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Platinum Priority – Brief Correspondence

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Systematic Review and Meta-analysis of the Clinical Effectiveness of Shock Wave Lithotripsy, Retrograde Intrarenal Surgery, and Percutaneous Nephrolithotomy for Lower-pole Renal Stones

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Abstract

The prevalence of urolithiasis is increasing. Lower-pole stones (LPS) are the most common renal calculi and the most likely to require treatment. A systematic review comparing shock wave lithotripsy (SWL), retrograde intrarenal surgery (RIRS), and percutaneous nephrolithotomy (PNL) in the treatment of ≤20 mm LPS in adults was performed. Comprehensive searches revealed 2741 records; 7 randomised controlled trials (RCTs) recruiting 691 patients were included. Meta-analyses for stone-free rate (SFR) at ≤3 mo favoured PNL over SWL (risk ratio [RR]: 2.04; 95% confidence interval [CI], 1.50–2.77) and RIRS over SWL (RR: 1.31; 95% CI, 1.08–1.59). Stone size subgroup analyses revealed PNL and RIRS were considerably more effective than SWL for >10 mm stones, but the magnitude of benefit was markedly less for ≤10 mm stones. The quality of evidence (Grading of Recommendations Assessment, Development, and Evaluation [GRADE]) for SFR was moderate for these comparisons. The median SFR from reported RCTs suggests PNL is more effective than RIRS. The findings regarding other outcomes were inconclusive because of limited and inconsistent data. Well-designed, prospective, comparative studies that measure these outcomes using standardised definitions are required, particularly for the direct comparison of PNL and RIRS. This systematic review, which used Cochrane methodology and GRADE quality-of-evidence assessment, provides the first level 1a evidence for the management of LPS.

Patient summary: We thoroughly examined the literature to compare the benefits and harms of the different ways of treating kidney stones located at the lower pole. PNL and RIRS were superior to SWL in clearing the stones within 3 mo, but we were unable to make any conclusions regarding other outcomes. More data is required from reliable studies before firm recommendations can be made.

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The prevalence of urolithiasis is increasing [1]. Lower-pole stones (LPS), defined as stones lying within a lower (inferior) pole calyx, are the most common renal stones. LPS are more likely to require treatment because they are less likely to pass spontaneously. The treatment of LPS is controversial, especially ≤20 mm stones [2], with competing interventions possessing advantages and disadvantages. Treatment options include percutaneous nephrolithotomy (PNL), retrograde intrarenal surgery (RIRS), or shock wave lithotripsy (SWL).

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We performed a systematic review and meta-analysis to compare the benefits and harms of PNL, RIRS, and SWL in the treatment of LPS (≤20 mm) in adults. Only randomised controlled trials (RCTs) were included, and Cochrane Collaboration standards and Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were strictly followed (Supplement 1). The primary outcome was stone-free rate (SFR) at ≤3 mo. Risk of bias (RoB) and Grading of Recommendations Assessment, Development, and Evaluation (GRADE) assessments were performed to appraise the quality of the evidence (level 1a) synthesised.

The search identified 2741 records, which were doubly screened, and 21 articles were scrutinised for eligibility. Twelve articles reporting on 7 RCTs recruiting a total of 691 patients were included (PRISMA diagram; Supplementary Fig. 1). Baseline characteristics and intervention protocols are summarised in Supplementary Tables 1 and 2. RoB assessment findings included low risk of selection, attrition, and reporting biases in most studies (Supplementary Fig. 2). Two studies reported industry funding [3–5].

Table 1 summarises the study findings. GRADE quality assessment was moderate for SFR of RIRS versus SWL and PNL versus RIRS but was low or very low for all other outcomes (Supplementary Table 3). Meta-analysis was possible only for the outcome of SFR for PNL versus SWL and RIRS versus SWL (Fig. 1) because of clinical heterogeneity.

Table 1 – Summary of results

	Study ID	Outcome	No. of patients		Value, % (*n*)		RR (95% CI)*	*p* value*
			PNL	SWL	PNL	SWL		
PNL vs SWL	Albala et al [3]	SFR (3 mo), ≤20 mm	48	45	95.8 (46)	40 (18)	2.40 (1.67–3.44)	<0.00001
		SFR (3 mo), 1–10 mm	20	19	100 (20)	63.6 (12)	1.56 (1.11–2.21)	0.01
		SFR (3 mo), 11–20 mm	28	26	92.9 (26)	23.1 (6)	4.02 (1.98–8.18)	0.0001
		Unplanned procedures	49	55	2 (1)	20 (10)	0.11 (0.01–0.85)	0.03
		Retreatment	49	55	6.1 (3)	14.5 (8)	0.42 (0.12–1.50)	0.18
		Hospital stay, 0–30 mm	49	55	2.66 d	0.55 d	Unavailable**	<0.0001
	Yuruk et al [10]	SFR (3 mo), ≤20 mm	31	31	96.7 (30)	54.8 (17)	1.76 (1.27–2.44)	0.0006
		Unplanned procedures	31	31	0 (0)	3.2 (1)	0.33 (0.01–7.88)	0.50
		Retreatment	31	31	0 (0)	9.7 (3)	0.14 (0.01–2.66)	0.19
		Complications	31	31	6.5 (2)	6.5 (2)	1.00 (0.15–6.66)	1.00
			RIRS	SWL	RIRS	SWL		
RIRS vs SWL	Pearle et al [5]	SFR (3 mo), ≤10 mm	32	26	72 (23)	65 (17)	1.10 (0.77–1.57)	0.60
		Unplanned procedures	32	26	3.1 (1)	7.7 (2)	0.41 (0.04–4.23)	0.45
		Retreatment	32	26	3.1 (1)	11.5 (3)	0.27 (0.03–2.45)	0.25
		Complications, postop	33	30	21 (7)	23 (7)	0.91 (0.36–2.29)	0.84
		Procedure time, min ± SD	NR	NR	90.4 ± 43.8	66.5 ± 27.9	Unavailable**	0.01**
		Hospital stay	35	32	0.06 d	0 d	Unavailable**	0.68**
	Salem et al [7]	SFR (3 mo), ≤20 mm	30	30	96.7 (29)	56.7 (17)	1.71 (1.24–2.35)	0.001
		Complications	30	30	16.7 (5)	23.3 (7)	0.71 (0.25–2.00)	0.52
	Kumar et al [6]	SFR ≤20 mm (3 mo)	90	90	86.6 (78)	66.6 (60)	1.30 (1.10–1.54)	0.002
		SFR <10 mm (3 mo)	49	53	87.7 (43)	71.7 (38)	1.22 (1.00–1.49)	0.05
		SFR 10–20 mm (3 mo)	41	37	85.4 (35)	59.5 (22)	1.44 (1.07–1.93)	0.02
		Unplanned procedures	90	90	17.7 (16)	21.1 (19)	0.84 (0.46–1.53)	0.57
		Retreatment	90	90	1.1 (1)	67.1 (60)	0.02 (0.00–0.12)	<0.0001
		Complications	90	90	11.1 (10)	6.6 (6)	1.67 (0.63–4.39)	0.30
	Sener et al [8]	SFR <10 mm (3 mo)	70	70	100 (70)	91.5 (64)	1.09 (1.01–1.18)	0.02
		Unplanned procedures	70	70	0 (0)	1.4 (1)	0.33 (0.01–8.04)	0.50
		Retreatment	70	70	0 (0)	8.6 (6)	0.08 (0.00–1.34)	0.08
		Complications	70	70	2.8 (3)	5.7 (4)	0.75 (0.17–3.23)	0.70
	Singh et al [9]	SFR (1 mo) 10–20 mm	35	35	85.7 (30)	54.3 (19)	1.58 (1.13–2.20)	0.007
		Unplanned procedures	35	35	0 (0)	5.7 (2)	0.20 (0.01–4.02)	0.29
		Retreatment	35	35	14.3 (5)	45 (16)	0.31 (0.13–0.76)	0.01
		Complications	35	35	31.4 (11)	48.6 (17)	0.65 (0.36–1.17)	0.15
			RIRS	PNL	RIRS	PNL		
PNL vs RIRS	Kuo et al [4]	SFR (3 mo), 11–25 mm	13	15	45.6 (6)***	66.7 (10)***	1.44 (0.73–2.87)	0.29
		Secondary Rx	NR	NR	25.0%	9.1%	Unavailable**	0.59**
		Complications	NR	NR	0.0%	6.7%	Unavailable**	0.999**
		Hospital stay, d	NR	NR	0	2.8 ± 2.2	Unavailable**	<0.001**
		Procedure time, min ± SD	NR	NR	125 ± 49	111 ± 38	Unavailable**	NS**
		Mean recovery, d ± SD	NR	NR	10.0 ± 7.7	23.5 ± 20.5	Unavailable**	<0.05**

CI = confidence interval; NR = not reported; NS = not significant; PNL = percutaneous nephrolithotomy; RIRS = retrograde intrarenal surgery; RR = risk ratio; Rx = treatment; SFR = stone-free rate; SWL = shock wave lithotripsy.

* RR, 95% CI, and associated *p* values were calculated from primary study data where possible.

** Insufficient data reported for calculation. Where possible, reported *p* values are stated. No RRs were reported.

*** Numerators were not reported. These are estimates using reported percentages and denominators.