路

2.1.2 Pressure vessel access

尿毒症患者穿着普通病号服, 要将袖子挽至肘关节处, 堆积的袖管会造成对血管通路的压迫^[3]。因为导管没有和肢体连在一起, 所以患者在翻身或移动肢体的同时, 可能会压到导管, 从而影响血管通路。

Patients who have uremia are dressed in ordinary patient service, with the sleeves being rolled up to the elbow joint. So the accumulation of the sleeve will cause compression of vascular access ^[3]. Because the catheter is not connected to the body, the patient may be pressed to the catheter while turning over or moving the body, thereby affecting the vascular access.

2.1.3. 导管及穿刺针易脱落, 严重者可危及生命

2.1.3 Catheter and the puncture needle is easy to fall off and can endanger life sometime.

患者可能会因为肢体挪动、不可控性的肌肉抽搐等原因, 不小心移动导管, 导致导管松动或脱落, 不仅会影响正常血透, 再次穿管还会增加患者痛苦及经济负担。

Because of the body moving, uncontrollable muscle twitching and other reason, patients may move catheter accidentally, leading catheter loose or fall off and will not only affect the normal hem dialysis, but also again put tube of increasing patients' pain and economic burden.

牵拉导管, 会导致穿刺针脱落。多数危重患者因经常更换体位, 或者突然出现低钠、低血压、手无意识抽动, 致动静脉穿刺针脱落而造成渗血、血肿等穿刺并发症, 给患者带来极大的痛苦和恐惧, 并且增加医护人员的工作量^[3]。由于导管脱落而导致不能及时做血透, 严重者还可能影响患者生命。

Pulling the catheter can lead to the puncture needle fall off. Most critically ill patients often changing posture, or the sudden appearance of a low sodium, hypotension and in tic cause dynamic venous puncture needle off and bleeding and hematoma complications, bring great pain and fear to patients and increase the workload of medical care staff. Due to the catheter off and the patients not being timely to do hem dialysis, severe cases may also affect the life of patients.

2.2. 个别新设计的血透病员服:

2.2. Individual New Design of Hem dialysis patient clothes

2.2.1. 此类病员服设计的信息极少

2.2.1 Such patient clothing design has very little information

笔者在医院中发现了上述问题后, 通过到图书馆查阅有关专业书籍以及上网搜索的方式, 试图寻找相关血透病员服, 尤其是防止血透导管脱落保护服的有关资料, 仅查到了极少数的血透病员保护服的信息, 且极少此类产品临床应用文献, 更没有查到防止血透导管脱落保护服的任何信息。

After finding the problem in the hospital, through consulting relevant professional books in the library and on Internet, trying to find related information of hem dialysis patient clothes, especially the relevant materials to prevent hem dialysis catheter protective clothing fall off, the author learn a little information of the hem dialysis patient protective clothing and there is almost no this kind of product literature particularly any information of preventing hem dialysis catheter protective clothing falling off.

2.2.2. 现有的血透病员防护服存在缺陷

2.2.2. The existing defects of hem dialysis patient protective clothing

在笔者找到的防护服中, 都只是设计了活动开口, 可避免患者着凉或暴露隐私, 但对防止导管脱落的这一最重要的功能却没有在防护服的设计中阐述。总体设计功能单一, 也不具有检测体温、增强免疫力等功能。当然, 他们的设计是迈出了从无到有的第一步, 而且都是从医务人员的角度, 加以临床的调查、实验得出的设计, 值得本人学习借鉴。

The several kinds of protective clothing that the author found, which were designed some values, can avoid catching cold or exposing patients' privacy. But for the most important function to prevent catheter loss, it is not described in the design of protective clothing. The overall design, being a single function, does not have the detection of body temperature, enhance immunity or other functions. Of course, their design is taken out of the first step, but also from the perspective of medical personnel, to be a clinical investigation, experimental design, it is worth learning from.

3、 研究意义

3. Research significance

综上所述, 有关此类血透病员服设计的信息极少, 现有的血透病员防护服又存在缺陷, 可见, 设计研究一套结构简单、操作便捷、易于换药、能有效防止患者导管滑脱等情况发生的新型多功能防护服非常必要。

According to the above situation, these kinds of hem dialysis patient protection clothing design have very little information and the existing have many defects. Visible, it is very necessary to research and design a set of simple structure, convenient operation, easy dressing, effectively prevent the occurrence of catheter slippage of novel multi-functional protective clothing.

研发设计

Research and Development

1、 设计方法

1. Experimental Methods

发现现存问题后, 下一步便是严谨的研发设计环节。本项目致力于研发一种适用于血液透析技术的多功能防护服。它需要在-件轻巧的病号服上尽可能多的满足患者的治疗需要, 已达到“多功能”的要求。所以, 这绝对不等于看什么东西有用处就直接加到我的防护服上, 而是需要从尿毒症患者的特殊需求出发, 在查阅大量医学资料, 并根据专业医护人员的建议, 结合或者病情后, 综合得出的设计方案。

本次防护服的研发过程主要运用文献法、实验法和观察法。总体来说, 是通过查找文献、询问专家、前往医院临床观摩等途径, 了解患者接受血液透析全过程中的生理需求、心理需求以及潜在的安全隐患, 从而设计出与患者需求相适应的保护装置, 并集合于一件防护服上。

设计-件拥有很多配件的防护服并不算很难, 但多而无用便使它的价值大打折扣, 而且还会增加患者的经济成本。因此该防护服要在轻便、经济的基础上实现多功能, 这便需要缜密周全的思维, 全方位地考虑问题, 并加以实际实验。

After finding existing problems, the next step is rigorous experiment. The experiment aims to develop a kind of multifunctional protective clothing. It needs to be light enough for treatment. However, it does not mean that any useful function is applied to our protective clothing. It should be based on the special requirements of uremia patients. In accordance with massive amounts of medical data and suggestions from medical workers, a design program is completed.

It is not too difficult to design protective clothing with a lot of parts, while the value will be reduced due to its useless functions which increase the cost for patients. Therefore, protective clothing should design with multi-functions based on convenience and economical. It needs careful thought in all directions and practice.

1.2. 材料选择

1.2. Material selection

1.2.1. 棉布

笔者考虑到棉布不易引起过敏, 而且质感舒适柔软, 所以首先想到选择棉布缝制-短袖防护服, 试穿后棉布没有弹性, 操作不便, 此材料被否定。

1.2.1 Cotton

The author considers that the cotton is not easy to cause allergies, and the texture is soft and comfortable, so the first thought is to choose cotton sewing short sleeved protective clothing. After trying on cotton, which is not flexible and inconvenient operation, so I have to find another material.

1.2.2. 高弹化纤布

笔者又考虑到化纤布料结实耐用, 同时易打理, 具有抗皱免烫特性, 所以把设想改为高弹化纤布料。但在找到此种布料的衣服试穿后, 由于不透气, 感觉不舒适, 此材料再次被否定。

1.2.2. High elastic fiber cloth

The author considers that chemical fiber fabric is durable, also easy to take care of and has the anti crease property, so the idea is changed into a high elastic fiber fabric. But after trying on, because of airtight, the feeling is not comfortable, this material is denied again.

1.2.3. 高弹纯棉布

笔者结合之前两次材料选择中的经验教训, 在询问了医院病房的护士长后, 改为用高弹纯棉布料制作短袖防护服。试穿后面料的伸缩自如且与皮肤接触面舒适、透气, 既增加患者舒适感; 同时, 此种布料变形性不会太强, 符合防脱落防护服的需求, 能有效固定颈部、锁骨下导管。

1.2.3. High elastic pure cotton cloth

The author combines the experience and lessons in the choice of two materials before and consult professional personage. Finally, I decided to use high elastic cotton cloth to make short sleeved protective clothing. After trying on, this material is fabrics and comfortable, breathable, both increasing patient comfort; At the same time, the elastic effect of this kind cloth is meeting the needs of anti-shedding protective clothing and can effectively fixed neck, subclavian catheters.

1.3. 制作活瓣

为了减少患者穿脱衣服, 便于护士维护导管, 设计在胸口部开设活瓣, 安装拉链。护士操作时, 直接拉开拉链, 打开活瓣, 不仅方便操作, 还可以保护患者隐私, 避免患者受凉。

1.3. Make flapper

In order to reduce the patients wearing clothes and off, and easy to be observed and maintained, the author design a valve in the chest part, install zip. When operating, the nurse can pull zipper and open the valve directly, it is not only having the

advantages of convenient operation, also protecting the privacy of the patient and avoiding catching cold in the patients.

1.4. 添加固定装置

为了防止中心静脉置管滑脱, 设计固定材料。

选择缝制 2 条布条, 将导管绑住以固定, 实验后发现布条绑得过松, 不容易使导管固定牢, 绑得过紧又易压迫血管通路。此方案调整。

参照家用吸盘原理, 设计在衣服内导管经过的部位安装吸盘, 将导管吸住, 不仅能妥善地保护导管, 而且还使导管固定得很牢固。

1.4. Add a fixed device

In order to prevent the central venous catheter slipping, it is important to design the fixed material.

Select the sewing 2 strips of cloth and tie catheter to be fixed, after the experiment, it is found cloth being tied too loosely and not easy to make the firm fixation of the catheter. Also when tied too tightly, it is easy to compress the vessel. This program needs to be adjusted.

Referring to the principle of household suction cups, fix a suction cup on the position of the catheter through the garment, suck the catheter. It is not only can protect the catheter properly, but also can make the catheter fixed strongly.

1.5. 添加其他装备

1.5. Add other equipments

1.5.1. 透气孔

尿毒症患者因为自身肾功能缺陷, 无法通过泌尿排毒, 此时, 身体机能中排出废物的另一途径——汗液就更为重要。若衣物透气性不佳, 便会导致衣物内部增温、汗液蒸发受抑制, 从而堵塞毛细孔、排毒减少, 严重者会引起身体局部红疹。同时, 尿毒症患者会伴有发热的现象。所以, 设计在保护服上开透气孔, 以增强衣物的散热性、利于出汗排毒。

1.5.1. Vent

Because of renal defects, Uremic patients have the urinary detoxification, at this time, another way of body function in discharge waste, the sweat, is more important. If the clothes is poor permeability, it will lead to laundry increased temperature and evaporation of sweat is suppressed, thereby clogging pores, detoxification reduced and serious cases inducing a partial body rash. Therefore, design to open the vent on the protective clothing, in order to enhance the heat dissipation of clothing and being conducive to sweating detoxification.

1.5.2. 体温计

尿毒症患者经常需要测量体温, 为防止量体温时体温计滑落, 容易造成玻璃破碎和水银中毒等危害。在该防护服的上臂缝制一个放体温卡的袋子, 根据需要测量体温, 不需要测量时患者可取下, 不影响治疗与生活, 具有安全、环保、实用、价廉的优点。

1.5.2. Thermometer

Uremic patients often need to measure the body temperature, in order to prevent the amount of body temperature fall off; it is easy to cause damage to glass and mercury poisoning. Sew a discharge temperature card bag In the upper arm of protective clothing, according to the needs of temperature measurement that does not require the measurement in patients with removable, it is does not affect the treatment and life, so has the advantages of safety, environmental protection, utility, low cost.

1.5.3. 托玛琳石

尿毒症患者由于长期电解质紊乱, 导致营养失调, 抵抗力下降。需设计添加一种可以增加患者抵抗力的产品增添在该防护服中, 通过比对筛选, 最后选择托玛琳石。

托玛琳石是一种天然宝石, 在矿物学中称为电气石。电气石可以发出波长为 $4 \sim 14 \mu\text{m}$ 的远红外电磁波辐射, 能够使生物组织温度升高, 细胞的通透性、生物电、胶体状态^[4]、酸碱度、酶系统发生改变; 利用电气石永久带电性能电解水, 生成羟离子 (H_3O^-), 羟离子具有表面活性作用(可使人体油份经过乳化、浸透、分散、溶化等过程最终分解)、还原作用(中和酸性物质)、吸附作用^[5](吸附一些重金属离子)、清洁作用(抗菌、灭菌)、除臭^[6]等; 它还可以加快血流速度, 抑制不饱和脂肪酸的过氧化, 改善微循环, 提高免疫力^[7]。

1.5.3. Tourmaline stone

Due to long-term electrolyte disorder, patients with uremia will have nutritional imbalance and resistance to decline. Add a product, which can improve the patients' resistance in the protective clothing, by comparing screening, finally chose ms tomalin stone.

Ms tomalin stone is a natural gem, known as tourmaline in mineralogy. Tourmaline can emit wavelength of $4 \sim 14$ microns of far infrared electromagnetic wave radiation, which can make the temperature rise of biological tissue and change cell permeability, bioelectricity and colloidal state^[4], ph value and enzyme system. Using properties of tourmaline permanently charged water electrolysis to generate hydroxyl ions (H_3O^-), hydroxyl ions with surfactant (can make human body oil samples by emulsification, soaked, dispersing and dissolving process decomposition), reduction (to neutralize acid), (adsorption some heavy metal ions), clean^[5]

(antibacterial, sterilization), deodorization, adsorption^[6]. It can also speed up the blood flow rate, inhibit the oxidation of unsaturated fatty acids and improve microcirculation the immune system^[7].

1.5.4. 粘扣式高领设计

领部采用粘扣式高领设计, 保护经颈静脉置管的中心静脉导管, 避免发生患者意识不清或睡眠中无意识将导管拔出, 粘扣方便观察和换药, 同时不会因为拉链划伤患者皮肤。

1.5.4. Velcro collar design

Design collar in sticking buckle type high collar, protect tube of central venous catheter via jugular vein catheter, avoid occurrence of patient unconscious or sleep pulling out the pipe unconsciously. It is convenient for observation and dressing gluing, also won't scratch the skin of a patient because of the zipper.

1.5.5. 短袖设计

部分前臂有造瘘管、人造血管的患者血透时需要露出胳膊, 患者会将长袖挽至肘关节处, 堆积的袖管容易造成对血管通路的压迫, 短袖设计可以避免上述问题。

1.5.5. Short sleeve design

Part of the forearm have fistula and artificial vascular graft, hemodialysis patients need to bare arms, with sleeves rolled to the elbow joint long time and the accumulation of sleeves easily lead to the oppression of vascular access, so short sleeved design can avoid these problems.

2. 设计验结果

2. Results

2.2. 产品设计图初稿

如图 1 所示包括: 连接设置的领口部 (1)、胸口部 (2)、肩部 (3) 和袖子部 (4); 胸口部 (2) 设有用于覆盖中心静脉置管的可揭开活动瓣 (5)。此外还有: 魔术贴 (6)、口袋 (7, 图 1 中未标出)、吸盘 (8)、透气孔 (9)、托玛琳石 (10) 和体温卡 (11)。

2.2. Product design

As Figure 1 shows include: equipped with connected and arranged on the collar part (1), chest part (2), shoulder (3) and the sleeve portion (4); chest part (2) for covering the subclavian hemodialysis catheter placement can be opened movable petal (5). In addition to: Velcro (6), pocket (7, Fig1 not marked), sucker (8), breathable hole

(9), tourmaline stones (10) and body temperature card (11).

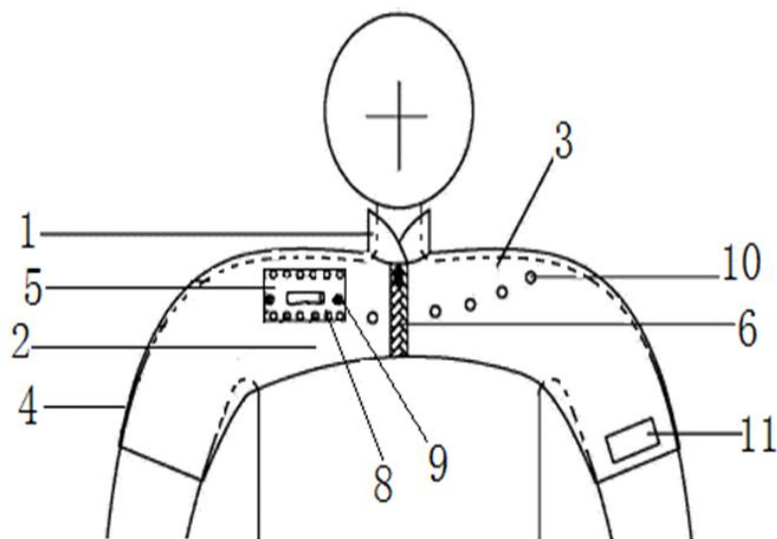


图 1 中心静脉导管防护服设计

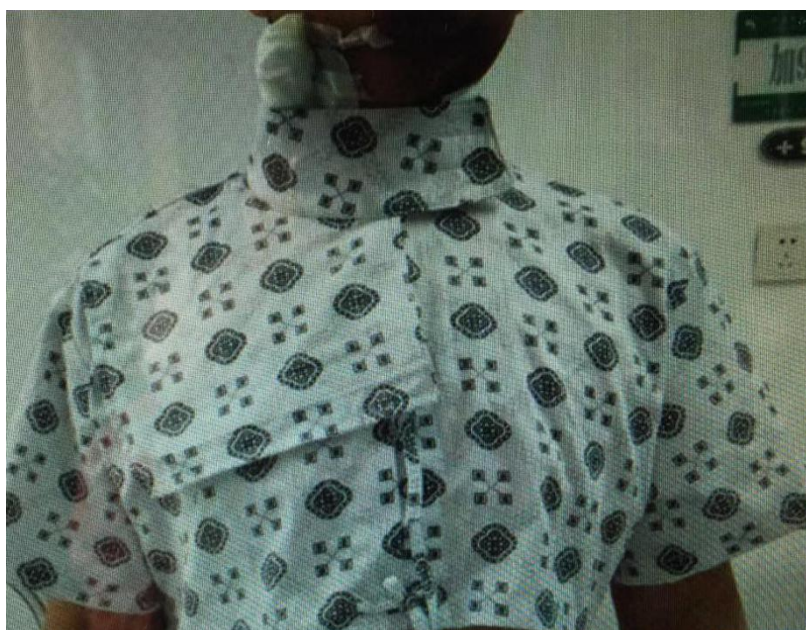


图 2 某患者正在使用初代防护服

3. 改进

3. Improvement

根据专家们的建议和临床实验的结果, 修改意见如下:

In accordance with the advice of experts and clinical experiment result, the suggestions on revision are as following:

3.1. 细节修改

由于患者反映拉链容易硌到皮肤, 便改为使用布条控制保护服的闭合(详见第二、三版防护服实物图)。但后期由于布条不美观、不方便, 将其改为纽扣。



图 3 作者答辩中穿着第二代防护服演示



图 4 作者展示第三代防护服

3.1 Detail changing

According to the feedbacks from patients that zipper will hurt their skin, so I use some soft strings instead to control the on and off of the clothes (As Fig3, Fig4). However, we found that the strings are not convenient or in aesthetic, so we changed them into buttons.

3.2. 增加不同款式

3.2. Different versions

防护服目前采用粘扣式高领设计, 优点上文已经阐述。但考虑到, 患者遍布全国各地, 且不同季节间的气温差异也较大, 所以设计出了长袖版、短袖版、高领版、无领口版的防护服。

A magic stick-high collar is designed for the current protective clothing. The advantages have been explained in the above. However, the patients lived in different regions where there are large temperature differences in different seasons; therefore, different styles with long sleeves, short sleeves, high collar and non-collar are designed.

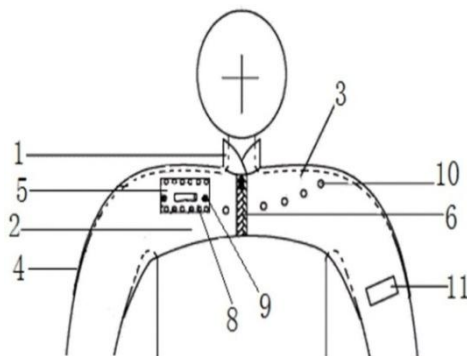


图 2 长袖版本

Diagram 2 Long sleeve version

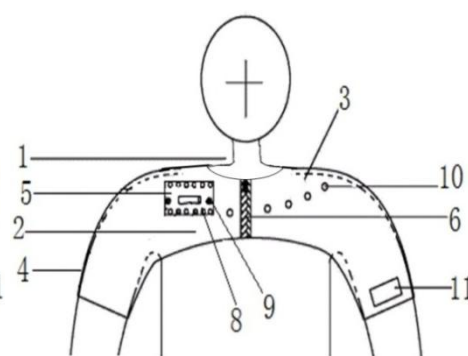


图 3 无领口版本

Diagram 3 Non-collar version

在临床试用的过程中, 作者发现, 本设计还可以适宜所有需要留置导管的患者使用, 如留置静脉港、CVC、PICC、胸腔闭式引流管等。拓展了使用范围, 有效避免各类导管滑脱。

In the probation term, I discovered that this design could be applied in almost every treatment which related to the catheters, including VPAC (Venous Port Access System), CVC (Central Venous Catheter), PICC (Peripherally Inserted Central Catheter), closed drainage of thoracic cavity and so on. As the application scope becoming larger, more medical incidents could be avoided.

最终, 第四代防护服问世。与先前的版本相比, 由于接受血透的患者多为门诊病人, 本版本的防护服采用了普通衬衣的外观, 他们可直接穿着防护服来回于家和医院, 不必二次更衣; 同时, 在正面两个口袋的内侧缝上托玛琳石, 既隐蔽了矿石包的肿胀感, 又能放置物品; 两臂内侧开有拉链, 拉开后可适用于各种前臂静脉输液的穿刺、观察与护理, 如 PICC、静脉留置针、输液钢针。



图 5 第四代防护服结构解析

临床研究与应用

Clinical research and application

1. 临床研究资料

1. Clinical research data

1.1. 研究场地及概况

1.1 Research field and overview

本创新产品前期在某三甲医院 A 进行临床试用。由于笔者学生的身份, 本次试用前后共分为了三段进行, 第一段于 2015 年暑假, 第二段 2015 年的十一长假, 第三阶段是 2016 年寒假, 为对本设计改进后的补充实验; 后期, 患者满意度较高, 数据结果与前期的实验数据近似, 所以只进行了保护服的穿戴与满意度的简单调查, 没有继续进行详细的数据统计。

在结合临床试用过程中患者和医护人员等专家的意见和建议, 笔者先后改进了数次防护服, 并在本设计取得较好反响后, 前往某三甲医院 B 试用, 再度收获好评和部分改良意见。

The innovative product is in clinical trial in Hospital A. As a student, I can only spend holidays studying in the hospital. I went to the hospital respectively in the summer holiday in 2015, the National Day holiday in 2015 and the winter holiday in 2016. After the experiment of the first and the second stage, a supplementary experiment for improving. Patients were satisfied with the clothing at the later stage. Data result was approximate to the experimental data at the early stage. A questionnaire was conducted on wearing, while no detailed data statistics was carried out.

After accepted the suggestion from patients and experts such as medical care staffs, the author improved this design for a couple of times, which received favorable comments and then was on probation in Hospital B earning a great deal of positive comments as well as some advices again.

在本论文中, 笔者将呈现临床试用的研究对象、方法、试用结果以及结论分析与讨论。

In this paper, the research object, method, test results and conclusion are presented.

1.2. 研究对象

1.2 Research object

以临床试用的第一阶段为例, 将医院 2015 年 7 月至 8 月中, 在院治疗的 40 名血透带管患者随机分组, 对照组 20 名, 其中男 9 名, 女 11 名, 年龄 42—76

岁。实验组 20 名, 其中男 12 名, 女 8 名。年龄 41—77 岁。两组患者一般资料比较, 差异无统计学意义($P>0.05$), 具有可比性。

Take the first stage of clinical experiment for example, 40 patients who have hemodialysis in this hospital during July to half of August 2015 were divided into control group (20 patients including 9 male patients and 11 female patients, in 42-76 years old) and experimental group (20 patients including 12 male patients and 8 female patients in 41-77 years old). Data of the two groups are compared and the difference does not has statistical significance ($P>0.05$) with comparability.

2. 临床研究方法

2. Clinical research methods

2.1 分别对两组患者进行导管维护平均耗时、穿防护服满意度(%)以及导管滑脱例次三项指标观察记录。

2.1 Record the average time for tube maintenance, satisfaction with protective clothing and case times of tube slip to the two groups.

2.2 两组患者均记录进行导管维护所耗时间, 其中实验组患者穿血液透析导管防护服, 对照组患者穿普通病员服; 两组均从患者解开衣服开始计时, 到护士维护完导管患者穿好衣服停止。

2.2 The time for tube maintenance of the two groups are recorded. The experimental group wore Hemodialysis catheter protective clothing while the control group wore ordinary patient gown. It started the timer from the patients unfastened their patient gowns until they put on their clothes with help of nurses.

2.3 在完成一次血液透析后, 为两组患者发放穿防护服满意度调查表, 统计平均满意度。

2.3 After one hemodialysis, the questionnaires are distributed to the patients to record the average degree of satisfaction.

2.4 同时, 对血透导管脱管例次进行统计。

2.4 In the meantime, case times of tube slip were recorded.



图 5 护士正在为本次实验组某患者进行导管维护



图 6 作者与护士在医院 B 进行临床观察

3. 临床研究结果

3. Clinical research result

3.1. 对照组具体统计结果

编号	年龄	性别	导管维护时间 (秒)	满意度 (%)	脱管例次
1	68	男	394	88	0
2	70	女	404	88	0
3	44	女	288	95	0
4	57	男	356	99	0
5	53	女	345	96	0
6	46	女	298	89	0
7	47	女	303	92	0
8	72	男	416	90	1
9	53	男	340	89	0
10	48	男	301	99	0
11	76	男	421	94	1
12	64	女	378	99	0
13	73	女	415	96	0

14	57	男	346	93	0
15	64	女	389	92	0
16	70	男	412	92	0
17	57	男	387	91	0
18	64	女	387	96	0
19	44	女	280	97	0
20	42	女	277	96	0
平均值			356.85	93.55	脱管总次 2 次

3.1 Statistical result of the control group

NO.	Age	Sex	Time of tube maintenance (s)	Satisfaction (%)	Case times of tube slip
1	68	Male	394	88	0
2	70	Female	404	88	0
3	44	Female	288	95	0
4	57	Male	356	99	0
5	53	Female	345	96	0
6	46	Female	298	89	0
7	47	Female	303	92	0
8	72	Male	416	90	1
9	53	Male	340	89	0
10	48	Male	301	99	0
11	76	Male	421	94	1
12	64	Female	378	99	0
13	73	Female	415	96	0
14	57	Male	346	93	0
15	64	Female	389	92	0
16	70	Male	412	92	0
17	57	Male	387	91	0
18	64	Female	387	96	0
19	44	Female	280	97	0
20	42	Female	277	96	0
Average			356.85	93.55	Total:2

3.2. 实验组具体统计结果

编号	年龄	性别	导管维护时间 (秒)	满意度 (%)	脱管例次
1	71	男	245	96	0
2	70	女	244	96	0
3	55	女	200	100	0
4	62	男	212	99	0
5	76	女	244	96	0
6	52	女	201	100	0
7	63	女	214	100	0
8	72	男	235	95	0
9	67	男	223	94	0
10	62	男	213	99	0
11	42	男	183	100	0
12	57	女	199	100	0
13	41	女	181	100	0
14	56	男	212	95	0
15	58	女	215	95	0
16	76	男	235	97	0
17	77	男	239	96	0
18	66	女	234	95	0
19	67	女	237	93	0
20	57	女	201	100	0
平均值			218.35	97.3	脱管总次 0 次

3.2. Statistical result of the experimental group

NO.	Age	Sex	Time of tube maintenance(s)	Satisfaction (%)	Case times of tube slip
1	71	Male	245	96	0
2	70	Female	244	96	0
3	55	Female	200	100	0
4	62	Male	212	99	0
5	76	Female	244	96	0
6	52	Female	201	100	0
7	63	Female	214	100	0
8	72	Male	235	95	0
9	67	Male	223	94	0
10	62	Male	213	99	0
11	42	Male	183	100	0
12	57	Female	199	100	0
13	41	Female	181	100	0
14	56	Male	212	95	0
15	58	Female	215	95	0

16	76	Male	235	97	0
17	77	Male	239	96	0
18	66	Female	234	95	0
19	67	Female	237	93	0
20	57	Female	201	100	0
Average			218.35	97.3	Total:0

3.3. 对照总结

组别	导管维护平均耗时(秒)	穿防护服满意度(%)	导管滑脱例次
对照组 (n=20)	356.85	93.55	2
实验组 (n=20)	218.35	97.30	0

3.3. Summary of comparison

Group	Time of tube Maintenance(s)	Satisfaction of wearing protective clothing(%)	Case times of tube slip
Control group (n=20)	356.85	93.55	2
Experimental group (n=20)	218.35	97.3	0

4. 研究意义

4. Significance of design

4.1 优点

4.1 Advantages

4.1.1 本设计实用创新、结构简单，采用弹力棉等原料制成，成本低廉。

4.1.1As this design is practical with simple structure, elastic cotton can be used for raw material to reduce the manufacturing costs. It's highly cost-effective.

4.1.2.本防护服中设置有活瓣，在护士观察导管穿刺部位或换药时，揭开活瓣便于操作，使病患者接受一次血液透析的总时长大大缩短。特别是对于较年老的患者，脱衣服时动作缓慢，使用本设计大大提升了速度。

4.1.2 Valves are designed in this protective clothing so that nurses can open the valves to check the puncture position or change fresh dressing to greatly shorten the duration of one hemodialysis. Especially for elder patients who move slowly when taking off clothes, the design increased the speed of taking off clothes.

4.1.3.本设计避免了不必要的身体暴露，保护患者的隐私。

4.1.3 This design avoids unnecessary body exposure and protected the privacy of patients.

4.1.4.血透导管防脱管保护服棉质面料，一方面富有弹性，患者普遍反应比较舒适；另一方面，使皮肤接触面舒适、透气增加患者舒适感。

4.1.4 The cotton fabric is highly elastic and breathable thus most patients said contact surface to skin was comfortable.

4.1.5.不少实验组的患者反映，由于使用了保护服，睡觉时便可不必担心自己误碰导管，终于能够睡个安稳觉了。

4.1.5.Many patients of experimental group said that due to protective clothing they were not worried to touch the tube accidentally when they slept and they were able to get a good night's sleep.

4.2 意义

4.2 Signification

通过笔者假期在医院期间的短暂观察，以及该医院护理部专业人士的反馈情况，患者对此设计的满意度比较高，而且，其确实简化了护士的护理工作、提高效率，同时又减轻患者痛苦、并能给予他们人文关怀。总体来说，已达到笔者研究的初衷。

Based on the observation in the hospital and feedback from the head nurse of general internal medical department in this hospital, the device got high satisfaction from patients. In addition, the device simplified the nursing work, increased efficiency and alleviated the suffering of patients with psychological support. In general, the device realized the original intention of the author.



图 7 人文关怀：作者为患者穿上第三代保护服

4.3 外界评价与认可

4.3 Comments and recognize

本设计得到专业领域的认可和肯定, 比如: “国际青年创新大赛”、“亚洲生物医学未来领袖大赛”, 其中, 在“亚洲生物医学未来领袖大赛”中, 我有幸受教于一位医学方面的知名专家——美籍教授、博士生导师赖恩茵教授, 从事分子医学的他也曾经对高血压治疗有过研究, 因此赖教授给了我一些专业的修改意见。

The design has gotten recognition and affirmation of multiple high level competitions such as “International Youth Innovation Competition” “Future Leader of Asian Biomedicine” in which I was lucky to be taught by a famous medical expert——American professor, doctoral tutor Lai Enyin who has engaged in molecular medicine. He has researched hypertension and he sent me some modification suggestions.

2016年7月, 我有幸在全球的竞争者中脱颖而出, 参选耶鲁大学全球青年学者项目 (the 2016 Yale Young Global Scholars Program) 的生物和生物医学科学专业学习。在耶鲁课堂 Capstone Project 的讨论上, 我做了本设计的分享与交流, 本设计的创新性和实用性得到了耶鲁生物学专家教授及参加 YYGS 的青年学生们的认可和赞扬。回国后, 我立即展开专利的申报工作, 国家专利局已正式受理, 将于 2016 年年底获得“实用新型国家专利”。

In the summer holiday in 2016, I fortunately passed through the international competition and participated in learning Biology and Biomedical Science Sessions of the 2016 Yale Young Global Scholars Program. I shared this issue on the Capstone Project in Yale, and gained a great deal of compliment and support of experts, professors and other participates. This encourages me to apply for patent as soon as I came back to China. The Chinese Patent Office has already receipted my application and will send me the certificate in December, 2016.

拓展与创新

Development and Innovation

在设计制作本产品的过程中, 笔者了解到不同类型的血液透析方案和血透过程中可能会发生的多种并发症, 这些都需要去进行更深入的研究, 才能针对问题, 改善保护服的性能, 提高疗效。

During designing and producing the product, the author learned various complications of different kinds of hem dialysis schemes and different processes of hem dialysis, which need further researches so that the protective clothing can be improved accordingly.

初步的成功激发了我更有信心地投入到继续深入的研究中, 以后我会结合传统中医精粹及当代先进的保健学、护理学知识, 从提高疗效及并综合治疗并发症的方面, 进一步对产品进行改进。

Due to the preliminary success I became more confident to devote myself to deep research. In the future, I will improve the product in terms of improving the efficacy and treating the complications based on the essence of traditional Chinese medicine and modern hygienic and nursing knowledge.

1. 预防并发症: 皮肤瘙痒

1. Prevent complications: Skin itch

笔者从临床经验丰富的护士那里了解到, 皮肤瘙痒也是常见并发症之一。尿毒症患者体内的尿素随汗液排出沉积于皮肤, 或继发性甲旁亢钙沉积于皮肤, 导致皮肤顽固性瘙痒, 透析常不能改善。另外, 尿毒症毒素能使患者皮肤汗腺、皮脂腺萎缩, 从而使毒素在皮肤沉积, 刺激皮肤产生瘙痒; 若病情严重, 血中毒素浓度较高, 势必会从皮肤排出, 形成尿素霜对皮肤产生刺激。我将继续在市面上寻找新型面料或透气设计, 改善患者的皮肤健康状态。

According to nurses of the nursing department, skin itch is one of common complications. Urea was excreted with sweat and deposited on the skin. Secondary hyperparathyroidism was also deposited on the skin resulting in refractory skin itch which is difficult to improve with dialysis. In addition, uremia toxin makes the sweat gland and sebaceous gland atrophy and the toxin will deposit on the skin to stimulate the skin to itch. If it became severe, the toxin will be definitely excreted from the skin in high concentration to form urea frost which will stimulate the skin. I will continuously seek new-type shell or breathable fabric to improve the health of the patients' skin.

2. 拓展：治疗高血压

2 Development: treatment of hypertension

2.1. 研究背景

2.1 Research background

2.1.1. 高血压现状

2.1.1 Current situation of hypertension

高血压指异常的血压升高，收缩压小于等于 140mmHg，舒张压大于等于 90mmHg^[9]。

Hypertension refers to abnormal elevation of blood pressure with systolic pressure less than or equal to 140mmHg and diastolic pressure great than or equal to 90mmHg^[9].

高血压是导致全球疾病负担的主要危险因素，2010 年高血压所致伤残调整寿命年(DALYs)占 7%，居所有危险因素的首位^[10]。全球每年至少有 760 万人死于高血压相关的心血管疾病，占全死因死亡的 13.5%^[11]。由此，可以观察得出，高血压是常见而且危害性较大的疾病。在我国，心血管病死亡居城乡居民总死因的首位，而其中,超半数的心血管病死亡都与高血压有关^[12-13]。所以，为高血压患者创造更好的治疗条件与途径，是十分重要的。

Hypertension is a key dangerous factor of global disease burden. Disability adjusted life year (DALYs)resulted by hypertension in 2010 accounted for 7% which occupied first place of all dangerous factors^[10]. Every year, at least 7.6 million people die from cardiovascular disease related to hypertension in the world, which accounts for 13.5% of the all-cause mortality^[11]. Therefore, it can be drawn that hypertension is a common disease but harmful disease. In China, death from cardiovascular disease stands for the first of all causes of death in urban and rural residents. In addition, more than half deaths of cardiovascular disease are related to hypertension^[12-13]. Therefore, it is important to create better treatment condition and approaches.

而对于现阶段的高血压治疗方法，多为药物治疗。鉴于笔者已研制出一套比较成功的保护服，所以，能否将高血压的相关治疗理念也融合进服装设计中，让病人在没有痛感、不必服药的情况下接受治疗，或许健康的心理还能使治疗事半功倍。

Most treatment for hypertension is drug therapy. As the author has developed an effective protective clothing, it will get double the results with integration of treatment of hypertension so that patients can receive treatment without pain and oral drug under healthy state.

2.1.2 个性化治疗理念

2.1.2 Concept of personalized medicine

个性化医疗 (Personalized Medicine), 又称精准医疗, 是指以个人基因组信息为基础, 结合蛋白质组, 代谢组等相关内环境信息, 为患者量身设计出最佳治疗方案, 以期达到治疗效果最大化和副作用最小化的一门定制医疗模式。Personalized medicine is called Precision Medicine which refers to the customized therapeutic schedule based on personal genomic information, combined with internal environment information of proteome and metabolite to realize the customized medical mode with maximum treatment effect and minimum side effect.

据调查,1990年中国有聋哑儿童一百八十二万多人, 其中因滥用抗生素而引起药物中毒性耳聋的患儿就有逾百万之众, 且这种态势仍以每年二万至四万人的速增长。目前, 中国每年因药物不良反应而住院治疗的患者多达二百五十万人^[14]。

According to the survey, there were more than 1.82 million deaf-mute children in 1990, among which there were more than 1 million toxic deafness children patients caused by abuse of antibiotic. The population of the deaf-mute children increases by 20 thousand to 40 thousand each year. Currently, there are more than 2.5 million patients admissioned for adverse drug reaction every year^[14].

由此可见, 治疗绝非只是“按方抓药”, 而是“按人抓药”, 需要医生结合病患者的具体致病病因、病症体现、个人身体素质等等个性化的要素, 从而最终综合得出最佳配药方案。个性化治疗为近几年的新兴医学方法, 笔者特意在以中华传统中医学为基础的保护服上增添了个性化治疗的一大新兴元素, 希望能以此为广大病患者带来更好的治疗体验。

It shows that treatment is not only filling the prescription according to visit but according to different patients. It is necessary for doctors to make the prescription based on personalized factors such as the specific cause of disease, symptoms, individual physical quality. As personalized medicine has been the new medical method in recent years, the author specially added the new element of personalized medicine to the protective clothing based on traditional Chinese medicine to bring better experience to the patients.

2.2. 治疗机理

2.2 Mechanism of treatment

2.2.1. 总体理念

2.2.1 General idea

在研发该保护服的过程中, 我发现可以研发用途更广的新型保护服, 由于高血压是尿毒症的并发症, 而且家里的两位老人家都患有高血压, 于是笔者计划研发一套能辅助治疗高血压的保护服装置。

During developing the protective clothing, I found that a new-type protective clothing with more extensive usage can be designed. As the hypertension is the complication of uremia. In addition, as there were two elder hypertension patients in

my family, the author planned to develop a set of protective clothing assisting treatment of hypertension.

在本新型防护服的设计中, 运用了我国传统中医学的理念, 使用传统中药中有扩管作用降压效果较显著的中草药, 以此为患者进行治疗; 同时, 结合了现代高分子材料技术, 将分子医学与防护服结合, 使用经皮给药的方式吸收中药的有效成分。在此基础上, 融入了现代医学的个性化治疗的理念, 应用中医“和而不同”的理念, 就是在“和”(都需要扩管)的基础上“不同”(不同病因添加使用不同药物)。在传承我国传统文化精髓的同时与西方前沿医学相互融会贯通, 以求达到更好的治疗效果。

In the design of the new-type protective clothing, thoughts of traditional Chinese medicine was applied and Chinese herbal medicine used for tube expanding with good effect to cure the subjects successively. In addition, drugs were combined with the protective clothing with the modern high molecular material technology. The effective ingredient of traditional Chinese medicine was absorbed in the way of transdermal delivery. The thoughts of personalized medicine of modern medicine are applied, with different drugs for tube expanding. Based on inherit age of essence of Chinese traditional culture and integration of west frontier medical science to realize better treatment effect.

2.2.2. 中药药材的选取

2.2.2 Selection of traditional Chinese medicine

首先, 笔者进行了药材的选取: 选取了适用于各种类型的高血压的扩管类药物。其中有: 丹参、三七、银杏叶。这三种药物均为当今临床使用较广泛的扩管药物, 是我国中医几千年的智慧结晶。

First, the author selected the medicinal materials. Drugs for different kinds of hypertension were selected, that were tube expanding drugs including Danshen, Panax notoginseng and folium ginkgo. The three drugs are generally used as tube expanding clinically. They are the gems of wisdom of thousands of years' traditional Chinese medicine.

其次是有效成分的提取: 目前中西医结合中草药提纯技术日趋成熟, 并已广泛地应用在临床上。而以上笔者选取的三种扩管类降压药物均已有了其西药提取物, 因此, 笔者便不再赘述有效成分的提取过程。

Second is extract of effective ingredient: in consideration of the combination of traditional Chinese medicine and modern western medicine, the effective ingredients have been extracted from many traditional Chinese medicinal materials. Extractive has been extracted from the above three drugs. Therefore, the extraction process of effective ingredient is not discussed here.

2.2.3. 人体吸收有效成分的方式

2.2.3 Ways that human absorb effective ingredients

人体有数种吸收药物的方式, 其中包括口服给药、舌下给药、注射给药、直肠给药、吸入给药和经皮给药。在本设计中, 病患者将通过皮肤吸收的方式吸收中药中的扩管药物。药物分子通过表层皮肤, 进入微血管, 从而进入毛细血管, 再通过血液循环系统到静脉, 紧接着到体循环, 最终到达靶器官。

There are several ways that human absorb drugs, which include oral medication, sublingual administration, injection, rectal administration, inhalation administration and transdermal delivery. In the design, the patients will absorb the tube expanding ingredient through skin absorption. The drug molecule entered into the micro vessel through surface layer and to the blood capillary. The drug moved to the vein in the blood circulation system and reached the target organ through general circulation.

2.2.4. 中药分子与保护纤维的融合

2.2.4 Integration of traditional Chinese medicine molecule and protective clothing fiber

一方面, 可以用物理浸泡法。

另一方面, 可以用高分子材料结合法。将中药有效成分的药物分子与高分子材料相结合, 形成一个药物缓释材料。药物缓释材料, 又称药物控释体系。它是用一定材料作载体, 使药物按设计的剂量, 在要求的时间范围内, 以一定的速度在体内缓慢释放, 达到对疾病更有效治疗目的的给药制剂。高分子材料能够固定住药物分子, 可以达到药物缓释的效果, 避免药物集中在初期挥发耗尽。

其中, 几种代表性的药物缓释材料为:

缓释材料聚(乳酸-丙氨酸): 直接以外消旋乳酸、L- 丙氨酸为原料采用熔融聚合法合成药物缓释材料聚(乳酸- 丙氨酸) 共聚物[P(LA- co-Ala)], 并用特性黏数、FTIR、¹H NMR、GPC、DSC、XRD 等手段进行系统表征。^[15-17]

药物缓释材料聚(乳酸氨酸): 直接以廉价的外消旋乳酸和赖氨酸为原料, 采用熔融聚合法合成药物缓释材料聚(乳酸赖氨酸) 共聚物[P(LAcoLys)]。^[18-19]

On one hand, physical soaking method can be applied, on the other hand, macromolecule combined method can be applied to combine the effective ingredient in the traditional Chinese medicine with high molecular material to slow release the drug so as to avoid the drug running out at the early stage.

2.2.5. 增加个性化治疗的理念

2.2.5. Provide the concept of personalized medicine

高血压有多种致病病因, 不同病因引起的高血压应采用不同的治疗方法。在上文的研究中, 笔者是基于所有高血压疾病的共同病症——血管侧壁压力高, 从而用扩管的药物进行治疗; 随后, 笔者将列举几类常见高血压, 并分别从其不同

致病因素入手，以研发出适应不同个体的个性化的降压保护服。

There are many etiologies of hypertension, thus it needs different drugs and different therapeutic methods. In the forgoing studies, the author used tube expanding drug for treatment based on the common symptoms, high pressure of side wall of blood vessel of the hypertension. Then, some common kinds of hypertension are listed with the suitable drugs based on the etiologies to treat the disease conveniently and efficiently.

2.2.5.1 高钠饮食引起的高血压

此类高血压患者需通过利尿排钠来进行治疗，临床上常使用利尿剂，如双氢克尿噻（HCT）来利尿排钠达到降压的目的；

2.2.5.1 High-salt diet induced hypertension

As it needs to excrete sodium, diuretic should be used such as hydrochlorothiazide (HCT).

2.2.5.2 肾性高血压（其中又分为肾血管性高血压和肾实质性高血压）

笔者目前没有找到针对此类高血压的特效药，一般是对此类患者使用比较普遍的降压药。但是，若患者伴有肾小球肾炎，应添加使用消炎药，治疗肾小球肾炎，从而提高疗效；

2.2.5.2 Renal hypertension (it is divided into renal vascular hypertension and renal parenchymal hypertension)

Anti-inflammatory drug should be used for hypertension caused by glomerulonephritis.

2.2.5.3 内分泌型高血压症（例如高血脂、糖尿病、高尿酸血症、前列腺肥大）

可以添加使用血管紧张素转化酶抑制剂（ACEI）；因为肥胖也属于内分泌型疾病，且肥胖易引起高血压，所以，若是因肥胖引起的高血压，可用降脂药，例如氟伐他汀；

2.2.5.3 Endocrine hypertension disease (such as high cholesterol, diabetes, hyperuricemia, prostatic hypertrophy)

Angiotensin converting enzyme inhibitor (ACEI) , Cilazapril, can be used. Lipid-lowering drug can be used for hypertension caused by fat such as fluvastatin.

2.2.5.4 神经性高血压症

此类高血压可以使用中枢性交感神经抑制药，例如利美尼定、莫索尼定，或者交感神经节后阻滞剂；

2.2.5.4 Neurological Hypertension

Central sympatholytic drugs can be used such as Rilmenidine, Moxonidine or sympathetic postganglionic retardant.

2.2.5.5 血管病变（例如左心室肥厚、心功能不全）

此类高血压应使用血管紧张素 II 受体拮抗剂（AIIA）类的抗高血压药物，例如氯沙坦。

2.2.5.5 Vascular disease (such as left ventricular hypertrophy and cardiac insufficiency)

AIIA should be used, such as losartan.

上述提到的药物^[9]，可用前文提到的高分子结合法将药物成分与保护服纤维结合。给予不同患者最适合于自己的一套个性化治疗方案！

The mentioned medicines^[9] can be composed by the medicine component and clothing fiber with the mentioned macromolecule combined method to customize the therapeutic schedule.

3. 未来规划

3. Future planning

3.1. 筹集资金，扩大试用范围

3.1 Raise fund and apply the device within bigger range

目前，此装置中的粘扣式高领设计版本的保护服已经制作出成品，并运用在某三甲医院 A 的 100 名血透带管患者身上。结果表明，该保护服减少了不良事故的发生，患者满意度达 100%（附注：此处的满意度指的是患者试穿的满意与否，本论文第三部分实验结果中的 98% 的满意度是指病患者试穿的满意度）。

Up to now, the designs of magic sticks and high collars have been produced and applied on 100 hem dialysis patients in Hospital A. The result showed that the protective clothing reduced emergencies and the satisfaction of patients reached 100% (remark: the satisfaction refers to the wearing satisfaction. The satisfaction of 98% in the experiment result in the third section of this paper refers to satisfaction of trying.)

笔者将计划再次完善改进后，继续联系商家制作出少量成品。首先赠送给给予我临床试验场地的医院 B 中进行血透治疗的患者试穿。笔者将再次利用寒暑假的时间去医院进行患者试穿的反馈情况的收集与整理工作，同时改进存在不足的地方。

In accordance with the author's plan, a manufacturer will be found to produce some products after improving. The products will be used for hem dialysis patients in Hospital B, which supported the author a lot. The author will collect the feedback of the wearing of the device in summer and winter holidays and improve the device accordingly.

3.2. 宣传推广并投入生产

3.2 Popularize and put on production

不论这次是否能获奖, 我都将借助各种资源、向国内外的各大医院或者医学研究机构写信, 阐述我的研究目的与计划, 积极推广该项目的积极意义与临床疗效, 希望能有机会得到更多机构及专业人士的支持、认可, 以对此产品做出更好的改进, 并把产品广泛应用在临床上, 让自己的发明创造能改变患者的命运, 造福人类!

No matter I get an award, I will write to different large hospitals or medical research institutes with help of various resources to explain the purpose of research and plan to promote the positive significance and clinical effects of the project. I hope I can get support from more institutes and professionals to improve the product and apply it clinically. I wish the patients can get better care due to my invention.

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参赛选手简介

李雨涵，女，2000年7月19日出生广州，现为国家级示范高中、奥林匹克训练基地——华南师范大学附属中学，高二级大学先修班学生。

一、德智体美全面发展，学科多次获奖。学习成绩优良，德智体美各科平衡发展。

语文：多次在《羊城晚报》等报刊发表文章，作文曾获语文报杯（国家级）二等奖。任华附初中奥校作文集《不老泉》（三十万字）主编。**数理化：**成绩优良，在广东省地理奥赛、数学希望杯、华罗庚杯、物理竞赛等比赛中屡屡获奖。**英语：**在美国旧金山教育系统高中语言能力测试中获 fluent 级别，两度获校级英语戏剧表演第一名。**艺术：**自幼学习芭蕾、钢琴、声乐、国画等，钢琴早已过十级，获中韩国际青少年合唱比赛一等奖。多次获钢琴、绘画方面的奖项。

二、有较强创新能力和钻研精神，在生物医学领域表现出了较强的天赋。

1、2015年到2016年挤出2年多的课余时间，自己动手研发制作了“血液透析多功能防护服”受到了专业人士的好评，并于2016年6月申请了国家实用新型发明专利，国家专利局已受理。研发论文于2016年5月在《临床心身疾病杂志》上发表；

2、2016年8月获第二届“亚洲未来生物医学领袖”大赛第四名（二等奖）；

3、由于在生物医学上有浓厚的兴趣及天分，2016年，从全球115个国家及美国50州的数万名申请者中，以4%的通过率脱颖而出，被 the 2016 Yale Young Global Scholars Program（耶鲁大学全球青

年学者项目) 录取, 前往美国耶鲁参加了生物医学的专业学习, 接受世界级大师的培训和指导, 更加坚定了从事生物医学的信心。

- 4、2016 年北京大学国际青年创新大赛已进入决赛 (前 50 名)
- 5、初二时获首届广东省青少年科技创新实践能力大赛三等奖;

三、较强的团队合作意识和沟通协调能力。

从小学一年级起担任学生干部, 四年级竞选大队委, 任初中学生会秘书部处长。长期的任职经历, 使本人有较强的团队合作意识和组织协调能力。任宣委时多次获校级墙报、手抄报一等奖; 获“朋辈心理辅导标兵”、“社会工作积极分子”的奖项。

导师个人简介

赖蒨茵，生理学博士，浙江大学求是特聘教授，博士生导师。赖蒨茵教授瑞典乌普萨拉大学生理学博士毕业，美国乔治城大学医学院博士后和助理教授。现任浙江大学医医学部生理系求是特聘教授，从事微小血管和肾小球入球动脉收缩活性的生理和分子生物学等方面的研究，探讨肾病和高血压病的病理生理机理。赖蒨茵教授发表 SCI 论文 27 篇，影响因子共计 130。论文发表于 Circulation Research, Diabetes, Hypertension, Kidney International, Am J Physiology 等国际一流杂志。受到国内外学术界的广泛关注及肯定。

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(说明：该导师是我今年参加浙江大学举办“第二届亚洲未来生物医学领袖”大赛进入决赛后，组委会推荐的指导老师。赖教授通过网络及电话对我的论文提出了一些修改意见。)

夏涛：华南师范大学附属中学，生物高级讲师，有多年教学及辅导学生参赛在经验，指导在学生多次获得生物方面在国际、国内大赛的奖项。

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