MEDwave

Living friendly summaries of the body of evidence using Epistemonikos (FRISBEE)
Medwave 2015;15(Suppl 2):e6254 doi: 10.5867/medwave.2015.6254

Shock wave lithotripsy, retrograde intrarenal surgery or percutaneous nephrolithotomy for lower pole renal stones?

Authors: Alejandro Rojas**[1,3]**, Héctor Gallegos**[1,3]**, José A. Salvadó**[2,3]**

Affiliation:
[1] Facultad de Medicina, Pontificia Universidad Católica de Chile, Santiago, Chile
[2] Departamento de Urología, Facultad de Medicina, Pontificia Universidad Católica de Chile, Santiago, Chile
[3] Proyecto Epistemonikos, Santiago, Chile

E-mail: jsalvado@med.puc.cl

Citation: Rojas A, Gallegos H, Salvadó JA. Shock wave lithotripsy, retrograde intrarenal surgery or percutaneous nephrolithotomy for lower pole renal stones?. *Medwave*2015;15(Suppl 2):e6254 doi: 10.5867/medwave.2015.6254

Publication date: 7/9/2015

Abstract

Among the therapeutic alternatives available for the treatment of lower pole renal calculi are extracorporeal lithotripsy, percutaneous nephrolithotomy and retrograde intrarenal surgery. There is controversy about which of these techniques is more effective, especially for stones smaller than 20 mm. Searching in Epistemonikos database, which is maintained by screening 30 databases, we identified four systematic reviews including 11 pertinent randomized controlled trials overall. We combined the evidence and generated a summary of findings following the GRADE approach. We concluded percutaneous nephrolithotomy probably increases success rate, but it is not clear if it decreases the need of retreatment compared to extracorporeal shock wave lithotripsy. In comparison to retrograde intrarenal surgery, it may increase success rate, but it is not clear if it decreases the need of retreatment. Retrograde intrarenal surgery may increase success rate, and probably decreases need of retreatment compared to extracorporeal shock wave lithotripsy.

Problem

Nephrolithiasis is a common urological disease in clinical practice. The probability of spontaneously eliminating stones mainly depends on their size and location. Renal lower pole stones have a very low probability of being eliminated so they occasionally require active treatment. Common therapeutic alternatives are extracorporeal lithotripsy, percutaneous nephrolithotomy and retrograde intrarenal surgery. There is controversy about which of these techniques is more effective, especially for stones smaller than 20 millimeters.

Methods

We used Epistemonikos database, which is maintained by screening more than 30 databases, to identify systematic reviews and their included primary studies. With this information we generated a structured summary using a pre-established format, which includes key messages, a summary of the body of evidence (presented as an evidence matrix in Epistemonikos), meta-analysis of the total of studies, a summary of findings table following the GRADE approach and a table of other considerations for decision-making.

Key messages

- Percutaneous nephrolithotomy probably increases stone free success rate compared to extracorporeal shock wave lithotripsy, but it is not clear if it decreases the need of retreatment because the certainty of the evidence is very low.
- Percutaneous nephrolithotomy may increase stone free success rate compared to retrograde intrarenal surgery, but it is not clear if it decreases the need of retreatment because the certainty of the evidence is very low.
- Retrograde intrarenal surgery may increase stone free success rate compared to extracorporeal shock wave lithotripsy, and probably decreases the need of retreatment.

About the body of evidence for this question

What is the evidence. See evidence matrix in Epistemonikos later	We found four systematic reviews [1],[2],[3],[4], that identified 19 pertinent primary studies reported in 25 references [5],[6],[7],[8],[9],[10],[11],[12],[13],[14], [15],[16],[17],[18],[19],[20],[21],[22],[23],[24],[25],[26], [27],[28], including 11 randomized controlled trials, reported in 17 references [6],[8],[9],[10],[15],[16],[17], [18],[21],[22],[23],[24],[25],[26],[27],[28]. This table and the summary in general are based on the latter.
What types of patients were included	All studies included patients with renal lower pole nephrolithiasis were included. The studies had a similar proportion of men and women, and they had a wide distribution in terms of age. All studies included patients over 18 years. Pretreatment average diameter of stones ranged between 4 mm and 30 mm.
What types of interventions were included	Four studies compared percutaneous nephrolithotomy to lithotripsy [6],[8],[23],[27],[28], five compared extracorporeal lithotripsy to retrograde intrarenal surgery [15],[16],[17],[21],[22],[24],[25],[26], and only one compared percutaneous nephrolithotomy to retrograde intrarenal surgery [18].
What types of outcomes were measured	Success of the intervention (defined as being stone free at different periods of follow-up), retreatment rate. Other outcomes were operative time, hospital stay, complication rate (defined as hematuria, fever, sepsis, ileus, etcetera) and quality of life. Length of follow-up ranged from 1 month to 16 months in the different studies.

Summary of findings

The information on the comparative effects of the different interventions for lower pole renal calculi is based on 11 studies including 885 patients.

1.- Percutaneous Nephrolithotomy versus shock wave lithotripsy

Four randomised controlled trials reported this comparison [6],[8],[23],[27],[28], including 340 patients overall. All studies reported success rate (stone free) at three months and only two studies reported need of retreatment.

- Percutaneous nephrolithotomy probably increases success rate compared to extracorporeal shock wave lithotripsy. The certainty of the evidence is moderate.
- It is not clear whether percutaneous nephrolithotomy decreases the need of retreatment because the certainty of the evidence is very low.

Percutaneous nephrolithotomy versus extracorporeal shock wave lithotripsy lower pole stone

Patients Lower pole renal calculi
Intervention Percutaneous nephrolithotomy (PCNL)
Comparison Extracorporeal shock wave lithotripsy (ESWL)

Outcomes	Absolute effect*		Relative effect (95% CI)	Certainty of the evidence (GRADE)
	WITH ESWL	**WITH PCNL**		
	Difference: patients per 1000			
Stone free	457 per 1000	900 per 1000	RR 1.97 (1.36 to 2.85)	⨁⨁⨁◯[1] Moderate
	Difference: 443 patients more per 1000 (Margin of error: 164 to 543 more)			
Retreatment	105 per 1000	144 per 1000	RR 1.37 (0.12 to 15.85)	⨁◯◯◯[1,2] Very low
	Difference: 39 patients more per 1000 (Margin of error: 93 less to 895 more)			

RR: Risk ratio.
Margin of error = 95% confidence interval (CI).
GRADE: evidence grades of the GRADE Working Group (see later in this article).

* The risk **WITH SWL** is based on the risk in the control group of the trials.
The risk **WITH PNL** (and its margin of error) is calculated from relative effect (and its margin of error).

1 There is inconsistency between studies (I^2=81% y 63% for stone free rate and retreatment respectively). Some do not show effect and others a very important effect.
2 The confidence interval includes the possibility of both options being clinically superior. The certainty provided by the evidence was downgraded in two levels.

2.- Retrograde intrarenal surgery versus percutaneous nephrolithotomy
Only one randomized trial evaluated this comparison [18], including 33 patients. Stone free rate and retreatment rate were reported at 3 months.

- Percutaneous nephrolithotomy might increase success rate compared to retrograde intrarenal surgery. The certainty of the evidence is low.
- It is unclear whether percutaneous nephrolithotomy decreases retreatment need compared to retrograde intrarenal surgery because the certainty of the evidence is very low.

Percutaneous neprholithotomy or retrograde intrarenal surgery for lower pole stone

Patients Lower pole stone
Intervention Percutaneous nephrolithotomy (PCNL)
Comparison Retrograde intrarenal surgery (RIRS)

Outcomes	Absolute effect*		Relative effect (95% CI)	Certainty of the evidence (GRADE)
	WITHRIRS	**WITH PCNL**		
	Difference: patients per 1000			
Stone free	312 per 1000	706 per 1000	RR 2.26 (1.03 to 4.97)	⨁⨁◯◯ [1,2] Low
	Difference: 394 patients more per 1000 (Margin of error: 9 to 688 more)			
Retreatment	188 per 1000	58 per 1000	RR 0.31 (0.04 to 2.71)	⨁◯◯◯ [1,2] Very low
	Difference: 130 patients less per 1000 (Margin of error: 180 less to 321 more)			

RR: Risk ratio.
Margin of error = 95% confidence interval (CI).
GRADE: evidence grades of the GRADE Working Group (see later in this article).

* The risk **WITH RIRS** is based on the risk in the control group of the trials.
The risk **WITH PNL** (and its margin of error) is calculated from relative effect (and its margin of error).

1 We downgraded the certainty of the evidence in one level because of risk of bias since the only trial was not blinded and did not report the information needed to assess other risk of bias criteria.
2 We downgraded the certainty of the evidence in one level because of imprecision. The confidence interval includes both a small and a large effect, which would lead to different decisions. For retreatment, the confidence interval includes superiority of each intervention.

3.- Retrograde intrarenal surgery versus shock wave lithotripsy
Five randomized controlled trials evaluated this comparison [15],[16],[17],[21],[22],[24],[25],[26], including 508 patients overall. All studies reported stone-free rate and retreatment need at three months.

- Retrograde intrarenal surgery might increase stone free rate compared to extracorporeal lithotripsy, but the certainty of the evidence is low.
- Retrograde intrarenal surgery probably reduces need for retreatment compared with extracorporeal lithotripsy. The certainty of the evidence is moderate.

Retrograde intrarenal surgery versus shock wave lithotripsy

Patients Lower pole stone
Intervention Retrograde intrarenal surgery (RIRS)
Comparison Shock wave lithotripsy (ESWL)

Outcomes	Absolute effect*		Relative effect (95% CI)	Certainty of the evidence (GRADE)
	WITH ESWL	WITH RIRS		
	Difference: patients per 1000			
Stone free	777 per 1000	940 per 1000	RR 1.21 (0.92 to 1.58)	⨁⨁◯◯ [1,2] Low
	Difference: 163 patients more per 1000 (Margin of error: 62 less to 451 more)			
Retreatment	334 per 1000	77 per 1000	RR 0.23 (0.07 to 0.73)	⨁⨁⨁◯ [1] Moderate
	Difference: 257 patients less per 1000 (Margin of error: 90 to 311 less)			

RR: Risk ratio.
Margin of error = 95% confidence interval (CI).
GRADE: evidence grades of the GRADE Working Group (see later in this article)

* The risk **WITH SWL** is based on the risk in the control group of the trials.
The risk **WITH RIRS** (and its margin of error) is calculated from relative effect (and its margin of error).

1We downgraded the certainty of the evidence in one level because of risk of bias. Studies lacked blinding, and did not report the information to assess other risk of bias criteria.
2 We downgraded the certainty of the evidence in one level because of imprecision. The confidence interval includes both a large superiority of intrarenal surgery as no difference between the two procedures, which would lead to different decisions.

About the certainty of the evidence (GRADE)*

⨁⨁⨁⨁
High: This research provides a very good indication of the likely effect. The likelihood that the effect will be substantially different† is low.

⨁⨁⨁◯
Moderate: This research provides a good indication of the likely effect. The likelihood that the effect will be substantially different† is moderate

⨁⨁◯◯
Low: This research provides some indication of the likely effect. However, the likelihood that it will be substantially different† is high.

⨁◯◯◯
Very low: This research does not provide a reliable indication of the likely effect. The likelihood that the effect will be substantially different† is very high.

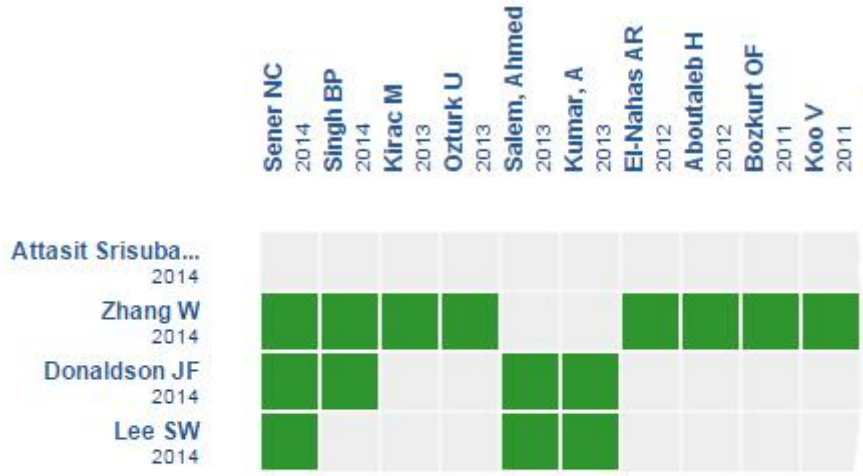
*This concept is also called 'quality of the evidence' or 'confidence in effect estimates'.
† Substantially different = a large enough difference that it might affect a decision.

Other considerations for decision-making

To whom this evidence does and does not apply
• The evidence included in this summary widely applies to patients with lower pole nephrolithiasis, independent of gender and age, provided they are over 18. As for the size of stones, patients had a minimum diameter of 4 mm and a maximum of 30 mm, being the average in most studies 10-20 mm.
About the outcomes included in this summary
• Stone free and need for retreatment were the outcomes selected, which are critical for decision making in the view of the authors of this summary.
Balance between benefits and risks, and certainty of the evidence
• It is not possible to adequately estimate benefit/risk, due to the very low certainty of the evidence for some critical for decision-making outcomes.
Resource considerations
• It is not possible to make an adequate estimate of cost/benefit, due to the very low certainty of the evidence for some critical outcomes.
Differences between this summary and other sources
• The main conclusion of this summary, i.e. percutaneous nephrolithotomy has a higher success rate for lower pole kidney stones, is consistent with that expressed in the four systematic reviews identified. • The conclusion is also in agreement with the main clinical guidelines [30].
Could this evidence change in the future?
• The likelihood of future evidence changing the information presented in this summary is high due to the very low certainty of the evidence for some critical for decision-making outcomes.

How we conducted this summary

Using automated and collaborative means, we compiled all the relevant evidence for the question of interest and we present it as a matrix of evidence.



Starting from any systematic review, Epistemonikos builds a matrix based on existing connections in the database.
The author of the matrix can select relevant information for a specific health question (typically in PICO format) in order to display the information set for the question.
The *rows* represent systematic reviews that share at least one primary study, and *columns* display the studies.
The boxes in green correspond to studies included in the respective reviews.

Follow the link to access the **interactive version:** Extracorporeal shock wave lithotripsy, percutaneous nephrolithotomy or retrograde intrarenal surgery for lower pole renal stones

Notes

The upper portion of the matrix of evidence will display a warning of "new evidence" if new systematic reviews are published after the publication of this summary. Even though the project considers the periodical update of these summaries, users are invited to comment in *Medwave* or to contact the authors through email if they find new evidence and the summary should be updated earlier. After creating an account in Epistemonikos, users will be able to save the matrixes and to receive automated notifications any time new evidence potentially relevant for the question appears.

The details about the methods used to produce these summaries are described here http://dx.doi.org/10.5867/medwave.2014.06.5997.

Epistemonikos foundation is a non-for-profit organization aiming to bring information closer to health decision-makers with technology. Its main development is Epistemonikos database (www.epistemonikos.org).

These summaries follow a rigorous process of internal peer review.

Conflicts of interest
The authors do not have relevant interests to declare.

References

1. Srisubat A, Potisat S, Lojanapiwat B, Setthawong V, Laopaiboon M.Extracorporeal shock wave lithotripsy (ESWL) versus percutaneous nephrolithotomy (PCNL) or retrograde intrarenal surgery (RIRS) for kidney stones. Cochrane Database Syst Rev. 2014 Nov 24;11:CD007044.| CrossRef | PubMed |
2. Donaldson JF, Lardas M, Scrimgeour D, Stewart F, MacLennan S, Lam TB, et al. Systematic review and meta-analysis of the clinical effectiveness of shock wave lithotripsy, retrograde intrarenal surgery, and percutaneous nephrolithotomy for lower-pole renal stones. Eur Urol. 2015 Apr;67(4):612-6. | CrossRef | PubMed |
3. Lee SW, Chaiyakunapruk N, Chong HY, Liong ML. Comparative effectiveness and safety of various treatment procedures for lower pole renal calculi: a systematic review and network meta-analysis. BJU Int. 2015 Aug;116(2):252-64. | CrossRef | PubMed |
4. Zhang W, Zhou T, Wu T, Gao X, Peng Y, Xu C, et al. Retrograde Intrarenal Surgery Versus Percutaneous Nephrolithotomy Versus Extracorporeal Shockwave Lithotripsy for Treatment of Lower Pole Renal Stones: A Meta-Analysis and Systematic Review. J Endourol. 2015 Jul;29(7):745-59. | CrossRef | PubMed |
5. Aboutaleb H, El-Shazly M, Badr Eldin M. Lower pole midsize (1-2 cm) calyceal stones: outcome analysis of 56 cases. Urol Int. 2012;89(3):348-54. | CrossRef | PubMed |
6. Albala DM, Assimos DG, Clayman RV, Denstedt JD, Grasso M, Gutierrez-Aceves J, et al. Lower pole I: a prospective randomized trial of extracorporeal shock wave lithotripsy and percutaneous nephrostolithotomy for lower pole nephrolithiasis-initial results. J Urol. 2001 Dec;166(6):2072-80. Erratum in: J Urol 2002 Apr;167(4):1805. | PubMed |
7. Bozkurt OF, Resorlu B, Yildiz Y, Can CE, Unsal A. Retrograde intrarenal surgery versus percutaneous nephrolithotomy in the management of lower-pole renal stones with a diameter of 15 to 20 mm. J Endourol. 2011 Jul;25(7):1131-5. | CrossRef | PubMed |
8. Carlsson P, Kinn AC, Tiselius HG, Ohlsén H, Rahmqvist M. Cost effectiveness of extracorporeal shock wave lithotripsy and percutaneous nephrolithotomy for medium-sized kidney stones. A randomised clinical trial. Scand J Urol Nephrol. 1992;26(3):257-63. |PubMed |
9. Deem S, Davalos J, DeFade B, Martinez F. Percutaneous nephrolithotomy versus extracorporeal shockwave lithotripsy for moderate sized kidney stones. J of Urology. 2010;183(4):e702-e3. | CrossRef |
10. Deem S, Defade B, Modak A, Emmett M, Martinez F, Davalos J. Percutaneous nephrolithotomy versus extracorporeal shock wave lithotripsy for moderate sized kidney stones. Urology. 2011 Oct;78(4):739-43. | CrossRef | PubMed |
11. El-Nahas AR, Ibrahim HM, Youssef RF, Sheir KZ. Flexible ureterorenoscopy versus extracorporeal shock wave lithotripsy for treatment of lower pole stones of 10-20 mm. BJU Int. 2012 Sep;110(6):898-902. | CrossRef | PubMed |
12. Havel D, Saussine C, Fath C, Lang H, Faure F, Jacqmin D. Single stones of the lower pole of the kidney. Comparative results of extracorporeal shock wave lithotripsy and percutaneous nephrolithotomy. Eur Urol. 1998;33(4):396-400. | PubMed |
13. Kirac M, Bozkurt ÖF, Tunc L, Guneri C, Unsal A, Biri H. Comparison of retrograde intrarenal surgery and mini-percutaneous nephrolithotomy in management of lower-pole renal stones with a diameter of smaller than 15 mm. Urolithiasis. 2013 Jun;41(3):241-6. | CrossRef |PubMed |
14. Koo V, Young M, Thompson T, Duggan B. Cost-effectiveness and efficiency of shockwave lithotripsy vs flexible ureteroscopic holmium:yttrium-aluminium-garnet laser lithotripsy in the treatment of lower pole renal calculi. BJU Int. 2011 Dec;108(11):1913-6. | CrossRef |PubMed |
15. Kumar A, Vasudeva P, Nanda B, Kumar N, Das MK, Jha SK. A Prospective randomized comparison between shock wave lithotripsy and flexible reterorenoscopy for lower caliceal stones ≤2 cm: a single-center experience. J Endourol. 2015 May;29(5):575-9. | CrossRef |PubMed |
16. Kuo RL, Lingeman JE, Leveillee RJ. Lower pole II: Initial results from a comparison of extracorporeal shock wave lithotripsy, ureteroscopy and percutaneous nephrostolithotomy for lower pole nephrolithiasis. J of Endourology. 2002;16(Suppl):A60.
17. Kuo RL, Lingeman JE, Leveillee RJ. Lower pole II: initial results from a comparison of shock wave lithotripsy (SWL), ureteroscopy (URS), and percutaneous nephrostolithotomy (PNL) for lower pole nephrolithiasis. J of Urology. 2003;169(Suppl):486.
18. Kuo RL, Lingeman JE, Leveillee RJ, Pearle MS, Watkins S. A randomized clinical trial of ureteroscopy and percutaneous nephrolithotomy for lower pole stones between 11 and 25 mm. Journal of Endourology. 2003;17:A31.
19. Netto NR Jr, Claro JF, Lemos GC, Cortado PL. Renal calculi in lower pole calices: what is the best method of treatment? J Urol. 1991 Sep;146(3):721-3. | PubMed |
20. Ozturk U, Sener NC, Goktug HN, Nalbant I, Gucuk A, Imamoglu MA. Comparison of percutaneous nephrolithotomy, shock wave lithotripsy, and retrograde intrarenal surgery for lower pole renal calculi 10-20 mm. Urol Int. 2013;91(3):345-9. | CrossRef | PubMed |
21. Pearle MS, Lingeman JE, Leveillee R, Kuo R, Preminger GM, Nadler RB, et al. Prospective, randomized trial comparing shock wave lithotripsy and ureteroscopy for lower pole caliceal calculi 1 cm or less. J Urol. 2005 Jun;173(6):2005-9. | PubMed |
22. Pearle MS, Lingeman JE, Leveillee R, Kuo R, Preminger GM, Nadler RB, et al. Prospective randomized trial comparing shock wave lithotripsy and ureteroscopy for lower pole caliceal calculi 1 cm or less. J Urol. 2008 May;179(5 Suppl):S69-73. | CrossRef | PubMed |
23. Preminger GM. Management of lower pole renal calculi: shock wave lithotripsy versus percutaneous nephrolithotomy versus flexible ureteroscopy. Urol Res. 2006 Apr;34(2):108-11. Epub 2006 Feb 7. | PubMed |
24. Salem A, Saad I, Emran A, Abdelhakiem M, Abdelrazzak O, Abdelkader M. Laser lithotripsy versus eswl for lower calyceal renal stones. Journal of Urology. 2013;189(4, Supplement):e751 (1829). | CrossRef |

25. Sener NC, Imamoglu MA, Bas O, Ozturk U, Goktug HN, Tuygun C, Bakirtas H. Prospective randomized trial comparing shock wave lithotripsy and flexible ureterorenoscopy for lower pole stones smaller than 1 cm. Urolithiasis. 2014 Apr;42(2):127-31. | CrossRef | PubMed |
26. Singh BP, Prakash J, Sankhwar SN, Dhakad U, Sankhwar PL, Goel A, et al.Retrograde intrarenal surgery vs extracorporeal shock wave lithotripsy for intermediate size inferior pole calculi: a prospective assessment of objective and subjective outcomes. Urology. 2014 May;83(5):1016-22. | CrossRef | PubMed |
27. Yuruk E, Binbay M, Sari E, Akman T, Altinyay E, Baykal M, et al. A prospective, randomized trial of management for asymptomatic lower pole calculi. The Journal of urology. 2010;183(4):1424-8.
28. Yuruk E, Binbay M, Sari E, Akman T, Altinyay E, Baykal M, et al. A prospective, randomized trial of management for asymptomatic lower pole calculi. J Urol. 2010 Apr;183(4):1424-8. | CrossRef | PubMed |
29. Ziemba JB, Matlaga BR. Guideline of guidelines: kidney stones. BJU Int. 2015 Aug;116(2):184-9. | CrossRef | PubMed |

Author address::
[1] Facultad de Medicina
Pontificia Universidad Católica de Chile
Lira 63
Santiago Centro
Chile