Endoscopic Combined IntraRenal surgery in Galdakao-modified Valdivia position and Prone Split Leg position: A review of the current literature

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ABSTRACT

Introduction and Objectives. The study evaluates the impact of patient positioning on the outcomes of Endoscopic Combined Intrarenal Surgery (ECIRS), highlighting its role in optimizing the treatment of complex kidney stones with a focus on safety and efficacy.

Materials and Methods. An extensive review of the current literature was conducted on PubMed, Web of Science, and Scopus databases in alignment with PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analysis guidelines) criteria [8] using the following keywords: "prone split leg position", "Galdakao modified supine Valdivia position", "ECIRS", "endoscopic combined intrarenal surgery". A total of 987 papers were identified and after applying the defined eligibility criteria 24 studies were included. A narrative synthesis was chosen as the method for analyzing the data extracted from the selected studies.

Results. The safety and efficacy of Endoscopic Combined Intrarenal Surgery (ECIRS) in Galdakao-modified supine Valdivia (GMSV) and Prone Split-Leg (PSL) positions were analysed for 1865 patients undergoing ECIRS in the GMSV position and 510 in the PSL position, primarily for staghorn, partial, or complete calculi. Surgical duration was comparable across both positions, ranging from 70 to 158 minutes, with hemoglobin decreases generally staying below 1.5 g/dL. For both positions a single tract was usually needed for the anterograde approach with comparable rate of success defined as stone free rate and a comparable percentage of complications, the most common being Grade I and II according to the Clavien-Dindo classification.

Conclusion. ECIRS in both Galdakao modified supine Valdivia position and Prone split leg position represents a viable and safe option for treating complex renal stones but further studies of good quality are needed to establish deeper insights into the comparative benefits of each position.

Key-words: ECIRS, endoscopic combined intrarenal surgery, Galdakao modified supine Valdivia position, prone split leg position

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INTRODUCTION AND OBJECTIVES

The challenge posed by complex cases of renal lithiasis led urologists to imagine new endourological approaches of the collecting system with the aim of improving the results and increasing the safety of these difficult procedures. A solution that seemed to meet a significant part of the requests was the Endoscopic Combined Intra-Renal Surgery (ECIRS). This procedure implies the use of various endoscopes, both rigid and flexible and a simultaneous retrograde and anterograde approach, in other words, it combines the percutaneous nephrolithotomy (PNL) and the Retrograde Intrarenal Surgery to provide more efficacy with a good safety profile in complex cases.
The dawn of this technique was recorded in the US in 1988, where Lehman and Bagley described for the first time a combined access of the upper urinary tract both in an anterograde and retrograde manner with the patient in a reverse lithotomy position [1], but only 20 years later, in 2008, this technique receives the name of Endoscopic combined Intrarenal Surgery(ECIRS) from Scoffone et al, pioneers in this field[2].

The existing body of published literature on this subject mainly emphasizes the role of ECIRS as a tailored approach to high volume renal stones or intricate kidney-ureteral stone disease, adding the advantages provided by flexible ureteroscopy to single access PNL. These are represented by visualizing the real-time intraoperative anatomy, reaching calyces otherwise difficult to reach by PNL alone, facilitating renal puncture and dilation, endovision renal puncture with through-and-through guidewire and the possibility of raising the rate of stone free by enabling the surgeon to identify and remove residual fragments [3]. In Endoscopic Combined Intrarenal Surgery (ECIRS), patient positioning plays a pivotal role.

This paper focuses on the two most frequently used positions for this procedure: the prone split-leg position and the Galdakao-modified supine Valdivia position, each offering distinct advantages and considerations for urologists.

The prone split-leg position, traditionally favored for its direct access to the renal anatomy, facilitates a straightforward pathway for renal stone management. This position allows for gravity-assisted drainage, potentially reducing the risk of infectious complications [4]. However, it poses challenges, including difficulties in airway management and limited access for the anesthesiology team, which may complicate the procedure for patients with severe comorbidities [5].

Conversely, the Galdakao-modified supine Valdivia position, a variant of the supine position, enables simultaneous antegrade and retrograde access to the urinary tract. This position is particularly beneficial for complex stone burdens or anatomical anomalies [6]. It offers improved patient comfort and easier airway management, making it a preferable choice for patients with respiratory or cardiovascular issues. Additionally, the supine position facilitates better ergonomics for the surgical team, potentially reducing operative times [7].

The choice between the prone split-leg and Galdakao-modified supine Valdivia positions in ECIRS depends on multiple factors, including the patient's clinical profile, the nature of the renal pathology, and the surgeon's expertise and preference. A thorough understanding of the advantages and limitations of each position is essential for optimizing patient outcomes in ECIRS.
The purpose of this study is to review the safety and efficacy of Endoscopic Combined Intrarenal Surgery (ECIRS) with respect to the choice of patient positioning during the procedure.

The primary goal of this review is to evaluate the variations in surgical duration, number of PNL tracts, hemoglobin drop, hospital stay length, and complication rates associated with ECIRS when performed in the prone split-leg position compared to the Galdakao-modified supine Valdivia position. Additionally, as a secondary aim, this analysis seeks to explore the stone-free rates achieved with each of these positioning strategies.

MATERIALS AND METHODS

An extensive review of the current literature was conducted on PubMed, Web of Science, and Scopus databases in alignment with PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analysis guidelines) criteria [8] using the following keywords: "prone split leg position", "Galdakao modified supine Valdivia position", "ECIRS", "endoscopic combined intrarenal surgery".

Our search was devoid of restrictions regarding publication period, but only papers in English were included. To enhance specificity, titles and abstracts were screened in a standardized manner and a manual search was also conducted through the references of selected articles to identify any additional studies that met the inclusion criteria. A narrative synthesis was chosen as the method for analyzing the data extracted from the selected studies.

Eligibility criteria: The study designs included randomized controlled trials (RCTs), comparative studies, and case series with at least 30 patients. Only studies that explicitly described the intervention as endoscopic combined intrarenal surgery for the treatment of renal and or reno-ureteral calculi were included. Another inclusion criterion was represented by the position in which ECIRS was performed, consequently, only patients who underwent the procedure in Galdakao modified supine Valdivia position and prone split leg position were eligible.

Ineligibility criteria: Papers were excluded if they were congress abstracts, editorials, expert opinions, case reports, book chapters, reviews, meta-analyses, or if they lacked data about the surgical position employed for ECIRS or outcome data. Studies in which ECIRS was used for treating other pathologies like incrusted stents and ureteral strictures were not eligible.

The literature search yielded 987 papers. After excluding 891 duplicates, congress abstracts, and book chapters, 96 studies remained for screening. Subsequently, 71 papers were excluded for being case reports, expert opinions, editorials, reviews, meta-analyses, having other indications or positions for ECIRS, or containing insufficient data. The full texts of the remaining 24 studies were examined and included in the review. Figure 1 presents the PRISMA flow diagram.

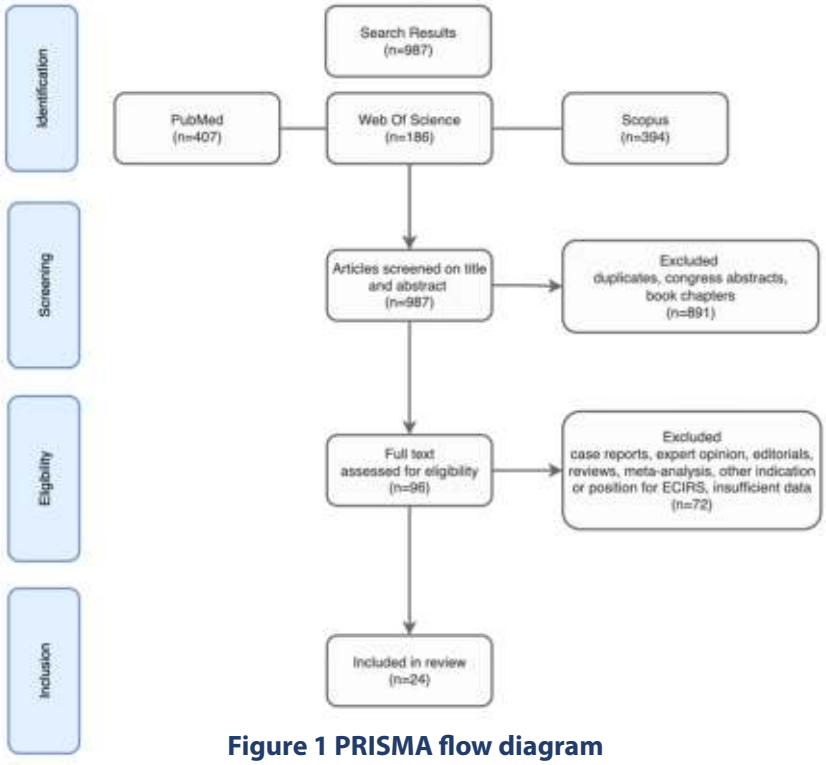


Figure 1 PRISMA flow diagram

RESULTS

Of the 24 eligible studies, three of them were prospective, and 21 were retrospective studies. In terms of study design only one Randomized Control Trial was encountered, the other selected studies were 16 comparative studies and seven case series. ECIRS in Galdakao-modified supine Valdivia position (GMSV) was described in 14 [2], [9-21] studies and right studies described the procedure in the Prone Split Leg position (PSL) [22-29]. Two studies had patients undergoing ECIRS both in GMSV and PSL position [30],[31].

The total number of patients across the studies who received ECIRS in GMSV position was 1865, the smallest number was reported by Jung [15] 30 patients, and the largest by Tabei [19] 370. As for PSL position we recorded a total number of 510 patients, Sugino [25] and Hamamoto [26] enrolled 30 patients in their studies and the largest number was reported in another study of Hamamoto [30],118 patients.

The type of calculi treated by ECIRS both in GMSV and PSL positions were mainly staghorn, partial, or complete, as illustrated in Tables 1 and 4.

For ECIRS in GMSV position the number of tracts needed for the anterograde approach varied from one to three as follows: ten studies reported using a single tract for the procedure [2], [10], [11],[13-17],[20],[31], three studies indicated the use one to two tracts [9],[30],[19] and two studies a range of one to three [18],[21], as showed in Table 2.

The mean surgical time for ECIRS in GMSV position ranged from 70 to 158 min [9],[17] with a significant variability across the studies, one of the causes being the lack of standardization for reporting this parameter, only two authors [30],[17] clearly explained how the surgical time was calculated (from cystoscopy to double J placement) and if the time for repositioning of the patient, if need, was included in the overall surgical time.

Regarding hemoglobin levels post-ECIRS in GMSV position, the values ranged between 0.41 and 2.03 g/dL, with the smallest decrease documented by Zhao [14] and the largest identified by Usui [13], but most of the studies reported a hemoglobin drop ≤1,5g/dl.

The range of hospitalization stay exhibits a notable variance, with the minimum length of stay being one day. This shortest duration is consistently observed across several studies, including those conducted by Goktug [9], Jung [11], Otsuka [12], Zhao [14], and Manikandan [18]. At the other end of the spectrum, the maximum reported hospitalization span extends to 12,8 days, as reported in Inonue's study [17] though the overall rate of complications for this study is only 7,3% or Wen [20] who reports also a long hospital stay, around ten days, the reason given is logistic problems, the difficulty of investigation and following patients in local hospitals.

Regarding complication rate, the overall percentage ranged from 7,3% [17] to 44.2% [13] as shown in Table 3. Most of the reported complications were categorized as I and II according to the Clavien-Dindo classification and they ranged from 1,55% [21] to 27,1% [12]. Grade III complications reported across the studies was 1.07%. The minimum reported incidence was 0.64% by Usui [13] and the maximum was 6.29% by Scoffone [2]. The incidence of Grade IV complications ranged from a minimum of 1.29% in the study by Usui [13], with several studies reporting none, to a maximum of 2.22% reported by Goktug [9]. No grade V Clavien-Dindo complication was reported.

In evaluating the effectiveness of ECIRS in GMSV position, stone-free rates exhibited notable variation across studies, particularly when considering the lowest and highest percentages achieved. The three studies with the lowest stone-free rates were Usui at 52% [13], Goktug at 64.4% [9], and Kuroda at 65.3% [21]. Conversely, the highest rates were observed in Otsuka at 97.2% [12], and Moon at 88%.[10] as shown in Table 3.

The criterion for defining a stone free status post-procedure was notably diverse across the reviewed studies, highlighting a significant challenge in comparing efficacy. Eight studies adopted a

threshold of 4mm as the definition of stone free, four studies set the limit at 3 mm, one study at 2mm, and another one defined stone free status as the total absence of residual fragments.

Table 1 Study type and stone features for ECIRS in GMSV position

Author	Study	No ECIRS patients	Stone dimension	Stone density (HU)	Stone type	Side (kidney)		Stone free definition
						Left	Right	
Goktug, 2023	Co.S Retrospective	45	900 (780 -1500) mm²	990(800 -1500)	Staghorn	21	24	<4 mm
Moon, 2023	Co.S Retrospective	200	29.76±14.35 mm	995.12±366.8	C.S./ Staghorn	N/A	N/A	<3 mm
Abouelgreed, 2022	Ca.Se Prospective	33	678.29±223.11 mm²	N/A	C.S.	17	16	< 4mm
Jung, 2022	Co.S Retrospective	100	28.7±15.2 mm	1013.9±360.0	C.S.	61	39	<3 mm
Otsuka, 2022	Co.S Retrospective	107	20.5 (8.7 -72.7) mm²	1104 (187 - 1864)	C.S.	56	51	<2 mm
Hamamoto, 2021	Co.S Retrospective	100	529.5 (224.6 - 951.6) mm²	1173.0 (979.0 - 1357.8)	C.S./ Staghorn	49	51	<3 mm
Usui, 2020	Co.S Retrospective	154	555.51±491.00 648.06±436.13mm²	1113.51±306.76 1139.70±307.58	C.S./ Staghorn	87	67	<4 mm
Zhao, 2019	Co.S Retrospective	66	640.21±377.22mm²	N/A	C.S./ Staghorn	32	35	<4 mm
Jung, 2018	Ca.Se Retrospective	30	28.86±14.86mm	961.23±365.74	C.S.	26	22	N/A
Leng, 2017	Co.S Retrospective	87	52.77mm	N/A	C.S./ Staghorn	N/A	N/A	<4 mm
Inoue, 2016	Ca.Se Retrospective	41	45.5±14.7mm	1106.8±322.1	C.S./ Staghorn	N/A	N/A	<4 mm
Manikandan, 2016	Ca.Se Retrospective	43	28.0±11.4mm	N/A	C.S./ Staghorn	18	25	<3 mm

GMSV=Galdakao-modified supine Valdivia, ECIRS = Endoscopic Combined IntraRenal Surgery, Co.S = Comparative Study, Ca.Se. = Case Series, RCT = Randomized controlled trial, N/A = Not Available, HU = Hounsfield units, C.S. = Complex Stones

Table 2 Technical features for ECIRS in GMSV position.

Author	Ureteroscope	Access Sheath	URS lithotripsy	Nephroscope	No of tracts	PNL lithotripsy
Goktug, 2023	7.5F Flexible	9.5-11.5F	Ho-YAG 4–12W 200 or 365 µm at 5-10 Hz	27F	1-2	Ballistic
Moon, 2023	Flexible Boston Scientific	11F/13F	Ho-YAG	12F or 20F	1	Hol-YAG
Abouelgreed, 2022	7.5F Flex X -2, Karl Storz	10/12F	Ho-YAG 200 µm 0.5 to 1.0 J at 5 to 10 Hz	18F Karl Storz	1	Ballistic/ Ultrasonic
Jung, 2022	Flexible	11-13F	N/A	18F Cook Medical; 15 - 16F Karl Storz; 24/30F Boston Scientific	1	N/A
Otsuka, 2022	URF-P5, Olympus	12F	Ho-YAG	26F	N/A	Ho-YAG
Hamamoto, 2021	URF-V2: Olympus;	9.5-16F	Ho-YAG	17.5-24F Karl Storz	1-2	Ballistic
Usui, 2020	Flexible	11-13F 13-15F	Ho-YAG	16.5F mini 24F-30F Karl Storz	1	Ho-YAG Ballistic
Zhao, 2019	7.5F Flexible	12-14F	Ho-YAG 200 µm 0.5 to 1.0 J at 30 to 40 Hz	16-18F	1	Ho-YAG 550 µm 1.5 to 3.0 J at 20 to 30 Hz
Jung, 2018	Flexible	N/A	Ho-YAG 200 µm	18F Cook Medical 24F (Boston Scientific)	1	Ballistic
Leng, 2017	URF-P5, Olympus	N/A	Ho-YAG 200 µm	16F	1	Ho-YAG

GMSV=Galdakao-modified supine Valdivia, URS = Ureteroscopy,
Ho-YAG= holmium-yttrium-aluminum-garnet, PNL = Percutaneous Nephrolithotomy, N/A=not available

Table 3 Outcomes for ECIRS in GMSV position.

Author	Surgical time (min)	Hemoglobin drop / Blood loss	Complications (Clavien -Dindo)	Hospitalization stay (day)	Stone free rate %	Stone free imaging
Goktug, 2023	70 (58 -110)	1.6 (1 -3) g/dL	15.5% 1 (2.2%) grade IV 1 (2.2%) grade III 4 (8.8%) grade II	2 (1 -3)	64.4	KUB and US
Moon, 2023	79.69±32.50	27.88±71.53ml	N/A	2 (1.75 -3)	88	NCCT
Abouelgreed, 2022	121.54±26.73	124.78±34.88 ml	21.2% 6 (18.2%) grade II	6.66±1.10	78.8	NCCT and KUB
Jung, 2022	82.23±35.68	1.21±1.17g/dL	N/A	2 (1 -3)	70	KUB
Otsuka, 2022	81 (29 -195)	1.3 (0.9 -3.7) g/dL	28% 1 (0.9%) grade III 29 (27.1%) grade II	5 (1 -36)	97.2	KUB
Hamamoto, 2021	126.0 (91.8 - 150.0)	0.8 (0.4 -1.3) ng/mL	20% 3 (3%) grade III 7 (7%) grade II	N/A	76	KUB and US
Usui, 2020	131.16±34.60 132.60±35.01	1.95±1.21 2.03±1.36 g/dL	31.2% 44.2% 2 (1.3%) /2 (1.3%) grade IV 0/1 (0.64%) grade III 13 (8.44%) /17 (11.03%) grade II	7.3 8.7	61.1 52.0	NCCT
Zhao, 2019	79.77±35.24	0,41 g/dL	7.5% 3 (4.54%) grade II	3 (1 - 7)	88.1	NCCT and KUB
Jung, 2018	89.23±36.14	N/A	N/A	3.63±7.77	86.7	N/A
Leng, 2017	87.5±15.47	1.561±0.371 g/dL	14.9% 2 (2.29%) grade II	9.659±3.52	79.5	KUB and CT
Inoue, 2016	158.4±51.3	1-2 g/dL	7.3% 3 (7.31%) grade II	12.8±7.3	73.2	KUB and US

GMSV=Galdakao-modified supine Valdivia, KUB = Kidney Ureter Bladder X-ray, US = Ultrasound, NCCT = Non-contrast Computed Tomography, CTU = Computed Tomography Urography, N/A = Not Available

For ECIRS in the Prone Split-Leg position five studies [24],[26],[28],[29],[31], utilized a single tract for PNL, one study used one to two [30] and one reported using one to three tracts for anterograde access [23]. Additionally, three studies did not specify the number of tracts used.

The shortest surgical time recorded was 47 minutes in Kallidonis' study [23] followed by Gao [24] at a mean of 63.27 minutes and the longest duration was reported by Hamamoto [28] with an average of 143.2 minutes. The hospital stay ranged for ECIRS in PSL position between 1,9 days [22] and nine days as reported by Yamashita [27].

The minimum hemoglobin loss was noted in Sugino's study at 0.88 g/dL [25] and the maximum noted by Kai was 1,58 g/dl [22]. The reported values for each study are detailed in Table 6.

Concerning the assessment of safety for ECIRS in PSL the overall rate of complications varies across the studies as follows: the minimum rate is reported by Hamamoto at 8,5% [26] and the maximum by Yamashita at 32% [27].

Complication severity, categorized according to the Clavien-Dindo classification, showed that grade I and II complications were the most frequently reported ranging from 0.33% [26] to 29.33% [27], most of them were febrile UTIs and cases requiring blood transfusions. The presence of grade III complications was reported in three studies [26],[27],[30], ranging from 0.33% to 4,23%, the authors mentioned cases of urinary tract injuries, or renal hemorrhage requiring angioembolization.
Only two studies reported grade IV complications, described as thoracic injury and sepsis, Hamamoto 2017[26] and Hamamoto,2021 [30] at 0,33% and 0.84% respectively.

In assessing the success of ECIRS in PSL position, the stone-free rate was overviewed.

The studies presenting the lowest stone-free rate were Yamashita [27] at 69.3% and Kai [22] at 75%, and the highest stone-free achievements were noted by Sugino [25] at 93.3% and Gao [24] at 97.8%.

As mentioned previously for ECIRS in GMSV position, the stone free rate definition was heterogeneous among the studies as shown in Table 6.

Table 4 Study type and stone features for ECIRS in PSL position

Author	Study	No ECIRS patients	Stone dimension	Stone density (HU)	Stone type	Side (kidney)		Stone free definition
						Left	Right	
Kai, 2023	Ca.Se. Retrospective	44	26.1±12.7 mm	1126.5±280.9	C.S./ Staghorn	22	22	<4 mm
Abouelgreed, 2022	Co.S Prospective	33	665.28±229.74 mm²	N/A	C.S.	16	17	< 4mm
Kallidonis, 2022	Co.S Prospective	33	35 (28.5 -43.5) mm	N/A	C.S./ Staghorn	N/A	N/A	Absence
Hamamoto, 2021	Co.S Retrospective	118	393.2 (261.2 - 663.6) mm²	1159.5 (919.1 - 1419.8)	C.S./ Staghorn	67	51	<3 mm
Gao, 2019	Co.S Retrospective	45	26±12mm	N/A	C.S./ Staghorn	18	27	<4 mm
Sugino, 2018	Co.S Retrospective	30	495.4±146.7mm² 531.0±102.9mm²	1051.6±39.0 946.0±94.6	C.S./ Staghorn	18	12	<4 mm
Hamamoto, 2017	Co.S Retrospective	30	627.7±129.3mm² 658.5 ± 136.8	627.7 ± 129.3 658.5 ± 136.8	C.S./ Staghorn	16	14	<4 mm
Yamashita, 2017	Ca.Se. Retrospective	75	147.1mm²	966 (299 -1727)	C.S./ Staghorn	44	31	<4 mm
Hamamoto, 2015	Ca.Se. Retrospective	42	959.2±111.3mm²	1031.2±46.2	C.S./ Staghorn	29	12	<4 mm
Hamamoto, 2014	Ca.Se. Retrospective	60	39.2±2.6mm	1043.7±36.2	C.S./ Staghorn	39	21	<4 mm

PSL= prone split leg position, ECIRS = Endoscopic Combined IntraRenal Surgery, Co.S = Comparative Study, Ca.Se. = Case Series, N/A = Not Available, HU = Hounsfield units, C.S. = Complex Stones

Table 5 Technical features for ECIRS in PSL position.

Author	Ureteroscope	Access Sheath	URS lithotripsy	Nephroscope	No of tracts	PNL lithotripsy
Kai, 2023	Flexible	11F/13F	Ho-YAG	18F to 20F	N/A	Ho-YAG
Abouelgreed, 2022	7.5F Flex X -2, Karl Storz	10/12F	Ho-YAG 200 µm 0.5 to 1.0 J at 5 to 10 Hz	18F Karl Storz	1	Ballistic/ Ultrasonic
Kallidonis, 2022	Flex-XC, Karl Storz	12-14F	Ho-YAG	22F or 30F	1-3	Ho-YAG 1 and 2 J at 30 to 60 Hz Ballistic
Hamamoto, 2021	URF-V2: Olympus;	9.5-16F	Ho-YAG	17.5-24F Karl Storz	1-2	Ballistic
Gao, 2019	Flexible	N/A	HolYAG	18F	1	Ultrasonic
Sugino, 2018	Flexible	12-14F	N/A	N/A	N/A	N/A
Hamamoto, 2017	URF-V2, Olympus	12-14F	Ho-YAG	18F Karl Storz	1	Ballistic
Yamashita, 2017	Flexible	12-14F 14-16F	Ho-YAG 200 lm	16.5-19.5F	N/A	Ballistic
Hamamoto, 2015	Flex X -2, Karl Storz	12-14F	Ho-YAG 0.5 to 1.0 J at 5 to 10 Hz	18F Karl Storz	1	Ballistic
Hamamoto, 2014	Flex X -2, Karl Storz	12-14F	Ho-YAG	18F Karl Storz	1	Ballistic

PSL= prone split leg position, URS = Ureteroscopy, Ho-YAG= holmium-yttrium-aluminum-garnet, PNL = Percutaneous Nephrolithotomy, N/A=not available

Table 6 Outcomes for ECIRS in PSL position.

Author	Surgical time (min)	Hemoglobin drop / Blood loss	Complications (Clavien -Dindo)	Hospitalization stay (day)	Stone free rate %	Stone free imaging
Kai, 2023	71.1±21.8	1.58±0.98 g/dL	13.6% 4 (9.1%) grade II	1.9±1.6	75	NCCT
Abouelgreed, 2022	118.87±27.12	125.55±36.70 ml	21.2% 5 (15.1%) grade II	6.71±1.12	81.8	NCCT and KUB
Kallidonis, 2022	47 (36 -65)	1.2 (1.1 -1.4) g/dL	9.1% 3 (9.1%) grade II	3 (2 -3)	81.8	KUB and US
Hamamoto, 2021	106.5 (82.3 - 143.8)	1.0(0.5 -1) ng/mL	31.3 1 (0.8%) grade IV 5 (4.2%) grade III 14 (11.8%) grade II	N/A	78.8	KUB and US
Gao, 2019	63.27±8.60	67.98±13.52 ml	28.9% 4 (8.8%) grade II	7.36±1.77	97.8	CT
Sugino, 2018	97.6±11.5 92.1±9.0	1.13±9.0 g/dL 0.88±9.0 g/dL	N/A	7.8±1.5 5.0±0.6	80 93.3	KUB
Hamamoto, 2017	102.9 ± 13.7 120.2 ± 11.5	0.93 ± 0.19 g/dL 1.39 ± 0.15 g/dL	26.67% 1 (0.3%) grade IV 1 (0.3%) grade III 1 (0.3%) grade II	4.9 ± 3.3 5.0 ± 0.7	80	KUB and US
Yamashita, 2017	124 (44 -220)	1.3 g/dl (0.8 to 6.2 g/dl)	32% 3 (4%) grade III 22 (29.3%) grade II	9 (3 -47)	69.3	NCCT
Hamamoto, 2015	143.2±9.2	1.43±0.2 g/dL	21.4% 1 (2.3%) grade II	6.8 - 0.5	83.3	N/A
Hamamoto, 2014	120.5±6.7	1.44±0.2 g/dL	8.4% 1 (1.6%) grade II	7±0.6	81.7	KUB and US

PSL= prone split leg position, KUB = Kidney Ureter Bladder X-ray, US = Ultrasound,
NCCT = Non-contrast Computed Tomography, CTU = Computed Tomography Urography, N/A = Not Available

DISCUSSION

Percutaneous nephrolithotomy (PNL) is the first therapeutical option for partial or complete staghorn calculi according to the current guidelines of the European Association, but the combination of PNL and retrograde intrarenal surgery (RIRS) is accepted as a good alternative for treating complex renal stones [32]. Even though the concept of a combined approach of the collecting system was born in the 80's, it only saw significant growth in recent years, driven by technological advancements, particularly in flexible scopes, thus more data is emerging from different studies. The main issue with the current data on ECIRS subject is the lack of enough good quality studies with a significant number of patients. In writing this review, we encountered the same setback. Among the 24 studies selected only one RCT [20] was found. When analyzing studies that can be classified as level of evidence three and four [34], the overall quality of data can be considered rather low.

Only two studies [30],[31] had as their primary goal the comparison between safety and efficacy of ECIRS in GMSV vs PSL position, while the majority analyzed the efficacy of ECIRS in GMSV or PSL position [2],[16],[18],[22],[28] or focused on the comparison between ECIRS in GMSV or PSL position with standard or miniaturized PNL[9],[10],[13],[14],[20],[24],[29].

Even though the heterogeneity of data in the reviewed studies was rather high, we can state that ECIRS employed both in GMSV or PSL position can reduce the number of tracts for the anterograde access compared to standard PNL, thus reducing the risk of bleeding. The majority of the analyzed studies used only one tract for PNL access and the reported hemoglobin drop across the studies was lees that 1,5 g/dl.

The combined use of PNL and RIRS determines a superior stone removal, on one hand due to easy access of the flexible scope to the upper calyces and the possibility of reaching stones located in a parallel calyx to the PNL tract and on the other hand because the flexible scope can shift fragments that can be removed with the help of the nephoscope.

The use of retrograde irrigation helps passive removal of small fragments through the nephoscope access sheath while lowering intrarenal pressure [15],[22],[31].

The presence of an access sheath has the clear advantage of preventing stone fragments migrated from the kidney to block the ureter. In all the analyzed studies such a sheath was used, variating in size from 9,5 to15 F, as shown Table 2 and Table 5. The diversity in the selection of both flexible and rigid scopes, alongside the range of energy sources for lithotripsy, did not impact the uniform achievement of high stone-free rates.

The average stone-free rate reported across studies hovered around 80%, yet the definition of this metric varied widely, as well as the differences in imaging techniques employed, and the moment in which this parameter was evaluated.

In terms of complications there were no notable difference between ECIRS in GMSV position compared to ECIRS in PSL position across the reviewed studies. Most of the reported complications were classified as Clavien -Dindo I and II, and the rate of grade III and IV was rather low. In one of the study [30] that directly compared GMSV vs. PSL for ECIRS, a greater incidence of urinary tract injuries and febrile urinary tract infections was noted. Though the overall outcomes in terms of safety and efficacy don't seem to differ significantly for the ECIRS in GMSV vs. ECIRS in PSL, there are advantages and disadvantages characteristic for each position both from the urological and anesthesiological point of view.

Galdakao modified supine position offers a considerable anesthesiological advantage regarding cardiovascular and respiratory dynamic, especially in obese patients [2],[6],[31]. Also, this position reduces the risk of neurological lesions and the rise in intraocular pressure described in PSL position. From the urological point of view this position allows a better access for introducing the flexible ureteroscope and has an increased rate of passive removal of stone fragments. The major disadvantages of this position are the rather difficult puncture for anterograde access, with a

significantly longer PNL tract, increasing the risk of bleeding as well as the fact that a constant collapse of the pyelocaliceal system happens in GMSV position. Prone split leg position offers a larger area for renal puncture and a decreased movement of the kidney allowing easy access to the renal pelvis [12]. The PNL tract is shorter, multiple tracts can be made if necessary and the percentage of organ lesion is lower than in GMSV position [28]. The fact that a better distention of the pyelocaliceal system can be obtained offers a better vision and allows a more efficient lithotripsy. The most frequently cited disadvantage for PSL position is the difficult retrograde access.

CONCLUSION

Although there is not enough good quality data to establish which of the two positions offers a better safety profile and superior outcome, ECIRS performed in either the GMSV or PSL position is a good, versatile, and safe alternative treatment of complex renal stones. The choice between positions should be tailored based on a thorough evaluation of anatomical, stone-specific, and surgeon-related factors. The analysis points to the necessity for standardized outcome reporting and further research, particularly through multicenter randomized controlled trials that will provide deeper insights into the comparative benefits of each position.

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