Pediatric Leukemia and the Eye

Where does leukemia rank among childhood malignancies in terms of incidence?
Where does leukemia rank among childhood malignancies in terms of incidence? It is #1 by a mile.
Where does leukemia rank among childhood malignancies in terms of incidence?

It is #1 by a mile

Leukemia accounts for what proportion of childhood malignancies?
Pediatric Leukemia and the Eye

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It is #1 by a mile

Leukemia accounts for what proportion of childhood malignancies?
About 1/3
Pediatric Leukemia and the Eye

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How many new cases of childhood leukemia occur every year in the US?
Pediatric Leukemia and the Eye

Where does leukemia rank among childhood malignancies in terms of incidence?

It is #1 by a mile

Leukemia accounts for what proportion of childhood malignancies?
About 1/3

How many new cases of childhood leukemia occur every year in the US?
About 4000
Where does leukemia rank among childhood malignancies in terms of incidence?
It is #1 by a mile

Leukemia accounts for what proportion of childhood malignancies?
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How many new cases of childhood leukemia occur every year in the US?
About 4000

To put this in perspective: How many new cases of retinoblastoma are there every year in the US?
Pediatric Leukemia and the Eye

Where does leukemia rank among childhood malignancies in terms of incidence?
It is #1 by a mile.

Leukemia accounts for what proportion of childhood malignancies?
About 1/3

How many new cases of childhood leukemia occur every year in the US?
About 4000

To put this in perspective: How many new cases of retinoblastoma are there every year in the US?
Only 200-300 or so.
Where does leukemia rank among childhood malignancies in terms of incidence? It is #1 by a mile.

Re its histology: Does pediatric leukemia tend to be lymphocytic, or myelogenous?
Where does leukemia rank among childhood malignancies in terms of incidence?
It is #1 by a mile

Re its histology: Does pediatric leukemia tend to be lymphocytic, or myelogenous?
Lymphocytic
Where does leukemia rank among childhood malignancies in terms of incidence?
It is #1 by a mile

Re its histology: Does pediatric leukemia tend to be lymphocytic, or myelogenous?
Lymphocytic

Does it tend to be acute, or chronic?
Where does leukemia rank among childhood malignancies in terms of incidence? It is #1 by a mile

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Where does leukemia rank among childhood malignancies in terms of incidence? It is #1 by a mile.

Re its histology: Does pediatric leukemia tend to be lymphocytic, or myelogenous? Lymphocytic

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Putting it all together, what sort of leukemia occurs in most pediatric cases? Acute lymphocytic (ALL)
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Does it tend to be acute, or chronic? Acute

Putting it all together, what sort of leukemia occurs in most pediatric cases? Acute lymphocytic (ALL)

My way to remember that ALL is the pediatric leukemia:
I think of ALL as standing for ‘Adults Least Likely’
**Pediatric Leukemia and the Eye**

Where does leukemia rank among childhood malignancies in terms of incidence?
It is #1 by a mile

Re its histology: Does pediatric leukemia tend to be lymphocytic, or myelogenous?
Lymphocytic

Does it tend to be acute, or chronic?
Acute

Putting it all together, what sort of leukemia occurs in most pediatric cases?
Acute lymphocytic (ALL)

My way to remember that ALL is the pediatric leukemia:
I think of ALL as standing for ‘Adults Least Likely’

In contrast, the common form in adults is acute myelogenous leukemia, AML = ‘Adults Most Likely’
Where does leukemia rank among childhood malignancies in terms of incidence? It is #1 by a mile

Re its histology: Does pediatric leukemia tend to be lymphocytic, or myelogenous? Lymphocytic

Does it tend to be acute, or chronic? Acute

Is ophthalmic involvement common in leukemia?
Where does leukemia rank among childhood malignancies in terms of incidence? It is #1 by a mile.

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Is ophthalmic involvement common in leukemia? Indeed it is
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Clinical involvement of which ophthalmic structures is common?
Pediatric Leukemia and the Eye

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It is #1 by a mile

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Clinical involvement of which ophthalmic structures is common?
--The orbit
--The anterior chamber
--The iris
--The retina
--The optic nerve
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Clinical involvement of which ophthalmic structures is common? --The orbit --The anterior chamber --The iris --The retina --The optic nerve

Which structure is most commonly affected by leukemia?
Where does leukemia rank among childhood malignancies in terms of incidence? It is #1 by a mile

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Clinical involvement of which ophthalmic structures is common? --The orbit --The anterior chamber --The iris --The retina --The optic nerve

Which structure is most commonly affected by leukemia? The choroid
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Clinical involvement of which ophthalmic structures is common?
--The orbit
--The anterior chamber
--The iris
--The retina
--The optic nerve

Say what? The choroid isn't even on the list. What the deal?

Which structure is most commonly affected by leukemia?
The choroid
Pediatric Leukemia and the Eye

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--The iris
--The retina
--The optic nerve

Which structure is most commonly affected by leukemia? The choroid

Say what? The choroid isn’t even on the list. What the deal? The deal is this: Being the most vascular structure in the eye, it should come as no surprise that the choroid is the structure most likely to be involved with a hematologic malignancy. That said…
Where does leukemia rank among childhood malignancies in terms of incidence? It is #1 by a mile

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--The optic nerve

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--The anterior chamber
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Say what? The choroid isn’t even on the list. What the deal?
The deal is this: Being the most vascular structure in the eye, it should come as no surprise that the choroid is the structure most likely to be involved with a hematologic malignancy. That said…leukemic choroidal lesions are very subtle, and thus easily missed on exam. For this reason, the choroid doesn’t make the list of ophthalmic structures likely to manifest clinical involvement in leukemia.
Pediatric Leukemia and the Eye

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Re its histology: Does pediatric leukemia tend to be lymphocytic, or myelogenous?
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Is ophthalmic involvement common in leukemia?
Indeed it is

Clinical involvement of which ophthalmic structures is common?
-- The orbit?
-- The anterior chamber?
-- The iris?
-- The retina?
-- The optic nerve?

OK, smart guy, which structure is clinically involved most frequently?

Which structure is most commonly affected by leukemia?
The choroid
Pediatric Leukemia and the Eye

Where does leukemia rank among childhood malignancies in terms of incidence?
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Re its histology: Does pediatric leukemia tend to be lymphocytic, or myelogenous?
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Is ophthalmic involvement common in leukemia?
Indeed it is

Clinical involvement of which ophthalmic structures is common?
--The orbit
--The anterior chamber
--The iris
--The retina!
--The optic nerve

OK, smart guy, which structure is clinically involved most frequently?
The retina

Which structure is most commonly affected by leukemia?
The retina

The choroid
Where does leukemia rank among childhood malignancies in terms of incidence? It is #1 by a mile.

Re its histology: Does pediatric leukemia tend to be lymphocytic, or myelogenous? Lymphocytic

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Is ophthalmic involvement common in leukemia? Indeed it is

Clinical involvement of which ophthalmic structures is common?
--The orbit
--The anterior chamber
--The iris
--The retina
--The optic nerve
--The vitreous?

Which structure is most commonly affected by leukemia?
The choroid

The vitreous isn’t on the list. Is it like the choroid, ie, commonly involved but clinically inapparent?
Where does leukemia rank among childhood malignancies in terms of incidence? It is #1 by a mile.

Re its histology: Does pediatric leukemia tend to be lymphocytic, or myelogenous? Lymphocytic.

Does it tend to be acute, or chronic? Acute.

Is ophthalmic involvement common in leukemia? Indeed it is.

Clinical involvement of which ophthalmic structures is common?
--The orbit
--The anterior chamber
--The iris
--The retina
--The vitreous? No!

Which structure is most commonly affected by leukemia? The choroid.

The vitreous isn't on the list. Is it like the choroid, ie, commonly involved but clinically inapparent? No, just the opposite--vitreous involvement is very rare in leukemia.
Pediatric Leukemia and the Eye

Where does leukemia rank among childhood malignancies in terms of incidence? It is #1 by a mile.

Re its histology: Does pediatric leukemia tend to be lymphocytic, or myelogenous? Lymphocytic.

Does it tend to be acute, or chronic? Acute.

Is ophthalmic involvement common in leukemia? Indeed it is.

Clinical involvement of which ophthalmic structures is common?
--The orbit
--The anterior chamber
--The iris
--The retina!

Next, we will drill down on retinal involvement in leukemia.

--The optic nerve

Which structure is most commonly affected by leukemia? The retina.

The choroid.
Pediatric leukemia and the eye

- Retinopathy more common than in adult leukemics
Pediatric leukemia and the eye

- Retinopathy less common than in adult leukemics
Pediatric leukemia and the eye

- Retinopathy **less** common than in adult leukemias
- Most common eye finding: RNFL hemorrhages (abb.) + one word
Pediatric leukemia and the eye

- Retinopathy less common than in adult leukemics
- Most common eye finding: RNFL hemorrhages

(Retinal nerve fiber layer)
Pediatric leukemia and the eye

- Retinopathy less common than in adult leukemias
- Most common eye finding: RNFL hemorrhages
  - Can be specific appearance
Q/A

- **Pediatric leukemia and the eye**
  - Retinopathy *less* common than in adult leukemics
  - Most common eye finding: **RNFL hemorrhages**
    - Can be *white centered (aka)*
      - eponym
Pediatric leukemia and the eye

- Retinopathy less common than in adult leukemias
- Most common eye finding: RNFL hemorrhages
  - Can be white centered (aka Roth spots)
Retinal hemorrhages in leukemia
(Full disclosure: I don’t know if these are kids)
What is the DDx for Roth spots?

--Leukemia (duh)
--
--
--(There are many others)
Pediatric leukemia and the eye

- Retinopathy less common than in adult leukemics
- Most common eye finding: RNFL hemorrhages
  - Can be white centered (aka Roth spots)

What is the DDx for Roth spots?
--Leukemia (duh)
--Subacute bacterial endocarditis
--Anemia
--Endophthalmitis
--(There are many others)
Pediatric leukemia and the eye

- Retinopathy less common than in adult leukemias
- Most common eye finding: RNFL hemorrhages
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What is the DDx for Roth spots?
- Leukemia?
- Subacute bacterial endocarditis?
- Anemia?
- Endophthalmitis?
-(There are many others)
Pediatric leukemia and the eye

- Retinopathy less common than in adult leukemics
- Most common eye finding: RNFL hemorrhages
  - Can be white centered (aka Roth spots)

Of these, which is the most commonly cause of Roth spots?
SABE

What is the DDx for Roth spots?
--Leukemia
--Subacute bacterial endocarditis!
--Anemia
--Endophthalmitis
--(There are many others)
Pediatric leukemia and the eye

- Retinopathy less common than in adult leukemias
- Most common eye finding: RNFL hemorrhages
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Note: There is inconsistency across Academy sources with regard to the term Roth spots:
--Early in the BCSC Path book, Roth spot and white-centered hemorrhage are used interchangeably and are said to occur “in a number of conditions;” later, the term pseudo-Roth spot is used to refer to white-centered hemorrhages secondary to leukemia. (Per the Master Index, pseudo-Roth spot appears nowhere else in the BCSC.)
--The Uveitis book uses ‘Roth spots’ when referring to white-centered hemorrhages secondary to bacterial endophthalmitis, but not when referring to those secondary to leukemia (these are termed ‘white-centered hemorrhages’).
--The Peds book simply says retinal hemorrhages in leukemia “may have white centers.”
--The online Academy source EyeWiki uses Roth spot to refer to white-centered hemorrhages of any cause.
--Puzzlingly, neither Roth spot nor white-centered hemorrhage appear in the index of the Retina book.
What’s the correct usage? I dunno. Caveat emptor.
Pediatric leukemia and the eye

- Retinopathy less common than in adult leukemics
- Most common eye finding: RNFL hemorrhages
  - Can be white centered (aka Roth spots)
- ONH can be infiltrated: two-words

(©Optic nerve head)
**Pediatric leukemia and the eye**

- Retinopathy **less** common than in adult leukemics
- Most common eye finding: **RNFL hemorrhages**
  - Can be **white centered (aka Roth spots)**
- ONH can be infiltrated: **Papilledema-like** appearance
Leukemia: ONH infiltration
(20 y.o. with recurrent ALL)
**Pediatric leukemia and the eye**

- Retinopathy **less** common than in adult leukemias
- Most common eye finding: **RNFL hemorrhages**
  - Can be **white centered (aka Roth spots )**
- ONH can be infiltrated: **Papilledema-like** appearance
  - Early ONH involvement → permanent loss of central vision: Medical emergency—need emergent treatment
Pediatric leukemia and the eye

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- ONH can be infiltrated: Papilledema-like appearance
  - Early ONH involvement → permanent loss of central vision:
    Medical emergency—need emergent radiation therapy
Pediatric leukemia and the eye

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- Most common eye finding: RNFL hemorrhages
  - Can be white centered (aka Roth spots)
- ONH can be infiltrated: Papilledema-like appearance
  - Early ONH involvement → permanent loss of central vision: Medical emergency—need emergent radiation therapy
    - Note: Chemo patients are abnormally sensitive to radiation therapy—blinding complication can occur!
Pediatric leukemia and the eye

- Retinopathy less common than in adult leukemics
- Most common eye finding: RNFL hemorrhages
  - Can be white centered (aka Roth spots)
- ONH can be infiltrated: Papilledema-like appearance
  - Early ONH involvement → permanent loss of central vision: Medical emergency—need emergent radiation therapy
    - Note: Chemo patients are abnormally sensitive to radiation therapy—blinding ONH atrophy can occur!
 Pediatric leukemia and the eye

- Retinopathy **less** common than in adult leukemics
- Most common eye finding: **RNFL hemorrhages**
  - Can be **white centered** (aka **Roth spots**)
- ONH can be infiltrated: **Papilledema-like** appearance
  - Early ONH involvement ➞ permanent loss of central vision: Medical emergency—need emergent **radiation therapy**
    - Note: Chemo patients are abnormally sensitive to radiation therapy—blinding **ONH atrophy** can occur!
- Leukemic infiltration of **anterior segment** can produce:
  - **H**eterochromia iridis
  - **H**ypopyon
  - **H**yphema
  - The **three H**’s of anterior segment leukemic infiltration
Pediatric leukemia and the eye

- Retinopathy less common than in adult leukemias
- Most common eye finding: RNFL hemorrhages
  - Can be white centered (aka Roth spots)
- ONH can be infiltrated: Papilledema-like appearance
  - Early ONH involvement → permanent loss of central vision: Medical emergency—need emergent radiation therapy
    - Note: Chemo patients are abnormally sensitive to radiation therapy—blinding ONH atrophy can occur!
- Leukemic infiltration of anterior segment can produce:
  - Heterochromia iridis
  - Hypopyon
  - Hyphema
Leukemia: Heterochromia iridis

Normal right iris

Left iris: Diffuse thickening, yellowish infiltrate
Leukemia: Hyphema (with a little hypopyon as well)
Pediatric leukemia and the eye
- Retinopathy less common than in adult leukemics
- Most common eye finding: RNFL hemorrhages
  - Can be white centered (aka Roth spots)
- ONH can be infiltrated: Papilledema-like appearance
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- Leukemic infiltration of anterior segment can produce:
  - Heterochromia
  - Hypopyon?
  - Hyphema

Is it a hypopyon, or pseudohypopyon?
Pediatric leukemia and the eye

- Retinopathy less common than in adult leukemics
- Most common eye finding: RNFL hemorrhages
  - Can be white centered (aka Roth spots)
- ONH can be infiltrated: Papilledema-like appearance
  - Early ONH involvement → permanent loss of central vision: Medical emergency—need emergent radiation therapy
    - Note: Chemo patients are abnormally sensitive to radiation therapy—blinding ONH atrophy can occur!
- Leukemic infiltration of anterior segment can produce:
  - Heterochromia
  - Hypopyon?
  - Hyphema

Is it a hypopyon, or pseudo-hypopyon? As with Roth spots vs Pseudo-Roth spots vs white-centered hemorrhages, the BCSC is unclear in this regard. Caveat emptor.
Leukemia: (Pseudo)hypopyon

With a little hyphema as well


- **Pediatric leukemia and the eye**
  - Retinopathy less common than in adult leukemias
  - Most common eye finding: RNFL hemorrhages
    - Can be white centered (aka Roth spots)
  - ONH can be infiltrated: Papilledema-like appearance

*Eyes with leukemic manifestations in the anterior chamber are at risk for the development of glaucoma, by two separate mechanisms. What are they?*

---

- Heterochromia iridis
- Hypopyon
- Hyphema
Pediatric leukemia and the eye

- Retinopathy less common than in adult leukemias
- Most common eye finding: RNFL hemorrhages
  - Can be white centered (aka Roth spots)
- ONH can be infiltrated: Papilledema-like appearance

**Eyes with leukemic manifestations in the anterior chamber are at risk for the development of glaucoma, by two separate mechanisms.**

*What are they?*

--- Tumor cells and/or RBCs can physically clog the TM, impeding aqueous egress

--- Posterior synechiae can develop, leading to pupillary seclusion and pupillary-block glaucoma

- **Heterochromia iridis**
- **Hypopyon**
- **Hyphema**
Pediatric leukemia and the eye

- Retinopathy less common than in adult leukemias
- Most common eye finding: RNFL hemorrhages
  - Can be white centered (aka Roth spots)
- ONH can be infiltrated: Papilledema-like appearance
  - Early ONH involvement → permanent loss of central vision: Medical emergency—need emergent radiation therapy
    - Note: Chemo patients are abnormally sensitive to radiation therapy—blinding ONH atrophy can occur!

Leukemic infiltration of anterior segment (e.g., hypopyon)

- Heterochromia iridis
- Hypopyon
- Hyphema

If a child (or adult, for that matter) presents with hypopyon, what general sort of condition is likely to top the initial DDx?
Pediatric leukemia and the eye

- Retinopathy less common than in adult leukemics
- Most common eye finding: RNFL hemorrhages
  - Can be white centered (aka Roth spots)
- ONH can be infiltrated: Papilledema-like appearance
  - Early ONH involvement → permanent loss of central vision: Medical emergency—need emergent radiation therapy
    - Note: Chemo patients are abnormally sensitive to radiation therapy—blinding ONH atrophy can occur!

Leukemic infiltration of anterior segment can produce:

- Heterochromia iridis
- Hypopyon
- Hyphema

If a child (or adult, for that matter) presents with hypopyon, what general sort of condition is likely to top the initial DDx? Uveitis
Pediatric leukemia and the eye

- Retinopathy less common than in adult leukemics
- Most common eye finding: RNFL hemorrhages
  - Can be white centered (aka Roth spots)
- ONH can be infiltrated: Papilledema-like appearance
  - Early ONH involvement → permanent loss of central vision: Medical emergency—need emergent radiation therapy
    - Note: Chemo patients are abnormally sensitive to radiation therapy—blinding ONH atrophy can occur!
- Leukemic infiltration of anterior segment can produce:
  - Heterochromia iridis
  - Hypopyon
  - Hyphema

If a child (or adult, for that matter) presents with hypopyon, what general sort of condition is likely to top the initial DDx? Uveitis

What is the general term for the set of conditions that can present like uveitis, but are not infectious/inflammatory (ie, not uveitides)?
Pediatric leukemia and the eye

- Retinopathy less common than in adult leukemias
- Most common eye finding: RNFL hemorrhages
  - Can be white centered (aka Roth spots)
- ONH can be infiltrated: Papilledema-like appearance
  - Early ONH involvement → permanent loss of central vision: Medical emergency—need emergent radiation therapy
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Leukemic infiltration of anterior segment can produce:

- Heterochromia iridis
- Hypopyon
- Hyphema

If a child (or adult, for that matter) presents with hypopyon, what general sort of condition is likely to top the initial DDx? Uveitis

What is the general term for the set of conditions that can present like uveitis, but are not infectious/inflammatory (ie, not uveitides)? Masquerade syndromes
Pediatric leukemia and the eye

- Retinopathy less common than in adult leukemics
- Most common eye finding: RNFL hemorrhages
  - Can be white centered (aka Roth spots)
- ONH can be infiltrated: Papilledema-like appearance
  - Early ONH involvement → permanent loss of central vision: Medical emergency—need emergent radiation therapy
    - Note: Chemo patients are abnormally sensitive to radiation therapy—blinding ONH atrophy can occur!

Leukemic infiltration of anterior segment:

- Heterochromia iridis
- Hypopyon
- Hyphema

If a child (or adult, for that matter) presents with hypopyon, what general sort of condition is likely to top the initial DDx? Uveitis

Let’s do a brief overview of masquerade syndromes then call it a day…

What are the general conditions that can present like uveitis, but are not infectious/inflammatory (ie, not uveitides)?

Masquerade syndromes
Masquerade Syndrome

A very basic distinction

?
Masquerade Syndrome

- Neoplastic
- Nonneoplastic

A very basic distinction
Masquerade Syndrome

Neoplastic

Nonneoplastic

A very basic distinction

?
Masquerade Syndrome

Nonneoplastic

Neoplastic

Solid

Hematologic

A very basic distinction
Masquerade Syndrome

Neoplastic

Solid

Nonneoplastic

Hematologic

ditto

?
Masquerade Syndrome

Neoplastic

Solid

Hematologic

ditto

Leukemic

Lymphoid

Nonneoplastic
Masquerade Syndrome

- Neoplastic
  - Solid
    - Hematologic
      - Leukemic
    - Lymphoid
      - ?
      - ?
      - ?
  - Nonneoplastic
Masquerade Syndrome

- Neoplastic
  - Solid
  - Hematologic
    - Leukemic
      - Primary CNS lymphoma
      - Secondary to systemic lymphoma
      - Lymphoproliferative dz

- Nonneoplastic
Masquerade Syndrome

- Neoplastic
  - Solid
  - Hematologic
    - Leukemic
    - Lymphoid
      - Primary CNS lymphoma
      - Secondary to systemic lymphoma
      - Lymphoproliferative dz

- Nonneoplastic
Masquerade Syndrome

Nonneoplastic

Neoplastic

Solid

Hematologic

Leukemic

Leukemia

Lymphoid

Primary CNS lymphoma

Secondary to systemic lymphoma

Lymphoproliferative dz

There it is...
Masquerade Syndrome

Neoplastic

Hematologic

Leukemic

Leukemia

Lymphoid

Primary CNS lymphoma

Secondary to systemic lymphoma

Lymphoproliferative dz

Solid

Nonneoplastic

ditto

?
Masquerade Syndrome

Neoplastic

Hematologic

Leukemic

Lymphoid

Primary CNS lymphoma

Secondary to systemic lymphoma

Lymphoproliferative dz

Nonneoplastic

Solid

Mets
ditto

Primary
Masquerade Syndrome

- Neoplastic
  - Solid
    - Mets
  - Hematologic
    - Leukemic
      - Leukemia
    - Lymphoid
      - Primary CNS lymphoma
      - Secondary to systemic lymphoma
      - Lymphoproliferative dz

- Nonneoplastic

Q
Masquerade Syndrome

Neoplastic

Hematologic

Leukemic

Lymphoid

Primary CNS lymphoma
Secondary to systemic lymphoma
Lymphoproliferative dz

Leukemia

Solid

Mets

Primary

Uveal melanoma
Rb

Nonneoplastic
**Masquerade Syndrome**

- **Nonneoplastic**
- **Neoplastic**
  - **Solid**
  - **Mets**
    - Primary
      - Uveal melanoma
      - Rb
    - ?
  - ?
    - Primary CNS lymphoma
    - Secondary to systemic lymphoma
    - Lymphoproliferative dz
Masquerade Syndrome

Nonneoplastic

Neoplastic

Solid

Mets
- Lung
- Breast

Primary
- Uveal melanoma
- Rb

Hematologic

Leukemic
- Leukemia

Primary CNS lymphoma
Secondary to systemic lymphoma
Lymphoproliferative dz

Lymphoid
Masquerade Syndrome

Neoplastic

Solid

Hematologic

Leukemic

Leukemia

Primary

Uveal melanoma

Rb

Mets

Lung

Breast

Nonneoplastic

Primary CNS lymphoma

Secondary to systemic lymphoma

Lymphoproliferative dz
Masquerade Syndrome

Neoplastic

Hematologic

Leukemic

Leukemia

Lymphoid

Primary CNS lymphoma

Secondary to systemic lymphoma

Lymphoproliferative dz

Solid

Mets

Primary

Retinitis pigmentosa

Ocular ischemic syndrome

Chronic rhegmatogenous RD

Intraocular foreign body

Pigment dispersion syndrome

Juvenile xanthogranuloma

Lung

Breast

Leukemia

Uveal melanoma

Rb

Nonneoplastic