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Four trocar configurations for robot-assisted radical prostatectomy for da Vinci SP devices: Comparison of pros and cons and pricing

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INTRODUCTION

Da Vinci single port (SP)-based surgery is considered an ideal surgical approach because of its minimal invasiveness, which reduces the number of ports required, thereby minimizing postoperative morbidity. Unlike its multiport counterparts, unintentional collisions between instruments are one of the greatest challenges during the learning curve period; however, this can be overcome gradually. Another difference from multiport devices is that they often collide with assistant-operated laparoscopic devices, which are also affected by trocar configuration.

Since the introduction of the da Vinci SP device, several approaches to the prostate for single port-based robot-assisted radical prostatectomy (SP-RARP) have been suggested, including Retzius sparing, transvesical [1], peritoneal [2], and extraperitoneal, which have been proposed as alternatives to the conventional transperitoneal approach that became commonplace in the era of the multiport-based RARP [3]. In addition to these approaches, trocar configuration methods have distinct advantages and disadvantages. Therefore, choosing an appropriate trocar configuration for each approach can reduce the cost and time of surgery. COSPUS (Consortium of Single Port Urologic Surgery) is a group of Korean urologists who have adopted SP to perform single-port urologic surgeries, including SP-RARP. Based on our experience, this article introduces four currently available trocar configurations for SP-RARP with different cost-effectiveness levels. Table 1 summarizes the characteristics and estimated minimum cost of each trocar configuration. The prices suggested in the table are available for uninsured use in South Korea in 2023 and should be understood as a comparison between each trocar configuration, as they may vary by country.

DA VINCI METAL PORT

The da Vinci SP system's metal port consists of an outer metal cannula, which is not consumable, and an inner entry guide, which is disposable and fits inside and separates the four insertions into their respective compartments. The outer metal cannula is 2.5 cm in diameter; therefore, it is possible to perform surgery using an incision of exactly this size, which is smaller than other ports (Fig. 1A). The advantages of metal ports include the lowest surgical cost and simplicity of the structure, which allow for rapid surgery, especially if the robotic arm needs to be changed frequently. However, the floating trocar technique, by which the remote center of the trocar is placed outside the body to improve the range of motion (Fig. 1B, C), cannot be applied by a da Vinci metal port trocar configuration, which is unsuitable for surgeries requiring much work near the trocar insertion site. This can also be used for an extraperitoneal approach; however, in this case, the workload and operation time can be reduced using a balloon device to secure the extraperitoneal space near the trocar insertion.

Table 1. Summary of characteristics and cost of four representative accesses to single port-based robot-assisted radical prostatectomy

	Metal port	Access Port™	Multi-purpose port	GelPort™
Incision size	2.5 cm	≥2.7 cm (up to 4 cm/7 cm)	≥2.7 cm (up to 4 cm/7 cm)	≥2.7 cm
Supporting floating trocar techniques	Not support	Fully support	Fully support	Limited support
Instruments need for trocar configuration	Metal Trocar™ (1), AirSeal™ trocar (1), or laparoscopic trocar (≥1)	Access Port™ (1), AirSeal™ trocar (1), or laparoscopic trocar (≥1)	Multi-purpose port (various brands, 1), Metal Trocar™ (1), AirSeal™ trocar (1), or laparoscopic trocar (≥1)	GelPort™ (1), Metal Trocar™ (1), AirSeal™ trocar (1), or laparoscopic trocar (≥1)
Essential needs for laparoscopic bag to remove specimen	Yes	No	No	No
Needs for an additional Metal Trocar™	Yes	No	Yes	Yes
List of expandable instruments and each cost (except Metal Trocar™)	Entry guide (180 USD) AirSeal™ trocar (230 USD) or laparoscopic trocar (≥1, per 90 USD) Laparoscopic bag (30 USD)	Access Port™ integrated with a dedicated entry guide (500 USD) AirSeal™ trocar (230 USD) or laparoscopic trocar (≥1, per 90 USD)	Multi-purpose port (≥200 USD) Entry guide (180 USD) AirSeal™ trocar (230 USD) or laparoscopic trocar (≥1, per 90 USD)	GelPort™ (540 USD) Entry guide (180 USD) AirSeal™ trocar (230 USD) or laparoscopic trocar (≥1, per 90 USD)
Estimated total cost of expandable instruments (single AirSeal™ trocar instead of laparoscopic trocars)	440 USD	730 USD	610 USD	950 USD
Pros	• The most cost-effective one • Easy to change the robotic instruments	• Better condition for a floating trocar technique	• Cost-effective option supporting a floating trocar technique	• No gas leak • High degree of freedom in port placement
Cons	• Inability to apply the probing trocar technique	• Difficult to replace robotic instruments during the floating trocar status	• Gas leakage • Wondering remote center	• The worst cost-effective one

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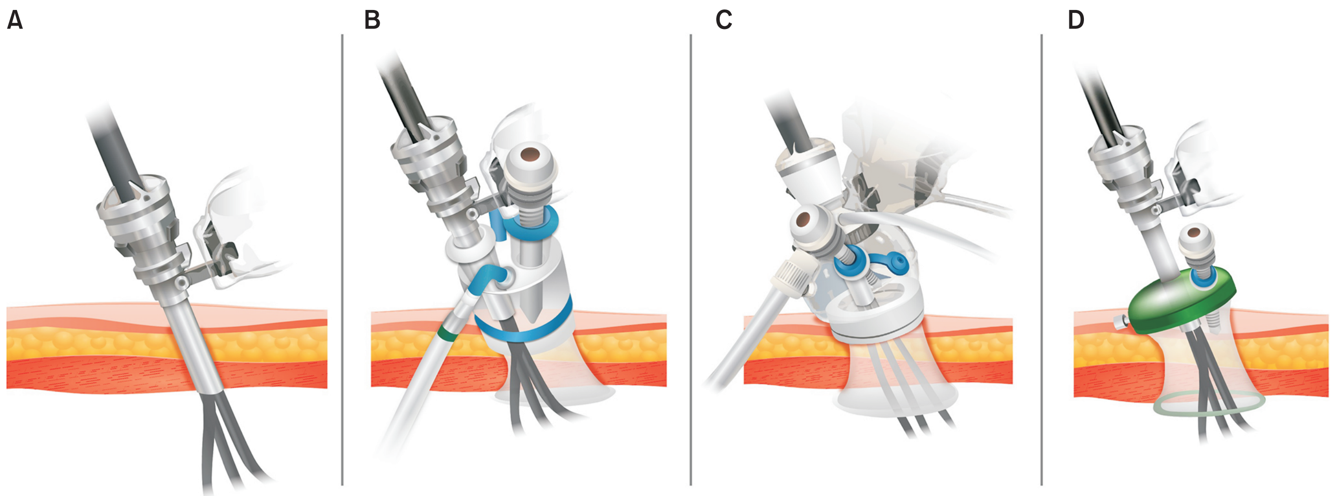

Fig. 1. Trocar placement for (A) da Vinci metal port, (B) da Vinci Access Port™, (C) multi-purpose port, and (D) GelPort™.

DA VINCI ACCESS PORT™

The da Vinci Access Port™ is a trocar developed by Intuitive Surgical, specifically for the SP device. It is designed to dock with the robotic arm as an entire trocar instead of the outer sheath of the metal port introduced earlier (Fig. 1B). In contrast to the da Vinci metal port, it specializes in the floating trocar technique, which facilitates operation near the trocar insertion site, including the transvesical approach [4]. Typically, a 2.7 cm or larger incision is made to allow for the floating trocar technique; therefore, unlike a metal trocar, the resected prostate can be removed from the body by the robotic arm through the incision itself without the need for a laparoscopic bag, which is an additional consumable for specimen removal. However, the size of the separate entry guide is smaller than that used for the metal trocar; therefore, internal collisions between the robotic instruments may be more frequent, especially when the trocar is floating. Accordingly, the assistant may need to get used to changing instruments more frequently than with other trocar configurations that use a metal sheath.

MULTI-PURPOSE PORT

Several other companies are releasing single-port trocar systems that support 2.5 cm sized da Vinci metal ports. Unlike the Access Port™, there is an additional step of inserting a separate metal port (Fig. 1C), but the cost tends to be lower because of the more straightforward structure of the trocar. It also supports the floating trocar technique, and the metal port can be pulled out of the body, making it easier to operate near the trocar insertion site. Like the da Vinci Access Port™, it consists of an intracorporeal and extracorporeal part, which are joined together at the surface of the incision site. The disadvantage is that CO_2 gas leakage due to incomplete sealing of the two parts is more frequent than that with the da Vinci Access Port™. Depending on the volume of the specimen, some models support two different sizes of incision windows of up to 4 cm and 7 cm, which is also the case for the da Vinci Access Port™.

GELPORT™

The GelPort™ system, developed by Applied Medical, is ideal because it allows the use of various trocars at angles optimized for the user, regardless of their shape and size [5,6]. In addition to the metal port, various laparoscopic trocars, such as AirSeal™ (CONMED), can be used simultaneously depending on the size of the incision window, and even relatively large specimens can be extracted without using a laparoscopic bag by opening the entrance while holding the specimen (Fig. 1D). Nevertheless, the floating trocar technique is only partially possible, which gives it an advantage over da Vinci metal ports for work near the incision site but a disadvantage over da Vinci Access Port™ and multi-purpose ports. It is the most expensive trocar system but has the least potential for extracorporeal leakage of CO_2 gas and the most freedom of port configuration and can therefore be used with any prostate approach route.

CONCLUSIONS

SP-based RARP is expected to become increasingly popular in the future. Depending on the operator's preferred approach to the prostate, the assistant's level of training, and the operator's workload, various port placements may be used, each with advantages and disadvantages. Understanding this and making appropriate choices will help quickly reach a plateau in operative time and outcomes in SP-RARP, which requires a learning curve.

CONFLICTS OF INTEREST

The authors have nothing to disclose.

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