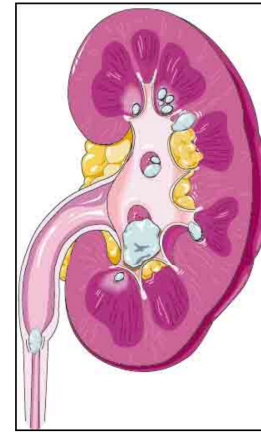
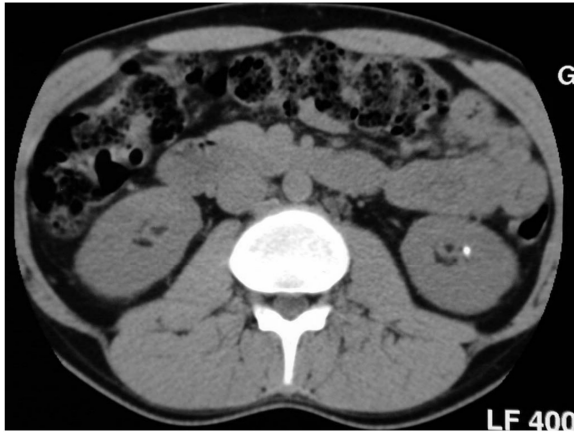


MANAGEMENT OF KIDNEY STONES WITH A RISK OF RECURRENCE IN AIRCREW MEMBERS: A FRENCH RETROSPECTIVE STUDY



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DISCLOSURE INFORMATION
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I have no financial relationships to disclose.

I will not discuss off-label use and/or investigational use in my presentation

The opinions or assertions expressed here in are the private views of the authors and are not to be considered as official or as reflecting the views of the French Military Health Service.

INTRODUCTION

In France: in the general population

Prevalence 10% (13.5% men, 7% women)

40-60 yo

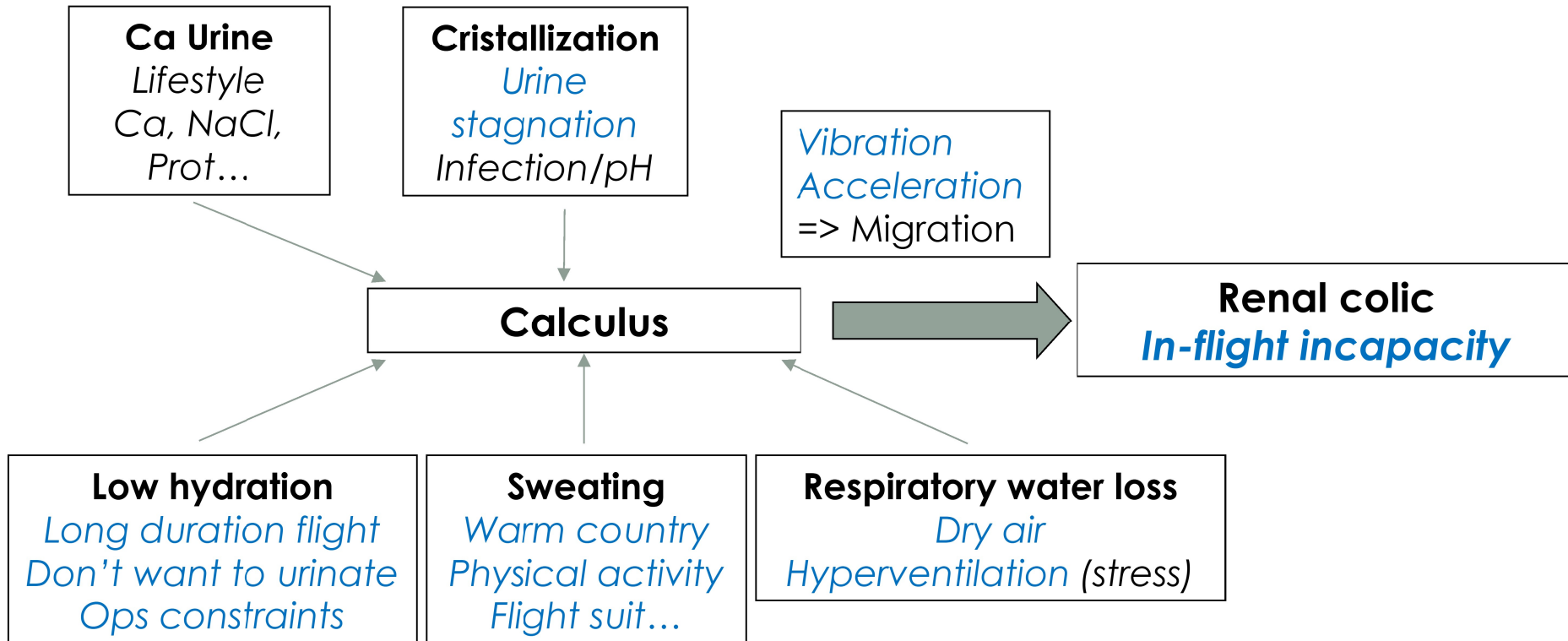
Presentation: renal colic

Recurrence: 53% after 3.5y

Calcium oxalate 72%

*Daudon, Ann Urologie, 2005
HAS guidelines, 2017*

AERONAUTICAL RISK FACTORS



KIDNEY STONES IN AIRCREWS

In France: in aircrews

- Prevalence: 3%
- Presentation: Renal colic 70%
- ⇒ in-flight renal colic 2 to 17%
- Recurrence: 33%



Same incidence in pilots vs non pilots (US)

Paris et al, Rev Med Aero Spat, 2002

Soula, medical thesis, University of Paris, 2009

Materson et al, J Uro, 2017

LITHIASIS IN AIRCREWS

1	OSAS
2	Kidney/urine tract cancer
3	Coronary artery disease
4	Refractive surgery
5	Renal lithiasis
6	Mood disorder
7	Stroke
8	Atrial Fibrillation
9	Rachis trauma
10	Veinous thrombo embolic disease

Top 10 waiver causes in military AM

Lutringer et al, Med Rev Aero Spat, 2019

LITHIASIS IN REGULATIONS



MINISTÈRE DES ARMÉES

Arrêté du 22 juillet 2021 relatif à la détermination et au contrôle de l'aptitude médicale
du personnel navigant des forces armées et formations rattachées

NOR : ARMH2122823A

Initial examination:

Residual kidney stones,
or history of kidney stones + recurrence risk => Unfit

Revalidation:

kidney stones + risk of renal colic/complication => Unfit/waiver

LITHIASIS IN REGULATIONS

COMMISSION IMPLEMENTING REGULATION (EU) 2019/27

of 19 December 2018

amending Regulation (EU) No 1178/2011 laying down technical requirements and administrative procedures related to civil aviation aircrew pursuant to Regulation (EU) 2018/1139 of the European Parliament and of the Council



MED.B.035 Genitourinary System

(c) Applicants with a diagnosis or medical history of the following may be assessed as fit subject to satisfactory genitourinary evaluation, as applicable:

(1) renal disease;

(2) one or more urinary calculi, or a medical history of renal colic.



shall be referred to the medical assessor of the licensing authority.

(c) Urinary calculi

- (1) Applicants with an asymptomatic calculus or a history of renal colic require investigation.
- (2) Applicants presenting with one or more urinary calculi should be assessed as unfit and require investigation.
- (3) Whilst awaiting assessment or treatment, a fit assessment with an OML may be considered.
- (4) After successful treatment for a calculus a fit assessment without an OML may be considered.
- (5) Applicants with parenchymal residual calculi may be considered for a fit assessment with an OML.

**Acceptable Means of Compliance
and
Guidance Material to Part-MED¹**

LITHIASIS IN REGULATIONS



COMMISSION REGULATION (EU) 2015/340

of 20 February 2015

laying down technical requirements and administrative procedures relating to air traffic controllers' licences and certificates pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council, amending Commission Implementing Regulation (EU) No 923/2012 and repealing Commission Regulation (EU) No 805/2011

ATCO.MED.B.035 Genitourinary system

(c) Applicants with a genitourinary disorder, such as:

(1) renal disease;

(2) one or more urinary calculi;

may be assessed as fit subject to satisfactory renal/urological evaluation.

(c) Urinary calculi

(1) Applicants with an asymptomatic calculus or a history of renal colic require investigation. A fit assessment may be considered after successful treatment for a calculus and with appropriate follow-up.

(2) Residual calculi should be disqualifying unless they are in a location where they are unlikely to move and give rise to symptoms.

Acceptable Means of Compliance
and
Guidance Material to Part-MED¹

FITNESS ASSESSMENT

- **Good/easy case:**

- 1 episode of renal colic
- With a temporary risk factor
- Stone free

=> Fit

- **Bad/difficult case:**

- Residual stones
 - At risk location ?
 - At risk size ?
- Recurrence risk factors

=> Unfit, need for evaluation

How to evaluate ?

AIMS OF THE STUDY

- To describe:

- The population of AM with a history of urine lithiasis at risk of recurrence

- To evaluate:

- The **incidence** of kidney stones with a risk of recurrence in AM
- The criteria leading to a **fit decision (and limitations)**
- The **evolution of stones** during the follow-up

METHODS

Included population:

Aircrew members examined in the AeMC Percy (Paris) between 2011 and 2021

History of at-risk urinary lithiasis



Retrospective study

Exclusion criteria:

Cabin crews

Low risk of recurrence

Data:

Duty, military/civilian status

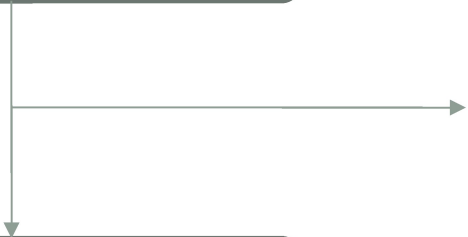
Lithiasis characteristics

Fitness assessment

Kidney stones evolution

RESULTS

95 aircrews

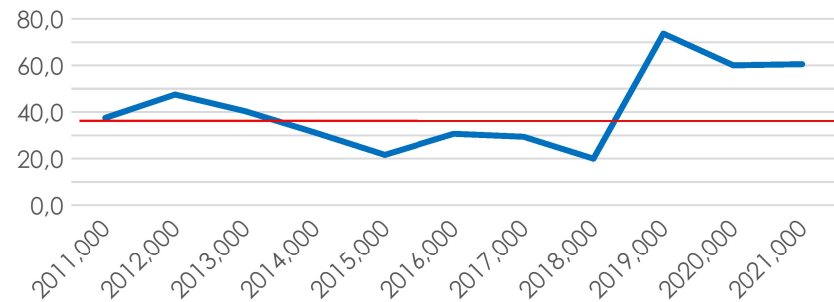


77 subjects included

18 subjects excluded:
4 incomplete data
14 cabin crews

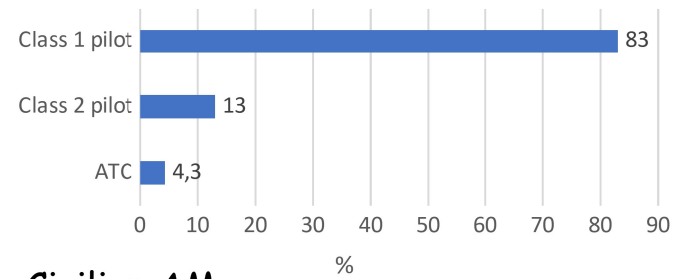
Mean incidence: 41/100,000/y
0.04%/y

Incidence of lithiasis at risk of recurrence

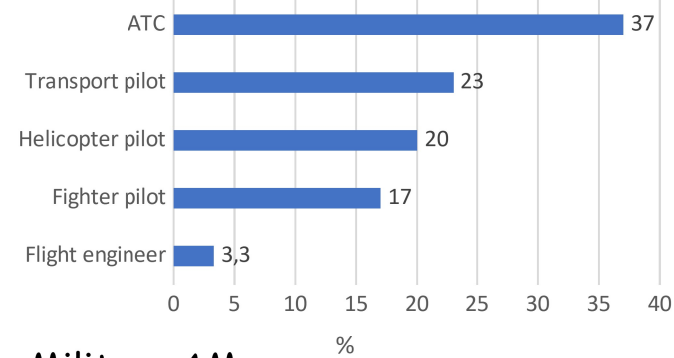


RESULTS

	Total (n=77)	Civilian (n=44)	Military (n=33)	<i>p-value</i>
Gender : Male	70 (91%)	40 (91%)	30 (91%)	1
Female	7 (9%)	4 (9%)	3 (9%)	
Mean age (years)	41.4 +/- 12.2	45.1 +/- 13.1	36.6 +/- 9.2	< 0.01
Pilot	62 (81%)	42 (95%)	20 (60%)	< 0.01
BMI	24.8 +/- 3.46	24.8 +/- 3.9	24.9 +/- 2.9	0.92
Sport >150min/week	28 (37%)	14 (32%)	14 (42%)	0.40
History of lithiasis	14 (19%)	9 (21%)	5 (16%)	0.56



Civilian AM



Military AM

RESULTS: DIAGNOSIS

	Total (n=77)	Civilian (n=44)	Military (n=33)	<i>p-value</i>
Form: Renal Colic	49 (64%)	25 (57%)	24 (73%)	0.19
Hematuria	17 (22%)	10 (23%)	7 (21%)	
Incidental	11 (15%)	9 (20%)	2 (6%)	
Renal Colic onset in flight on duty	8 (16%) 4 (8%)	6 (24%) 0	2 (8%) 4 (16%)	0.09
Diagnosis test				0.8
CT scan	37 (50%)	21 (51%)	16 (48%)	
ultrasound	15 (20%)	9 (22%)	6 (18%)	
ultrasound+Rx	10 (14%)	4 (10%)	6 (18%)	
none	12 (16%)	7 (17%)	5 (15%)	

RESULTS

- **Number** of calculus:

- Unique: n=29 (38%)
- Several : n= 48 (62%)
 - Mean number : 3 +/- 3 calculi
 - Bilateral : n=35 (51%)

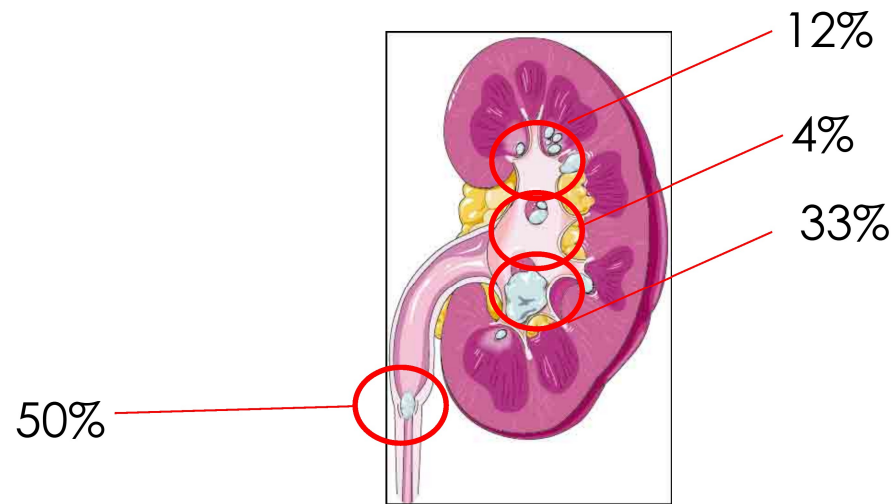
- **Location**



- **Size:** 5.6 +/-3.3 mm

- **Type:**

- Calcium oxalate: n=28 (36%)
- Unknown: n= 49 (64%)

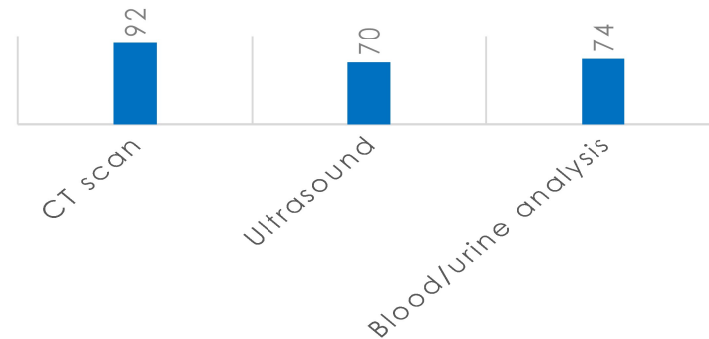


RESULTS: TREATMENT

- **Ureteroscopy** 28 (36%)
 - Need for laser fragmentation 5 (6%)
 - Need for JJ stent 19 (25%)
- **Extracorporeal lithotripsy** 23 (30%)
- **Stone free** after treatment 17 (22%)

AEROMEDICAL ASSESSMENT

- Performed tests

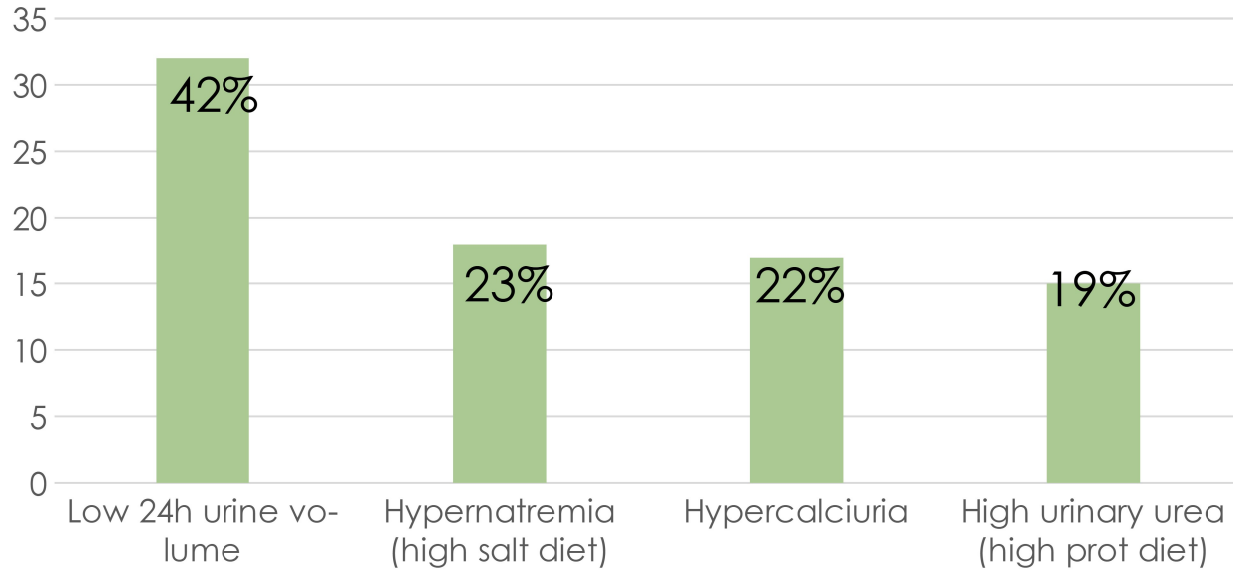


- **Underlying pathology: 16 (21%)**

- Kidneys/Urine tracts abnormalities (*Lenarduzzi-Cacchi-Ricci* disease etc): 7 (9%)
- Randall's plaques: 8 (10%)
- Hyperparathyroidism: 2 (3%)

AEROMEDICAL ASSESSMENT

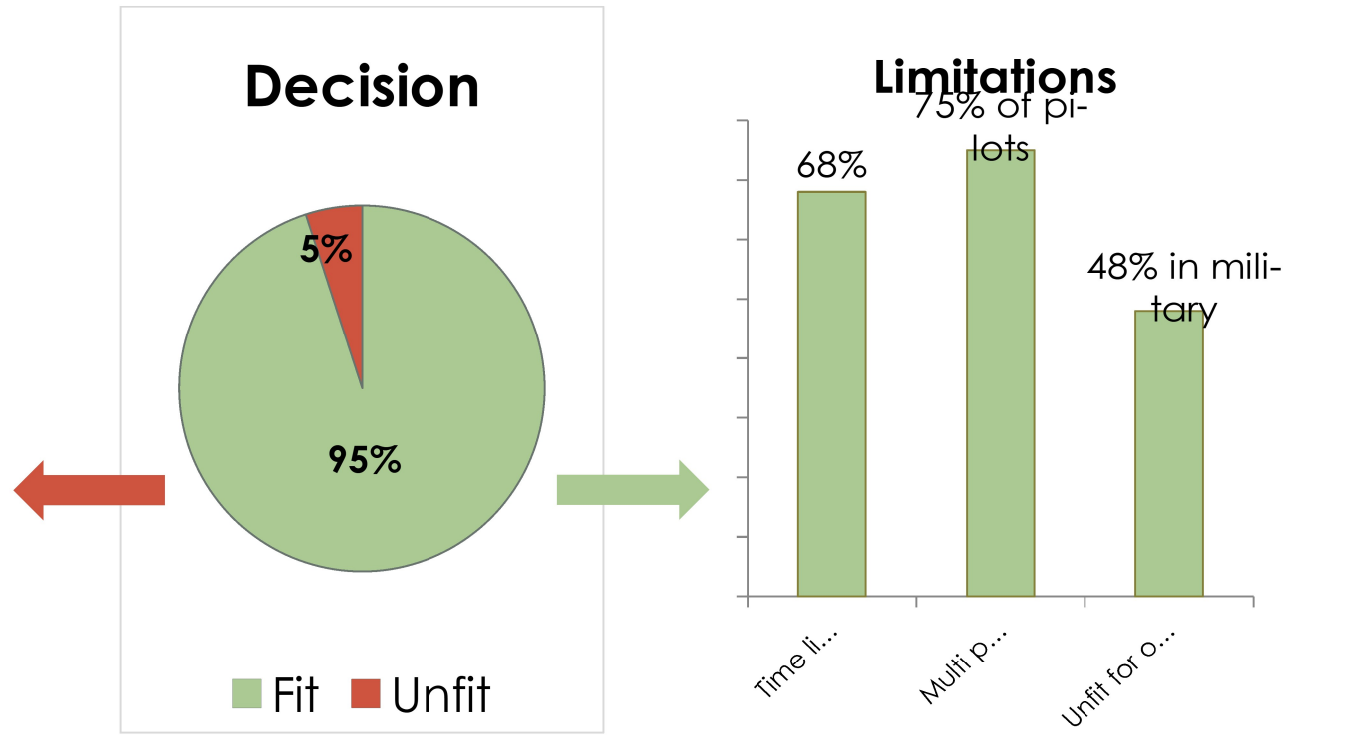
Metabolic testing



Hypercalcemia: n=1

Hyperoxaluria: n=2

FITNESS DECISION



RISK FACTORS OF MULTIPILOT LIMITATION

	Multi pilot limitation (n=44)	No multi pilot limitation (n=15)	p value
Age (y)	46.1 +/- 12	36.3 +/- 10	<0.01
Underlying disease	23%	21%	1
Residual stone	95%	27%	<0.01
Stones number	3.2 +/- 3.1	1.4 +/- 0.7	0.03
Bilateral stones	60%	17%	<0.01

No difference with type of treatment, stones location, jetpilot/aerobatics...
But correlation with unfitness for overseas deployments in military

FOLLOW-UP

- Lithiasis evolution: (n=74)
 - No: 34 (46%)
 - **Renal colic: 15 (20%)**
 - Imaging evolution: 30 (41%)
 - Stones migration/evacuation: 17 (23%)
 - Increased stones number/size: 13 (18%)
- Change in fitness decision: 25 (34%)
 - Less limitations: 17 (68% of them)

After a period of **4.3 +/- 5 years**

EVOLUTION RISK FACTORS

	Evolution (n=39)	No Evolution (n=34)	p value
Military	56%	32%	0.04
BMI (kg/m ²)	25.5 +/- 3.8	24.3 +/- 2.5	0.09
Sport > 150min/week	29%	47%	0.11
Low 24h urine vol	70%	42%	0.04
Underlying disease	26%	21%	0.61
Stone free	29%	12%	0.08
Stones number	2.9 +/- 3.5	2.7 +/- 1.6	0.13
Bilateral stones	36%	67%	0.01
Stone size	5.8 +/- 4.4	5.5 +/- 2.1	0.95

No difference with type of treatment, stones location, jetpilot/aerobatics...

DISCUSSION

	This study	General French pop	Aircrews
Incidence (/y)	0.04%	0.26%	0.21% (In Navy pilots)
Prevalence	-	10%	3 to 4.6%
Renal Colic	64%	-	70-78%
In flight Renal colic	16%	-	1.75-17%
Recurrence	54%	50%	33-44%

Paris et al, Rev Med Aero Spat, 2002

Daudon, Ann uro, 2005

Soula, medical thesis, University of Paris, 2009

Hayms et al, J uro, 2011

Zerrik et al, Rev Med Aero Spat, 2014

Materson et al, J Uro, 2017

AEROMEDICAL ASSESSMENT

Differences between:

Theoretical risk factors of recurrence

vs

Risk factors of multi pilot limitation

vs

Evolution risk factors



Underlying disease
Residual stones
Size/location
Aerobatics
Lifestyle

Age
Residual stones
Bilateral
Number

Lifestyle (hydration)

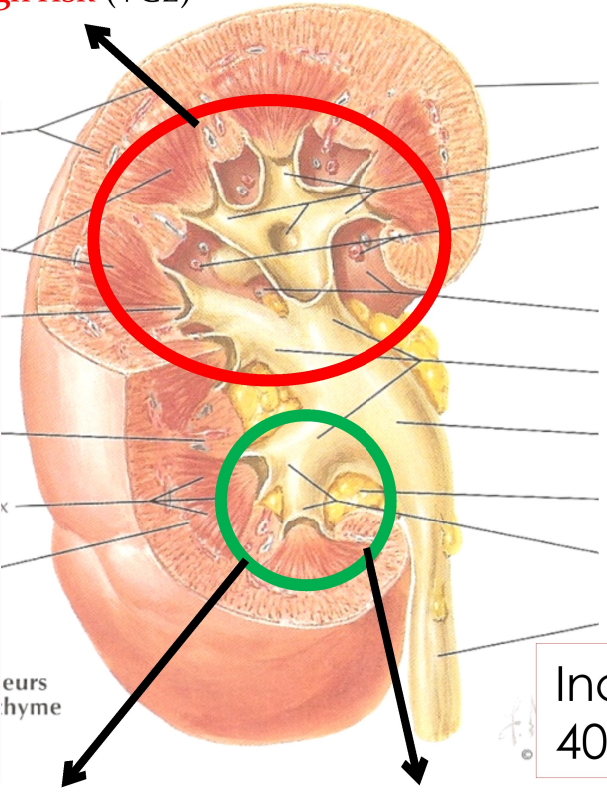
AEROMEDICAL ASSESSMENT

- Could we really say there is no risk in case of:

- Safe location of the residual stone
- Small residual stone
- Stone free



Usually considered as high risk (+Gz)



Location and migration:

- Parenchymal → No (Except Randall's plaques)



- Upper calyx 100%
- Middle calyx 55.6%
- Lower calyx 40.0%

Incidence of pain in patients: 40-50% whatever the location

Usually considered as low risk

But with a higher risk of growth $p=0.002$

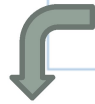
In this study: No correlation with evolution

Burgher et al, *J endourol*, 2004
 Mitchell et al, *J Am Osteopath Assoc*, 2016

DOES THE SIZE REALLY MATTER?

French urology guidelines:

Hors nature du calcul	< 2 cm	> 2 cm	Coralliformes ou calculs complexes
Remarques	Si LEC : pas plus de 2 séances à 3 semaines d'intervalle Après PNA : délai de 3 semaines	LEC 4 à 6 semaines après NLPC	Pas plus de deux tunnels dans la même séance
	< 5 mm asymptomatique : pas de traitement systématique	Pas de LEC seule	Chirurgie ouverte (néphrotomie anatrophique) pour coralliforme complexe



<5mm+no symptom= No treatment => usually considered as **low risk in aircrews**

≤ 4mm residual stone

=> 43% of symptomatic episode/intervention in 2-3 years after treatment



In this study: residual stones size

No correlation with OML and evolution

Carpentier et al, Progrès en urologie, 2014

Khaitan et al, Urology, 2002

Raman et al, J Urol, 2009

Streem et al, J Urol, 1996

STONE FREE= ZERO RISK?

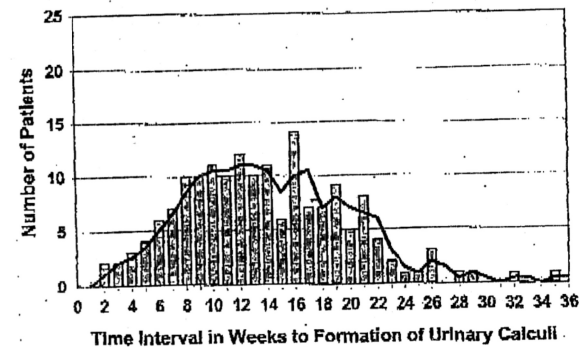
Duration of a calculus formation and migration:

- Koweit 2003, 182 patients

Mean estimated time to formation of urinary calculi = **93 days**

- Mali 2013, 41 patients

Mean time spent in Mali before renal colic= **60 days**



In this study: residual stones

Correlation with multipilot limitation ($p < 0.01$)

No significant link with evolution ($p = 0.08$)

Evan et al, journal of urology, 2005

Abdourahman et al, progrès en urologie, 2014

CONCLUSION

- 0.04% of AM per year with kidney stones at risk of recurrence
 - Presentation: **renal colic** 64% (in-flight 16%)
- Residual stones = **multi pilot** (p<0.01)
- **Recurrence in 54%** (after 4.3y)
 - Main risk factor: low urine volume (p=0.04)
 - Link with residual stones size/number/location => unclear
- Our role: **recurrence prevention**
 - Lifestyle advice
 - Follow-up

