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Hans汉斯

完全置入式静脉港并发症及管理

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摘　要

完全置入式静脉港(Totally Implantable Venous Access Devices)是由一个在皮下组织中放置的储槽及与之连接的导管组成，而导管的末端位于中心静脉。静脉港是目前较为安全的一种方式，但仍存在一定的并发症。在这其中静脉港的设计及使用材料的不同对并发症的发生率有一定的影响。本文将从设计、材料、放置静脉港、留置静脉港方面分析相关并发症及预防方法。

关键词

静脉港，并发症，化疗

Complications and Management Strategies of Totally Implantable Venous Access Devices

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Abstract

The Totally Implantable Venous Access Devices is composed of a reservoir placed in the subcutaneous tissue and a catheter connected to it, and the end of the catheter is located in the central vein. Venous port is currently a relatively safe method, but there are still certain complications. Among them, the design of the venous port and the different materials used have a certain impact on the incidence of complications. This article will analyze the related complications and preventive me-

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thods from the aspects of design, materials, placement of venous port, and indwelling venous port.

Keywords

Implantable Venous Access Devices (IVADs), Complication, Chemotherapy

1. 引言

自从 1982 年完全置入式静脉港首次被报道至现在[1]，静脉港被广泛用于周围静脉通道输液不佳和长期需要持续应用含有发泡剂的药物、抗生素、输血及静脉营养治疗的患者[2] [3] [4]，特别是用于癌症化疗[5] [6]。虽然一次性中心静脉导管可以解决输液时的难题，但其末端缺少安全、美观、护理方便的储槽，导致患者出现行动受限、疼痛、美观等问题，而静脉输液港的出现解决这些问题[7]，同时减少了护理的并发症、简化了导管护理流程[8]。

尽管静脉港被认为是长期留置中心静脉通道中最安全的方式，但仍存在 2%~18%的并发症发生率[9] [10] [11] [12] [13]。从病理生理学的角度来看，早期的并发症是由于在导管插入和港座置入操作时对邻近结构的损伤而造成，而晚期并发症是由于导管长期留置、外力[14] [15] [16]或不当使用造成港座破裂产生。

2. 装置设计

在经典、开放式静脉港导管末端所产生的负压会促进血管中 5 毫米的血液反流入导管尖端，反流的血液可能会凝结后导致堵塞。有导管末端防反流瓣膜设计的静脉港可以在回抽时依然保持正向压力，防止血液反流。虽然普通导管和防反流导管在感染及血栓的发生率上无明显差异[17] [18] [19] [20]。但在 Biffi 等在 2001 年的实验中对 Grochong 导管(三向瓣膜导管)和普通导管回抽困难的发生率进行了对比，因三向瓣膜可以对抗流入及流出的不同压力，在不使用时瓣膜保持关闭，其回抽困难的发生率要高于普通导管。Carlo 等对比有压力激活安全瓣膜的导管和普通导管，结果显示其回抽困难的发生率高于普通导管[21]。2014 年一篇对 Grochong 导管的置入技术和导管尺寸对比的研究中再次证明了有阀门导管的回抽困难发生率较高[20]。根据数据，Groshong 导管在预防导管内凝血或导管阻塞方面似乎没有任何优势，在感染或血栓发生率上与同类导管相比，也没有显著的差异。压力激活安全阀导管可能在预防导管内凝血方面有一些优势，但没有证据表明会降低其他并发症发生率，而且需要安装额外的动力装置，较为繁杂。

经过耐高压技术改进的导管可以进行高容量的注射，这样可以降低由于机械损伤所造成的导管破裂及断裂的概率；但这种导管并不适用于血液透析，但有些特殊材料类型的静脉港通过添加港室内的横膈膜等方式将流量及压力调整至血液透析所需要的标准，使静脉港可以用于透析；虽然没有文献对耐高压静脉港耐用性的比较，但回顾性分析相关文献显示静脉港底座隔膜在 1000 次穿刺使用后无破损，导管无因机械性原因而导致的破损及折断[15] [16] [17]。

静脉港有单腔或双腔，双腔港有两个平行的导管和两个完全独立的储存腔，这样就可以解决同时输注两种可能发生反应的药物的需求。然而双腔静脉港使用较少，因为这样的静脉港可能与感染的高发有关[22] [23]。

3. 导管材料

深静脉导管材料通常由人工合成的弹性或聚合材料制成，如聚乙烯、聚酰氯、聚四氟乙烯、硅树脂或聚氨酯。对于静脉港的导管目前常用的材料是聚氨酯和硅树脂。导管材料的特性是值得我们注意的关键，其表面老化变性可能导致生物膜形成，从而使血栓及感染的风险增加。一项研究硅树脂和聚氨酯的机械和表面特性的文献表明，短期内导管表面材料无明显改变，但随着时间的推移，两种材料都会由于丢失硫酸钡分子而出现表面不规则现象，硫酸钡嵌入材料中的作用是不让射线穿透导管[24]。这种现象可能导致导管预先出现断裂点，与聚氨酯导管相比，在硅树脂导管中更明显。有研究表明在手臂港的放置使用中，聚氨酯导管相关感染和导管内血栓的发生率明显高于硅树脂[25]；而血管内血栓及静脉血栓形成率没有明显差别。与材料数据一致的是聚氨酯机械故障发生率较高(2.6% vs. 0.3%；p 值 50.02)。聚氨酯导管总体并发症发生率高于硅树脂(46.2% vs 9.3%，p 值 ＜0.0001)；而其因管理导管相关并发症的拆除率也较高(10% vs 4.6%) [26]。由于在研究手臂港时可能高估了导管走行较长、拉应力较大、低感染、闭塞、折断及机械性并发症的可能性，而认为硅树脂更适合手臂港，但在血液透析时的数据结果可能正好与之相反。但是没有文章在同样的条件下对比手臂港使用上述两种材料的数据，只是描述因需要抗高压、防导管的塌陷等原因建议使用聚氨酯材料。

4. 放置时相关并发症

4.1. 抗生素的预防使用

目前对于非置入式的深静脉导管的广泛共识是：在放置时进行有效的防护(手卫生、皮肤的无菌准备及无菌技术运用)，降低相关感染的效果优于预防使用抗生素[27]。在美国虽然没有指南明确推荐放置静脉港预防使用抗生素，但 2013 年进行的一项调查显示 88.2%的医生放置静脉港后预防使用抗生素[28]。一项针对 2154 名患者置入静脉港 30 天后数据的荟萃分析发现，没有接受预防性抗生素治疗的患者对比使用者感染的发生率为 1.6% vs 1.1% [30]。以上分析显示预防使用抗生素对降低导管相关感染并没有显示出优势，并且抗生素有药物过敏、增加耐药性、影响正常菌群等不良反应，国内较少文献推荐使用。目前暂无有力随机试验证明预防性使用抗生素可能降低导管相关感染的发生率，常规不推荐使用[24]。

4.2. 放置的技术

导管插入分为手术方式(ST)与 Seldinger 经皮穿刺方式(PT) [30]。手术通常以头静脉为解剖标志，也可使用其他静脉[31]。经皮穿刺是通过颈内静脉、锁骨下静脉或头静脉进行，由于时间置入时间较短且不需要进入手术室操作[2] [12]，已成为常用的方法。早期的文献中报道由于技术不成熟，经皮穿刺的气胸、血胸、穿刺动脉及心律失常的发生率明显高于手术，但由于超声技术的引入，以上并发症的发生率由 18.7%下降到只有 1.5% [12]。因并发症较少及避免暴露于射线下，目前提倡超声引导穿刺[2] [32]。使用 Seldinger 技术作为手术失败后再次置管方式后将总体成功率从 80.5%提高到 93.9% [33]。然而一个 1006 名患者的荟萃分析表明[2] [34]，两种放置方式在总并发症上无明显差异(包括血胸、气胸、感染、导管血栓形成、狭窄、弯折或药液漏出，导管移位、港座反转，血肿、血清肿、神经麻痹、胸导管损伤和死亡)，特别是感染率上无明显差异。但值得注意的是经锁骨下穿刺组比较经手术放置锁骨下导管组导管相关性并发症概率较高(血栓、纤维蛋白鞘形成，狭窄，导管扭转，药液外渗，导管移位，导管脱落) [35]。最终选择哪种方式进行置管取决于所选择方式的可能发生的风险。在严重脱水、中性粒细胞缺乏、放疗后及其他可能增加并发症发生率的患者中，应优先采用超声引导经皮穿刺，以最大限度地减少穿刺失败和气胸发生率。对于不适合经皮穿刺的病人来说，可以选择手术，比如穿刺部位肥胖、疤痕或先前进行过手术、骨

骼畸形和淋巴水肿的患者。

4.3. 放置的位置

通常我们选择穿刺锁骨下静脉和颈内静脉[36] [37]，而港座被放置在穿刺同侧锁骨下胸壁皮下[5] [38]，超声实时引导特别适用于颈静脉导管插入术[39]。有经验的医生进行锁骨下和内颈静脉穿刺都是安全可行的[40] [41] [42] [43] [45]。在初期常选用的是锁骨下静脉插管的方式，因颈内静脉置管时皮下隧道必须跨越锁骨，在进入颈内静脉时所呈角度较小，导管发生堵塞的可能性大。而在近年文献提出锁骨下并发症较多，目前多主张颈内静脉插管。

4.4. 气胸

气胸是由于在插入导管时意外损伤胸膜使空气从肺部组织进入胸膜腔引起[45] [46]。不同研究报道的发生率各不相同，最近的研究报告的发病率在 0.5%到 2%之间[47] [48]。经锁骨下静脉穿刺置管被广泛认为接近肺尖而容易导致气胸[49] [50] [52]。因此，有一部分作者建议采用实时超声引导颈内静脉穿刺来降低气胸的风险[39]。诊断：因术中透视无法准确查看导管头位置，术后的胸部 X 线检查可以确定其位置，并对是否有气胸进行补充诊断。但是延迟发生的气胸可能无法在术后检查中得到诊断[52] [53] [54] [55]。治疗：不稳定的病人应该用大口径胸导管进行胸腔闭式引流治疗[56]。患者如无症状、气胸范围小(从胸廓顶到肺尖的距离小于 3 厘米，或压缩程度 ＜15%)，并且在初次摄片后几小时内其范围并没有增大，就可以出院[57] [58]。有症状的病人和范围大的(从胸廓顶到肺尖的距离大于 3 厘米，或压缩程度大于 15%)病人应该用一个小口径胸管来治疗[49] [59] [60]。

4.5. 血胸

在经皮中心静脉导管插入术中，很少发生血胸。一般发生在胸内动脉的意外穿刺或静脉撕裂后[61] [62]。诊断及治疗：在手术过程中或术后出现突然发作的呼吸困难和低血压时，应怀疑血胸。超声可在胸膜腔中血量为 50 ml 时探查到，而胸片在出血量为 300 ml 或更多时才可诊断出[63]。可行胸腔闭式引流和液体复苏，但是如果出血总量超过 1500 ml，或者 2~3 小时内持续出血达 200~300 ml，就应手术探查[35]。通过动脉栓塞行介入治疗也是另一种治疗手段[64]。

4.6. 误穿动脉

颈内动脉(3%)被误刺穿损伤较锁骨下动脉(0.5%)高[65]。但锁骨下动脉损伤出现会因位于锁骨下方无法按压止血而更难处理[51]。虽然出血有自限性，但可以因发生大量血肿出现压迫症状及动静脉瘘[66] [67] [68]。预防诊断及治疗：避免动脉穿刺严重并发症的关键是熟悉解剖，高度怀疑误穿动脉后快速退针按压止血。直接的压迫止血、必要时气管插管避免气道受压、液体复苏是治疗的主要手段。

4.7. 心律失常

心律失常是由于导丝或导管进入心脏和心内膜的机械刺激引起的。尽管大多数病例都是良性的房律性心律失常，一般来说，导丝不应该超过 18 厘米(尤其是在右侧)，不应进入右心房。出现心率失常时，应积极处理，严重时进行心肺复苏。

4.8. 空气栓塞

空气栓塞是罕见的置港并发症，当中心静脉压低于大气压水平时，插入 14-G 的针头在 3.5 mmHg 的压力梯度 2~3 秒内就会发生[69]。诊断：由此产生的症状主要是由吸入空气的体积所决定的，可发生氧

饱和度降低、突然发作呼吸困难，严重者循环衰竭和死亡[70] [71] [72]。经食管超声心动图是最敏感的诊断方式，应在不确诊的情况下加以考虑[73]。预防：重在预防，应注意患者体位(头低脚高位)，避免插入管道的外周压力增高而造成的压力梯度。

5. 静脉港座留置并发症

5.1. 切口裂开

静脉港底座在放置后可能因技术操作不当、癌症造成的营养不良、化疗后免疫力低下等原因造成切口愈合不良。放置港座的位置应避免在接受过放疗的区域、既往行乳房切除术的皮瓣区，切口缝合应无张力[74]。贝伐单抗通过抑制血管内皮生长因子来抑制血管生成，如果置港和贝伐单抗治疗时间间隔小于14 天，可能造成切口不愈合，如切口裂开可以取出港座或是进行二次缝合[75] [76]。建议对皮肤较薄及可能发展为恶病质的患者应将港座放置在更深的位置，以防迟发性皮肤坏死和港座外露[76]。港座也不应放置在文胸系带处及安全带穿过处皮下[77]。

5.2. 局部药液外渗

据报道使用静脉港导致局部药物的外渗发生率为 0.1%~6%。主要由导管破裂或港座穿刺隔膜的破裂使药物进入周围组织所致[74] [78]。当使用蝶翼针的时候，隔膜应该能够承受数百次的穿刺，如果其他针头代替或放置较长时间，隔膜就可能会老化泄漏[79] [80]。症状主要与渗漏药物的毒性和渗漏剂量有关。刺激性药物主要引起疼痛和炎症，也可能导致严重的坏死和溃疡[76] [81] [82] [83]。常见的早期症状是肿胀、发红、疼痛和灼烧，以及输液不畅和回抽困难。蒽环的药物损害缓慢不易发现，可能持续数周[83] [84]。在使用静脉港前应检查其通常程度，如不畅及出现早期不适症状，不应强行使用。当发生药液渗漏时，应冷敷减少蒽环药物的损害，同时也要热敷加速组织周边的循环。可应用透明质酸可减少细胞外膜生物碱的浓度[84]，静脉注射右旋糖是一种蒽环霉素外渗的解毒剂。二甲基亚砜是一种用于治疗顺铂、丝裂霉素 C 和蒽环霉素渗漏的抗氧化剂[85]。不推荐局部或全身皮质激素治疗。

6. 静脉港导管留置并发症

6.1. 堵塞

导管堵塞在不同的研究中发生率差异较大，从 0%到 47%不等[86]。导管堵塞通常指回抽或注射或两者都有困难[87]。导管阻塞的发生通常与机械力(如夹闭综合征)、药物的沉积、全肠内营养、药物互相反应后沉淀、纤维蛋白鞘的形成、导管内外血栓的形成有关[88]。导管阻塞通常出现血液无法回抽或无法正压推注。要鉴别造成堵塞的原因，首先应尝试调整进针位置及导管是否存在打折，应该仔细检查药物是否存在不相容的，排除这些后，最常见的阻塞原因是血栓阻塞。正压无法推注，进行溶栓治疗后可治疗性诊断通常的做法是将抗凝药物封存在静脉港及其导管内停留至少 30 分钟。如果溶栓剂不能再通，则可使用剥除鞘膜，但因为是有创操作，不作为常规推荐。然而，剥除为有创操作，很少被使用或推荐。通常情况是进行药物治疗后无效的患者，选择移除静脉港或再次放置。

6.2. 深静脉血栓

对于容易出现导管相关性静脉血栓的高风险患者，应考虑是该原因导致出现静脉港导管不通畅，可能出现的症状包括血管出现侧支循环，局部水肿，温暖，红斑，血栓形成的触痛，但绝大多数是无症状的。而静脉港放置的患者静脉血栓形成的危险因素包括导管头位置不正、导管相关性感染以及导管管腔尺寸过大。由于缺乏前瞻性研究，导管相关静脉血栓形成的治疗存在一定的争议[70]。美国胸科医师学会

提出的建议是移除静脉港后进行抗凝治疗[89] [90]。如果所涉及的静脉是腋窝或更加近心的静脉，建议3个月的抗凝治疗。如患者需要保留导管继续治疗的，建议保留导管期间同时持续抗凝治疗。在癌症患者中，低分子肝素较其他抗凝血剂应用更广泛。溶栓治疗应考虑低出血风险、有较好预后及较长寿命的患者，并因血栓位于锁骨下及腋静脉有持续症状的患者。此外，没有足够的数据支持预防性使用纤维蛋白溶解剂，如尿激酶预防导管相关性血栓形成。

6.3. 感染

尽管感染是所有型号静脉港的主要并发症，但发生率与使用的设备类型有关。2006年系统回顾性文献中，Maki 等报道了导管相关的感染发生率(1000 导管日)分别为短期无隧道的导管 2.7、隧道置入式导管 1.6、完全植入式导管 0.1，虽然完全置入式静脉港较其他类型导管的感染率较低，但感染仍然是导致取出静脉港的主要原因[91]。美国疾病控制和预防中心的建议已经被证明是非常有效的减少并发症的发生率[24]。增加静脉港导管相关的感染风险的情况包括：设备的高频率使用、全肠内营养的使用、在置管时多次穿刺、血液恶性肿瘤和中性粒细胞缺乏症[92]。与导管相关的感染可以是局部的(穿刺部位、导管置入段或港座的囊袋取)或全身脓毒血症[93]。如果在入口点或囊袋区域有红斑、疼痛、组织坏死、渗出或脓包，则应怀疑局部感染。在脓毒血症的病例中除了全身症状之外，患者可能有或没有局部症状，全身症状包括发热、寒战或全身炎症反应[92]。上述两种情况都有必要在抗菌素治疗前从局部和中心静脉导管内取脓液或血液培养[93]。如果没有全身感染，局部感染脓肿或囊袋部位坏死，则需要经 7 至 10 天短期抗菌治疗后移除移除静脉港。在静脉港相关感染的治疗中，应以细菌培养的结果进行治疗，但在获得血液培养前，可以进行经验性的抗菌治疗。万古霉素是对革兰氏阳性菌治疗的一线药物。对中性粒细胞缺乏的癌症患者和危重病人中，选择的抗生素应覆盖革兰氏阴性菌，同时考虑到念珠菌感染。细菌培养结果指导最终的抗生素治疗。诊断为脓毒血症后应排除出现转移性感染(心内膜炎、化脓性血栓性血栓和骨髓炎)的可能，如果存在则影响是否需要移除静脉港及抗菌治疗的持续时间。在转移性感染的患者中，在血培养阳性、感染金黄色葡萄球菌或念珠菌感染并进行抗感染治疗后持续 72 小时发热，需要移除静脉港。对金黄色葡萄球菌感染的治疗中，建议感染科专家会诊结合超声心动图进行评估[94]。在无并发症的血液感染如葡萄球菌，肠球菌，和某些革兰氏阴性菌，可在进行短暂规范的全身抗菌素治疗及抗生素锁疗法治疗后保留静脉港，直至感染清除后，更换放置位置后继续使用此静脉港。短期的、系统性的抗菌素与抗生素锁疗法相结合是可能的。在清除感染后，应推迟更换端口设备，直到确认菌血症的清除为止，并应选择一个新的放置设备的位置。

6.4. 导管移位

导管由于受夹闭综合症或外在机械应力作用，例如对安全带减速的拉拽，紧身衣服的摩擦，用小注射器的强力冲洗导管(<10 毫升)，或者没有明显的原因[96] [96]。有的病人在使用时通常只是出现端口故障或外渗症状；而心悸和心律失常在导管断裂后才会发生[95]。可以通过胸部摄片及实时的透视证实，如果预计患者体重会减轻的应将港座放置的更深些，导管尽可能不穿过锁骨较突出处，穿刺点和底座的得隧道应该垂直。否则应用介入的方法从股静脉处取出断裂的导管[97] [98] [99]。

7. 护理相关操作

1) 蝶翼针穿刺：对相关人员进行设备维护和护理培训是降低导管相关并发症的关键[27]。以下是美国癌症治疗和预防中心对导管维护有关的建议：维护、触诊、更换辅料前用肥皂和水洗手或者用含酒精的消毒剂涂擦手部，进行港座穿刺时应使用无菌手套和口罩，这是操作时可以进行的最好的防护措施。穿刺部位的皮肤必须用氯己啶溶液或 70%的酒精进行消毒，在穿刺时皮肤应保持干燥[27]。指南建议使

用无损伤针治疗，防止港座穿刺隔膜因损伤发生破损及血液渗漏[100] [101]。关于无损伤针穿刺使用时间长度及针头跟换频率上尚无明确的建议。覆盖于港座皮肤的透明敷料应每隔一周更换一次，如果敷料潮湿、污垢或松动应及时更换。还有建议使用无菌、透明、半透性的敷料来覆盖导管部位。局部穿刺点使用抗生素不被推荐为预防感染的措施。密切观察可能感染的皮肤及全身变化。

2) 导管冲洗和封管：由于生物蛋白与装置的导管表面聚合面发生相互作用，所有长期放置于血管内的导管材料都容易形成蛋白质生物膜，而这可能是导管堵塞的主要原因。导管的冲洗和封管是防止这种并发症的关键。由于没有公认的技术流程及规范，目前遵循的大多为局部区域的实践操作经验流程[102]。2012 年在法国进行一种体外模型模拟生物蛋白膜形成的试验，研究人员人工涂抹牛白蛋白模拟生物膜，并用 10 ml 注射器以每秒推注 2 ml/秒(间隔 0.4 秒)的脉冲式冲管，这种技术利用冲洗液的紊流(雷诺数大于 1000)，可以有效去除 90%的蛋白生物膜。为了尽量减少给药物质或血液附着在导管内表面或残留的纤维蛋白上，一种常见的推荐做法是先用生理盐水冲洗，然后给药，最后再用足量生理盐水冲洗(缩写为 SAS，生理盐水－给药－生理盐水) [103]，不同导管材料应根据导管制造说明书的推荐选择肝素或普通盐水为最佳冲洗液。虽然肝素有抗凝作用，但在使用过程中也存在不良事件[104]。许多研究结果提示使用肝素在导管的感染及防止堵塞方面并未明显优于生理盐水，生理盐水是安全有效的方式[105]，所以在癌症患者中生理盐水封管及冲管被许多指南所推荐。在成人放置静脉港的患者中，建议在使用静脉港进行药物治疗或抽血后依据说明书的推荐频率进行冲洗[106]。封管是将少量的液体推注入静脉港并存留在港座及导管内，而留存的液体量取决于港座的容积，一般为 2.5 ml 左右，推注最后 0.5 ml 封管液依旧保持正压推注[103]。在早期的文献中，静脉港的冲洗和封管的频率至少为 4 周一次，但目前有文献提出最长 12 周一次，数据显示期间并没有发生感染、堵管及血栓[102] [107] [108]。但对没有在使用而是长期维护中的静脉港的正式推荐是每 4 周利用生理盐水对留置的静脉港进行冲管及封管，而对于使用中的静脉港每 4 周进行盐水冲管后利用 5 ml 肝素冲管后封管[108]。

8. 患者健康教育

患者的认知对静脉港的使用起着重要的作用。需要告知患者什么可以做或不能做，健康教育可以减少焦虑和提高满意度。2014 年对癌症中心 47 名患者进行的一项调查中，20 名受访者中有 7 人表示从未接受相关知识告知，44 名受访者中有 29%的人不知道哪些症状需要引起关注。患者对静脉港维护及使用知识的了解，帮助减少护理中可能发生的并发症，同时也可以为在患者在发生并发症中提供心理支持及理论支持储备。

9. 结论及展望

与传统的中心静脉置管及对患者满意度程度来看，需长期静脉港治疗的患者因其低感染可能性而逐渐增多。2016 年美国有 168 万新确诊的癌症患者需要静脉通道进行化疗 25。而中国的发病人数不会低于此，但由于地区经济差异及医保问题，静脉港近 10 年正在我国被大多数癌症患者和少数需长期留置静脉输液通道的患者逐渐接受。静脉港的设计、材料科学、置入及护理技术将继续发展，这样能极大降低静脉港并发症的发生。尽管迄今为止取得了进展，而医务人员对静脉港并发症的了解是减少并发症的根本。因此，作为医生应该熟悉静脉港的常见并发症及治疗方法、预防手段，为静脉港持续良好的使用提供医疗技术支持。未来研究的重点应该放在患者对静脉港知识的认识及护理技术的标准化制定，同时要重视患者在使用过程中的情绪及心理变化，从人文等角度更好服务患者。

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